GIBSON — MODERN TRENDS IN PLASTIC SUT

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IN

PLASTIC SURGERY

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Edited by

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PREFACE

Two problems of selection face the editor of a book of this kind; the subjects to be covered and the contributors who can best do so. Plastic surgery is still an ill-defined specialty. Devoted neither to a single anatomical area nor to a particular set of organs, its techniques have found application in many surgical fields, and the treatment of a wide range of congenital and pathological lesions now comes within its orbit. Special interests abound and the practice of no two plastic surgeons is precisely alike. Fortunately it was not the function of the book to deal exhaustively with its title and the subjects chosen are those in which I felt that the majority of plastic surgeons were interested to a greater or less degree.

From the outset I decided that the contributors should not necessarily be confined to the United Kingdom. Plastic surgery has expanded rapidly since World War II and has developed in subtly different ways in different countries. The work being done elsewhere is often little known, partly through language barriers, partly because of varying degrees of conservative parochialism. Yet it is essential that we keep informed not only of advances at home but of recent trends overseas. The authors were therefore selected from the international field and are those who, so far as I am aware, have most to offer in each subject. Many of the techniques described and the opinions expressed differ from the orthodox British approach but, while they may provoke criticism, they should also stimulate thought and may shed new light on old problems. Randall's contribution on hare lips, for example, not only brings up to date developments since Le Mesurier's classical papers but also includes at my request his technique for operating under local anaesthesia in infants. Primary bone grafting of cleft palates, too, has been little used if at all in Great Britain, but, as Rehrmann's review shows, it has been widely adopted in Germany and Scandinavia with outstanding results.

The basis of many of the contributions have of course been published before in various journals. But two may be entirely new to English-speaking readers. Lorthioir's method of treating burns by abrasion has been previously published only in French. At first sight it may seem unnecessarily traumatic, but it is a logical concept and, having seen some of his cases in Brussels, I believe the technique will take its place in local treatment. Reports of the ingenious and original techniques which Schmid has developed for reconstruction of the nose have appeared mainly in German; the minimal forehead scarring, the retention of full movement of the forehead muscles

and the refinement of the finished result may come as rather a revelation to those who still think in terms of the massive forehead flap. Morel-Fatio's well illustrated description of his techniques for some cosmetic facial operations is also new in the sense that it has been prepared specially for this volume. There is an increasing demand for operations of this kind and I felt that a detailed exposition of the sound techniques of an acknowledged expert might be welcomed by many. Mustardé's method of correcting prominent ears was in a sense an afterthought. It was still experimental when the book was planned but increasing personal experience has emphasized its simplicity, precision and permanence and I felt that it had to be included, even although Morel-Fatio describes a quite different technique.

This has been an opportunity to obtain from some who have introduced new techniques in recent years an up-to-date report and details of the modifications which time and experience have suggested. Strömbeck's technique for mammaplasty has the advantages of safety, simplicity, ease of execution and, above all, adaptability. Those who tried it following his original description in 1960 will find the present illustrations and operative details much easier to follow and appreciate his critical appraisal of the procedure. In the same way Watson follows up his experience of free dermo-fat grafts for augmentation mammaplasty and discusses their place relative to other methods. Converse has repeatedly stressed the importance of approaching the mandible intra-orally. To those who began before the antibiotic era this may still seem hazardous, but his work leaves no doubt that it is usually the method of choice today; it is also surprisingly easy and the exposure is frequently better than is possible from the submandibular route. Hueston, who has recently put into words the doubts of many about radical fasciectomy for Dupuytren's contracture, stresses the importance of a more conservative approach and summarizes his clinical research in this field. The primary excision of extensive burns seemed an unattainable ideal until the pioneer work of Jackson and his colleagues was published in 1960 and this he now brings up to date. His work and also that of Lorthioir emphasizes the need for plastic surgeons to be in close contact with burn patients throughout their course.

In some subjects there were many small advances to be reviewed rather than one or two major innovations and I have been fortunate in obtaining authors who are internationally known for their previous work in these fields. McCormack and Entin have co-operated to cover between them modern thought on all aspects of hand surgery with the exception of Dupuytren's contracture.

Braithwaite has approached the operative treatment of cleft palate from the physiological standpoint and discusses it in relation to other developments in this field. Many plastic surgeons who find genital abnormalities difficult to correct will welcome Matthews' contribution. Fitzgibbon and Bodenham have long been interested in the treatment of skin tumours and have a wealth of experience to draw from. Intra-oral cancer is reviewed by Kiehn and DesPrez, who have been responsible for many innovations, particularly the useful inturned flap to provide lining; they also discuss the role of chemotherapy.

The use of prostheses is still controversial. Perhaps the day will come when we can replace any defect with living tissue, but we are still far from that goal and until then artificial substitutes will continue to be needed. Edgerton has dealt comprehensively with the various buried prostheses which are available and discusses their advantages and their risks. A good external prosthesis can spare a patient many months of reconstructive surgery and every plastic surgeon should be aware of what can be achieved and have readily available the services of someone who has the artistry and skill to make them. Smith, with whom I have long been associated, describes some of the many excellent prostheses he has made.

In conclusion, I should like to thank all the contributors for their willingness to write and for the kindly way they accepted my requests and criticisms.

TOM GIBSON

Glasgow, 1963

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CHAPTER 1

TISSUE REPAIR AND TISSUE TRANSPLANTATION

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TISSUE REPAIR AND WOUND HEALING

The process of repair and regeneration is fundamental to the whole practice of plastic surgery and our best results are those in which repair is completed in the minimum time with the minimum of complications. Yet we are still ignorant of many of the mechanisms involved and can only control them indirectly by avoiding any known inhibitory factors. Man, unfortunately, has poor regenerative powers compared with many animals. The salamanders, for example, will grow a new limb to replace one which is amputated, but man cannot replace lost tissue in this way. Most mammals too can close large skin defects rapidly and efficiently by wound contraction. One of the 'imperfections of man' (Medawar, 1957) is the ineffectual nature of contraction in human wounds; it is so slow, accompanied by so much fibrosis and gives such unstable results that it is part of our task to prevent it. Much research has been carried out on these and similar problems; much remains to be done. It is only possible here briefly to indicate the present position and for a full and critical review of recent literature, the reader is referred to the excellent monograph of Russell and Billingham (1962).

Epithelial Resurfacing

The initial phenomenon in re-epithelialization of any wound large or small, is not proliferation of cells but cell migration. The cells of the exposed basal layer move amoeba-like over the raw surface. In superficial wounds such as abrasions, or donor areas after removal of very thin split skin grafts, resurfacing by migratory activity proceeds rapidly and is complete within a few days. In deeper and particularly in full-thickness wounds there is often a delay of some days before any migration can be found at the wound margin (Pepper, 1954); thereafter it proceeds rapidly. Howes (1943)

found the average rate of epithelial advance in full-thickness wounds in rabbits' ears to be about 0·5 mm per day. Epithelial mitosis occurs after cellular migration, partly at the wound margin and partly in the migrated cells; by this latter proliferation, the original single cell layer thickens and stratifies. When wide defects are being covered, the two processes exist simultaneously; there is an advancing migratory single layer of cells while behind the epithelial layers are increasingly hyperplastic. It is still not known what causes apparently static epithelial cells to assume amoeboid activity. Weiss (1961) has postulated that epithelial cells have specific surface configurations through which they bond precisely with their neighbours; if wounding leaves them with unsatisfied lateral 'valencies' they migrate until they are once more surrounded on all sides by cells of their own kind. Certainly, cell migration ceases immediately the migrating edge meets another epithelial layer.

Migratory epithelium has the remarkable property of being able to undermine the most adherent crusts and free them from the underlying tissue; on this depends the success of the exposure treatment of wounds and burns. Clark and Clark (1953) from transparent ear chamber observations suggested that the migrating cells secrete a proteolytic enzyme to clear their way beneath scabs, blood clots and necrotic tissue. The migratory edge is at first loosely attached to the bed and may be torn off with adherent dressings. It becomes, however, very rapidly fixed although the exact process involved is not known.

Connective Tissue Restoration

Whether the wound has been closely appositioned by sutures or whether there is a skin defect, the immediate local reaction is one of acute inflammation, a non-specific response involving a number of different processes designed to increase the blood supply to the part, counteract bacterial invasion, remove necrotic tissue and blood clot, and prepare for the definitive repair.

New blood vessels appear within the first 3 days as solid endothelial buds arising from pre-existing vessels. These capillary growths develop a lumen and form anastomoses with others of their kind or pre-existing vessels in the wound. As the vascular pattern of the wound develops, the immature capillaries are modified into arterioles, venules or large channels; indeed, in transparent chambers in rabbits' ears continuous change in the evolution of the new capillaries can be observed.

Although it seems likely that the changing function is mediated by the varying pressures of the blood in the capillary, the initial growth of endothelial sprouts in a fresh wound is probably not dependent on a *vis a tergo*. Williams (1953) transplanted small pieces of omentum into transparent chambers in rabbits' ears and noted the outgrowth of many endothelial buds. Merwin and Algire (1956) made similar observations with grafts of mammary and tumour tissue. This may well explain the puzzling phenomenon of 'take' of free grafts; the usual hypotheses of (*a*) chance direct anastomoses between cut ends of vessels in graft and bed, (*b*) anastomoses between endothelial outgrowths from the bed and the open ends of vessels in the graft, or (*c*) invasive penetration of the graft by new vessels, are not very convincing. However, if the empty blood vessels on the cut surface of the graft are still capable of producing endothelial buds, then the 'take' of a free graft is very similar to the healing of an appositional wound.

Coincidental with the development of new blood vessels, fibroblasts migrate into the wound in increasing numbers and proliferate there. There is still discussion about their origin, whether from proliferation of local fibroblasts or from circulating cells in the blood stream. Allgöwer (1956) produced indirect evidence in favour of the latter theory; he found, for example, that human leucocytes in tissue culture will produce a connective tissue network and that wounds on the ears of rabbits which have severe leucopenia from total body irradiation (the ear being screened) produce much less granulation tissue than the controls. On the other hand, MacDonald's (1959) studies in rats with tritiated thymidine (which is taken up by cells in mitosis and is demonstrable with autoradiographs) favour a local origin; the cells affected were undifferentiated connective tissue cells around blood vessels and hair follicles near the wound. New fibroblasts were observed in these sites from whence it is believed they migrate into the wound where further proliferation occurs.

It is now generally agreed that the fibroblast is the cell most intimately concerned with formation of new collagen fibres and that the fibrils themselves form on the surface of the cell. These fibrils align themselves rapidly in groups to form typical adult collagen fibres. Elastic fibres also appear in the wound but the source of their synthesis is not known. In addition to the fibrous structures there is also found in healing wounds an amorphous mucopolysaccharide ground substance. Watts (1961) believed that its formation is essential to collagen deposition.

Wound Contraction

In a sutured incisional wound, healing is rapidly accomplished by the three processes of acute inflammation, epithelial migration, and connective tissue repair. In open wounds or those which heal by second intention, the interesting phenomenon of wound contraction plays an important part. There is some semantic confusion between ' contraction ' and ' contracture '. Abercrombie, James and Newcombe (1961) defined ' wound contraction ' as the process whereby the intact skin bordering a full-thickness deficit is drawn from all sides centripetally over the wound bed in the early stages of repair. The term ' contracture ' they reserved for the shortening or reorientation of an established mass of scar tissue. Russell and Billingham (1962) believed that they are simply different stages in the same process. Some distinction, however, is plainly desirable and ' wound contraction ' and ' scar contracture ' are used here to describe the two processes.

Wound contraction may be observed most favourably in the common experimental animals in whom skin defects will rapidly shrink until represented by a thin scar. Surprisingly enough, rectangular or triangular defects behave differently from circular wounds (Abercrombie, James and Newcombe, 1961). In straight-sided wounds, the mid-point of the sides moves centrally much more rapidly than the corners; a triangular wound ends as a three-pointed stellate scar, a square wound as a four-pointed scar, and an oblong defect has a central limb added. Wound contraction in fact closes such wounds in the same way as a surgeon might suture them. Circular wounds, on the other hand, close in a puckered fashion and area for area at a slower rate than those with straight sides; in addition, the perimeter shrinks in length by about 40 per cent whereas in oblong wounds it may actually increase (Billingham and Russell, 1956). In man, wound contraction occurs at a very much slower rate and far from being a beneficial process, much of plastic surgery is concerned with preventing and correcting the deformation it causes. It may adequately and harmlessly close small defects on the trunk and thigh, but over joints and on the face its effects may be disastrous.

The simple explanation that wound contraction was due to the shrinking of the new collagen fibres in the granulation tissue is no longer tenable. Deposition of collagen is almost absent in scorbutic animals, and Abercrombie, Flint and James (1956) found that wounds in such animals contracted at the same rate as in non-scorbutic controls. This has led to an unsuccessful search for factors outside the granulation tissue to explain contraction. Various

hypotheses have been suggested: (*a*) that the skin surrounding the wound might grow and push the edges over the defect, (*b*) that the skin edges themselves might grow, and (*c*) that a ring of contractile material develops in or near the margin of the wound. This latter theory, the ' picture frame effect ', was developed by Watts, Grillo and Gross (1958) who found that excision of the central area of granulation tissue had no effect on the rate of contraction and the skin margin only retracted if it were separated from the base of the wound. On the other hand, it is generally agreed that if an area of granulations in the centre of a wound is isolated by incising around it, it will immediately retract; in other words, it is under tension. Any theory based on forces in or around the wound margin therefore fails since these would put the granulation tissue in a state of compression. Abercrombie, James and Newcombe (1960) have confirmed that contraction is a function of the granulation tissue by splinting the wound margins during healing; sudden removal of the splint results in very rapid contraction and this can be largely abolished by first removing most of the granulations. Since collagen is not the active contracting agent, some other element of granulation tissue must have this property; what this is remains to be determined.

Although the cause of wound contraction is unknown, it is a matter of everyday observation that it can be stopped by covering the granulations with dermis which has the effect of hastening the change from highly vascular granulation tissue to mature fibrous tissue (Gillman and colleagues, 1953). The effect is almost quantitative; epithelium without dermis has little effect and scar contracture is most severe; full-thickness skin grafts have the most striking effect and scar contracture thereafter is minimal. Even on freshly cut defects, skin grafts have roughly the same result; the thicker the layer of dermis, the less scar contracture will ensue.

Scar Contracture

The process of wound healing does not stop when the wound is closed and covered with epithelium; there is still the phenomenon of scar contracture with or without keloid formation to run its unpredictable course. Practically all research work has been carried out on the early stages of wound healing and we are still profoundly ignorant about the later processes. We are aware that ' thin skin grafts contract more than thick grafts ' (although clinical observation will show that it is not the wrinkled graft which has contracted but the tissue immediately beneath). We are also aware that when