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Configurational changes within the dermis of meshed split skin grafts: a histological study

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Summary—By placing a series of vertical cuts through the skin graft, the meshing process increases the area of exposed dermis. This extra dermis contains the cut ends of vessels derived from the subpapillary plexus. Histological examination has shown that each of the skin bridges within the mesh changes shape so that these vessels come to open on to the undersurface of the graft, where they are advantageously placed to participate in revascularisation of the graft.

A skin graft may be considered to be a bilamellar sheet consisting of a highly elastic dermis and a relatively inelastic epidermis. Because of this difference in mechanical properties a skin graft always shows a tendency to curl towards its dermal surface. This same tendency to curl is shown by each of the skin bridges within the lattice work of a meshed split skin graft. As a result, when the mesh is spread on to a recipient surface not only the undersurface but also the edges of the skin bridges appear to adhere to the recipient bed (Fig. 1). To investigate this observation a histological study was made.

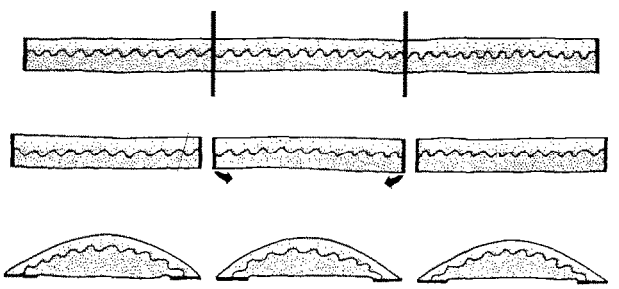

Fig. 1

Figure 1—Cross-section of position assumed by meshed split skin grafts.

Materials and methods

Medium thickness split skin grafts were taken from live human donors using an electric dermatome. The thickness of the grafts varied between 0.4 and 0.6 mm. The grafts were meshed, by machine, to produce a mesh with a 1:1.5 expansion ratio. Specimens were placed on flat, moist glass, which represented the recipient surface. They were fixed in this position, paraffin blocks prepared and the sections stained with haematoxylin and eosin.

The geometric arrangement of the mesh was studied by meshing sheets of graph paper.

Results

The histological sections uniformly confirm the clinical observation: rearrangement occurs within the dermis so that the horizontally cut undersurface and the vertically meshed edges come to lie in the same plane on the undersurface of the graft (Fig. 2). Such rearrangement of graft shape will, of course, produce a similar rearrangement of the vascular network within the dermis (Fig. 3). If the edges of the skin bridges are examined, the vessels of the subpapillary plexus may be seen opening on to what is now the undersurface of the graft (Fig. 4).

The extra area of dermis exposed by meshing is considerable. It may be calculated from a knowledge of the number of perforations per unit area, the length of each perforation and the dermal

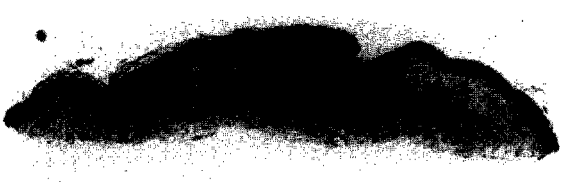

Fig. 2

Figure 2—Cross-section of a single skin bridge. (Magnification ×40). H & E

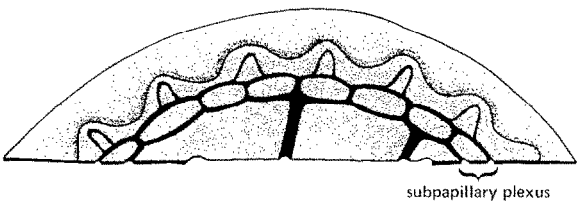

Fig. 3

Figure 3—Arrangement of blood vessels within a skin bridge.

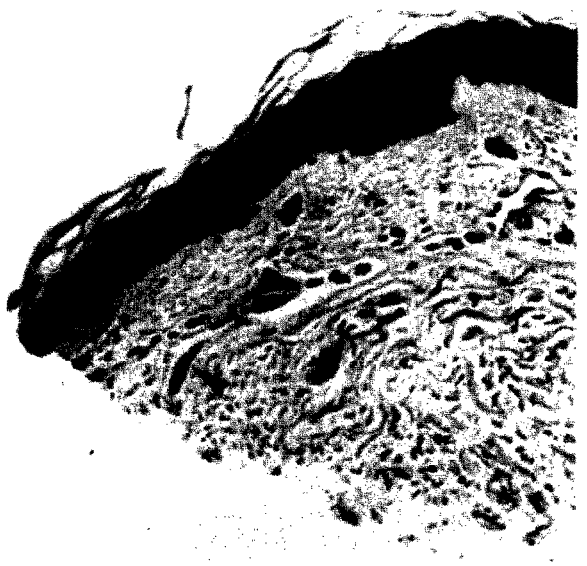

Fig. 4

Figure 4—Edge of the skin bridge (Fig. 2) showing subpapillary vessels opening on to the undersurface of the graft. (Magnification × 195). H & E

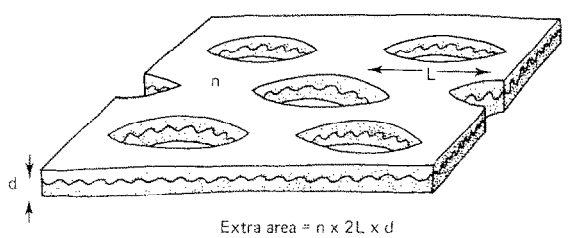

Fig. 5

Figure 5—Extra area of dermis exposed by meshing. (n = the number of perforations per unit area. L = the length of each perforation. d = the thickness of dermis).

thickness (Fig. 5). In the example illustrated there is a 43% increase in area of exposed dermis (Table). In other words, the area of potential dermal contact with the recipient bed is increased by almost half as much again. Moreover, this extra dermis is very richly supplied with blood vessels derived from the subpapillary plexus.

Table 1 Example showing the increase in the area of exposed dermis when a graft with a dermal thickness of 0.36 mm (Fig. 2) is meshed.

Expansion ratio	*n (per cm²)*	*L (cm)*	*d (mm)*	*Extra area of dermis per cm² unmeshed graft (cm²)*
1:1.5	12	0.5	0.36	0.43

Discussion

Vascularisation of skin grafts has long been thought to occur by link-up of the vessels in the recipient bed with those in the graft (Thiersch, 1874). Recent studies confirm this (Okada, 1986). Anastomoses occur when capillary buds, derived from the recipient site, fortuitously encounter vessels opening on to the undersurface of the graft (Converse *et al.*, 1975). The greater the number of cut vessels on the undersurface of the graft the more likely this is to occur (Smahel and Clodius, 1971). This may explain the relative ease with which thin skin grafts and grafts taken from vascular donor sites become vascularised.

A split skin graft taken through the middle of the dermis will have relatively few blood vessels on its undersurface as only the vertically running vessels in transit between the subdermal and subpapillary plexuses will be divided. The process of meshing places a series of vertical cuts through the graft resulting in multiple division of the horizontally arranged subpapillary plexus. When placed on a recipient surface the elastic curling of the skin causes this rich plexus to face the recipient bed, thus increasing the number of cut blood vessels on the undersurface of the graft.

Although the mesh graft was designed as a method of expanding a split thickness skin graft to many times its original size (Lanz, 1908), it also has the ability to adapt accurately to irregular recipient contours and allows free drainage of blood through its interstices. The recognition that these incidental properties may enhance graft take has led to the use of mesh grafts in an unexpanded form (Davison *et al.*, 1986). This study demonstrates yet another

incidental property of mesh grafts that may be pertinent to their successful vascularisation.

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