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## SOME PROBLEMS OF AURICLE RECONSTRUCTION IN MICROTIA\*

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Reconstruction of the auricle in cases of microtia is one of the most difficult problems in plastic surgery. The rudimentary auricle most frequently forms a longitudinal skin fold which usually includes misshapen remnants of cartilage. Congenital hypoplasia of the auricle is usually accompanied by atresia of the external auditory meatus and dysplasia of the middle ear. In most patients suffering from microtia a typical faciomaxillary deformity can be observed, most frequently together with ipsilateral hypoplasia of the masseter, the mandibular joint and the zygomatic. The surgical treatment of faciomaxillary disfigurement embryogenetically connected with dysplasia of the auricle constitutes a special and extraordinarily difficult problem which we are going to deal with in one of our next papers.

Most papers on reconstruction of the auricle were published in recent years. Initially, the conviction prevailed among surgeons that reconstruction of an auricle to an almost normal shape was impossible. This view is still widespread. However, it must be stated that following a long period of unsuccessful or very little effective attempts at reconstructing auricles, a marked advance in resolving this difficult problem has now been made. Here an important role was played by the work of Converse (2, 3, 4) and Tanzer (7, 8). It seems that it can already be stated with justification that further improvement of the methods and surgical technique will lead to results satisfactory both to the patient and the people around him, which, in fact, should be the main criterion of success when judging the work of plastic surgeons.

In 1956 we made a number of attempts at reconstructing auricles but experienced many failures and disillusion which seems to be the fate of all surgeons dealing with this problem. After eight years of little encouraging experience with the surgical treatment of 66 patients with unilateral and of seven with bilateral microtia, we revised the firmly established views we hitherto had considered to be correct. We also tried to attain better results by changing the method of auricle reconstruction and introducing new material for grafting.

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Here we only wish to present our experience with and the present views of some of the problems of auricle reconstruction. Therefore, many real problems of auricle reconstruction will be omitted altogether or dealt with marginally.

I am of the opinion that in unilateral microtia with normal hearing in the other ear, no reconstruction of the external auditory meatus with mobilization of the middle ear ossicles or fenestration should be undertaken. Since up to 1961, I, together with Radziminski, had performed reconstruction of the external auditory meatus in almost every patient with microtia, I wish to explain, why I have changed my views on the entire operation.

1. The main cause of the child's (particularly in boys) and his parents' distress is not defective hearing, but the disfigurement due to dysplasia of the auricle.

2. In most patients, permanent improvement of hearing is not sufficiently marked to justify such extensive an operation in every case of unilateral microtia.

3. Quite frequently chronic suppurative inflammation of the middle ear is present which, for a long time, makes it impossible to carry out any reconstructive operation at all and after eventual operation frequently becomes the cause of failure due to infection of the graft.

4. Anatomic irregularities in the region of the mastoid process sometimes necessitate forming the external auditory meatus so near the hair line that there is not enough hairless skin available for reconstruction of the auricle.

5. The scars resulting from reconstructing the external auditory meatus make subsequent plastic operations very difficult.

The above considerations made us abandon reconstruction of the external auditory meatus in unilateral microtia. A similar view is now also held by Converse, Tanzer and Peet (5).

In particular, I wish to discuss the questions of utilizing the dysplastic auricle as material for the reconstruction and of choosing the material for the skeleton of the auricle to be reconstructed.

The first operation is always preceded by a very exact delimitation of the site for the reconstructed auricle. For this purpose, a model of a regularly shaped auricle is cut out from X-ray film. Most important is the marking of the lower margin of the ear lobe and the upper margin of the helix. Proper planning of the site of the auricle is of particular importance with regard to frequent hypoplasia of the ipsilateral half of the face which sometimes leads to considerable asymmetry. In each case of microtia we endeavour, at the first operation, to utilize the skin of the dysplastic auricle to form the ear lobe, and, if possible, also the tragus of the future auricle.

We start the operation with a transverse incision of the dysplastic auricle forming two unequal sections, the lower measuring  $\frac{3}{4}$  of the whole. Then the misshapen cartilage is completely removed. The lower section is then separated at its base except for a small pedicle at the lower margin, rotated backwards and sutured to the wound edges of a horizontal incision made along the line

previously marked according to the model auricle. In this way the ear lobe is reconstructed (Fig. 4, 13, 15).

Reconstruction of the ear lobe from the dysplastic auricle and its implantation at the correct site is considered very important for the final result of reconstruction of the whole auricle (Fig. 2, 8, 12, 14, 17).

If the upper section of the dysplastic auricle is suitable for forming the tragus, we try to shift it downwards to the site where the tragus should be reconstructed (Fig. 4, 5, 7, 8). It must, however, be stressed that we sometimes abstain from using this material if transposition to the correct site requires several operations, because they increase the number of scars in this region.

As to the choice of material for the skeleton graft, most authors are of the opinion that autogenous cartilage is the most suitable for the purpose.



Fig. 1—8. Auricle reconstruction with conserved homogenous cartilage grafts.



However, our experience shows that this problem requires further discussion. We, therefore, wish to present our observations on using conserved homogenous cartilage together with polyester nets.

In 51 patients, we employed conserved homogenous cartilage for the skeleton of the auricle. The grafts were conserved in Ringer-Locke solution with the addition of antibiotics at about 0° C. Systematic sterility tests were made, throughout the whole period of conservation. In order to evaluate the suitability of conserved cartilage, apart from clinical observation, histological and histochemical investigations were carried out on material obtained during corrective operations. Microscopic examination of 29 specimens of implanted conserved homogenous cartilage showed that the overall histological structure of the cartilage had been preserved for four years and that changes were insignificant and did not detract from the suitability of the graft. We wish to stress that macroscopically even five years after implantation, the cartilage had preserved its original appearance, consistence and firmness and its size had not diminished.

Our clinical experience and the results of microscopic investigations permit the assertion that conserved homogenous cartilage is a most suitable material for grafts to be implanted into the midst of tissues and we, therefore, also use it for reconstruction of the auricle.

The cartilage is modelled in one block according to an X-ray film pattern of the auricle to be reconstructed. On the thus shaped model of cartilage the raised contour of the helix is carved and the anthelix is given the correct elevation by stitching a layer of perlon threads over it.

The skin incision for the introduction of the cartilage graft is made 2 to 3 cm. above the hairline. Mobilization of the skin is carried out far beyond the outline of the auricle to be reconstructed in order to avoid tension in the skin after the graft has been implanted.

To ensure close contact of skin and graft, particularly along the helix, mattress stitches are first made through skin and the graft edge. Then a dressing of moist cotton wool is applied only under slight pressure and left 7 to 8 days. Thus through contact of skin and graft is achieved.

In two patients an abscess developed near the graft necessitating its removal. In six patients the free skin graft covering the dorsal surface of the reconstructed auricle underwent partial necrosis which resulted in exposure of the graft. In two of these patients we succeeded in re-covering the exposed cartilage with skin transposed from the immediate neighbourhood, but in the other four patients the cartilage had to be removed. On follow-up examination one to three years after implantation of homogenous cartilage, the graft was found to be fractured in 10 patients.

Fracturing of cartilage can be explained by the fact that the grafts had been modelled into a thin plate and implanted to a site particularly prone to trauma. It should, moreover, not be forgotten that costal cartilage was used for grafting

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Alichniewicz, Bardach, Kozłowski, Pruszczyński: Research on Grafted Conserved Homogenous Cartilage. (Acta Chir. plast. in the press.)

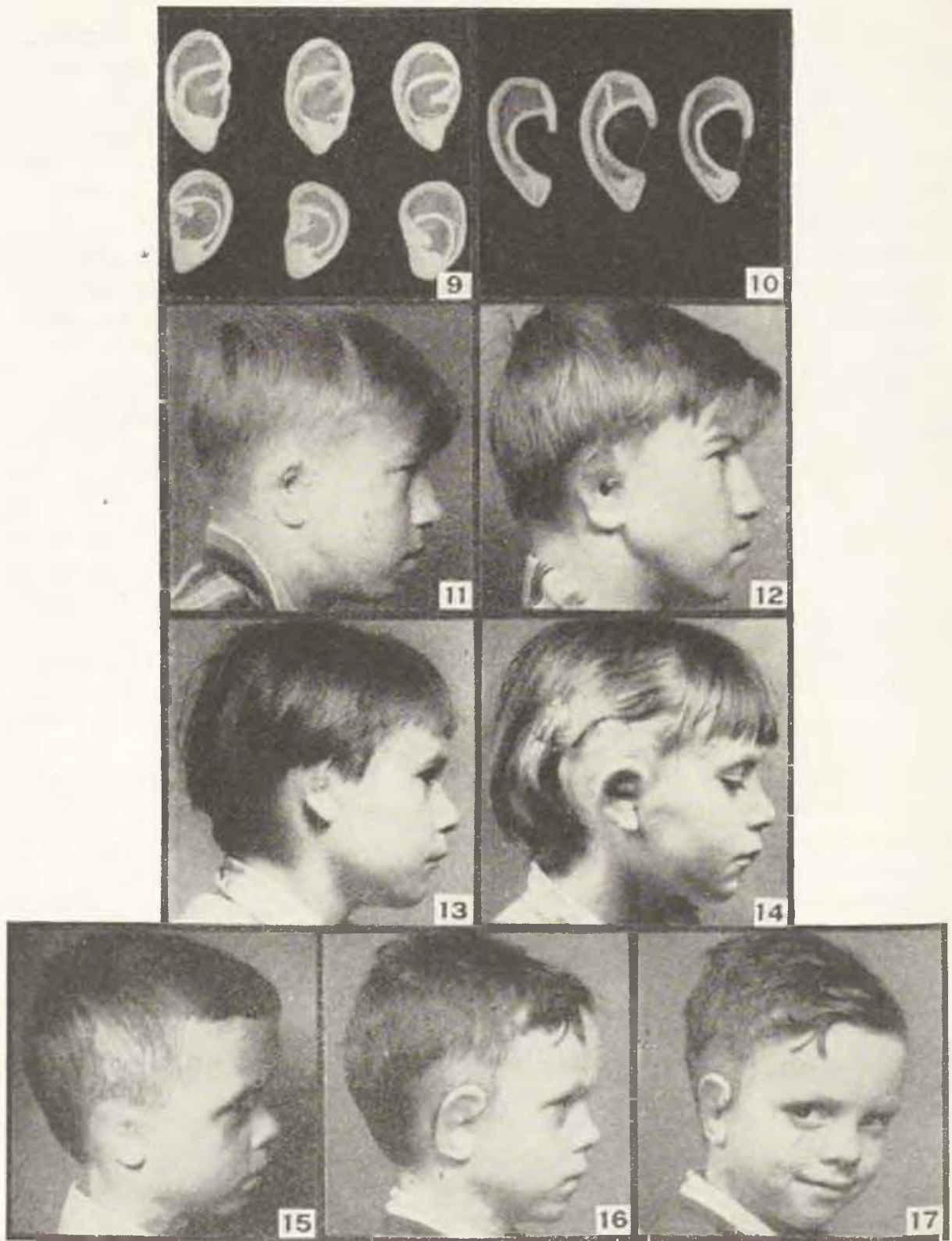


Fig. 9. First model of polyester net grafts. — Fig. 10. Currently used models of polyester net grafts with polypropyl fibre tube reinforcement of helix and anthelix. — Fig. 11—17. Auricle reconstructed with polyester net graft skeleton (first model).

which is hyaline cartilage, i.e. not very elastic and brittle, unlike that in the normal auricle which is elastic cartilage and, therefore, not prone to fracturing. In spite of our clinical experience and the microscopic investigation which demonstrated that conserved homogenous cartilage is a most suitable material for grafting into the midst of tissues and despite the satisfactory results achieved in a number of patients [2, 5, 8] the above described failures made us search for other graft materials. We were looking for material which could be modelled as near to the shape of an auricle as possible before operation. After consultation with Mr. Zbieranowski of the Knit Wear Industry Central Laboratories in Lodz, the first model of an auricle skeleton made of polyester fabric was produced (Fig. 9). Afterwards models were made of different sizes corresponding to the different age of children.

The models had all the qualities of normal auricles except sufficient elasticity. When implanted, they gave quite good results [14, 16, 17]. Based on our previous clinical experience with grafts of polyester nets in 12 patients, we, together with Mr. Zbieranowski, made further improvements. We altered the shape of the graft, and in order to provide the required elasticity, we used tubes of polypropyl fibre for the formation of the helix and anthelix [10].

In this paper we are not reporting our limited experience with the use of polyester fabric grafts in 18 patients, because the longest period of follow-up has only been 18 months. It seems to us, however, that research along these lines is interesting and quite hopeful.

#### CONCLUSION

1. Formation of the external auditory meatus is not expedient in unilateral microtia.
2. The dysplastic auricle ought to be used, in the first place, for the reconstruction of the ear lobe and, if possible, also for that of the tragus.
3. Conserved homogenous cartilage is a most suitable material for the skeleton of reconstructed auricles. It should, however, be noted that such grafts fracture quite frequently (in about 20%).
4. The employment of skeleton models of polyester fabric seems to be very promising. However, further clinical observations are necessary.

#### SUMMARY

The author is of the opinion that in unilateral microtia with normal hearing in the other ear, it is inadvisable to reconstruct the external auditory meatus.

With a view to the final result of auricle reconstruction, he ascribes special importance to the formation of the ear lobe from part of the dysplastic auricle and its implantation to the correct site. He reports his own observations with the employment of conserved homogenous cartilage grafts in 51 patients. He also describes the use of polyester net grafts but does not evaluate the results, because of too short a follow-up period.



## R É S U M É

### **Certains problèmes de la reconstruction du pavillon de l'oreille en présence d'une microtie**

J. Bardach

L'auteur est d'avis qu'au cas d'une microtie unilatérale, avec conservation de l'ouïe du côté de l'autre oreille, il ne semble guère indiqué de créer le conduit auditif externe.

En ce qui concerne le résultat final de la reconstruction du pavillon de l'oreille, c'est la formation du lobule de l'oreille à partir des segments du pavillon dysplastique et son implantation à l'endroit approprié qui est de la plus haute importance. L'auteur présente ses propres expériences, faites avec l'implantation de greffons cartilagineux homogènes conservés sur 51 malades. Il décrit également la manière d'utiliser des greffons en filets poly-estériques, mais sans apprécier les résultats ainsi obtenus, étant donné que le temps d'observation était trop court.

## Z U S A M M E N F A S S U N G

### **Einige Probleme der Rekonstruktion der Ohrmuschel bei Mikrotie**

J. Bardach

Der Verfasser vertritt die Ansicht, dass es bei einseitiger Mikrotie mit erhaltenem Gehör des anderen Ohrs nicht richtig ist, den äusseren Gehörgang neuzubilden.

Von besonderer Wichtigkeit für das Endergebnis der Ohrmuschelrekonstruktion ist die Bildung des Ohrläppchens aus einem Teil der dysplastischen Ohrmuschel und seine Implantierung an der richtigen Stelle. Der Verfasser berichtet über seine Ergebnisse bei der Verwendung von Transplantaten aus konserviertem homogenem Knorpel bei 51 Patienten. Er beschreibt auch die Anwendungsart von Transplantaten aus Polyesthergeweben, bewertet jedoch die Ergebnisse nicht, da die Beobachtungsdauer zu kurz war.

## R E S U M E N

### **Algunos problemas de la reconstrucción del lóbulo auricular en microtia**

J. Bardach

El autor es de opinión que, en el caso de la microtia unilateral con buen oído en la otra oreja, no es correcto formar un canal auditivo externo.

La cosa que es muy importante en relación con el resultado final de la reconstrucción del lóbulo auricular es la creación del lóbulo auricular desde la parte displástica del lóbulo y su implantación al puesto correcto. El autor presenta aquí sus propias observaciones empleando un injerto de piel tomado del cartilago homogéneo en 51 pacientes. También describe la técnica del empleo del injerto de piel de las rejas de poliestéreo, pero no evalúa los resultados porque el período de observación fue demasiado corto.

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## VASCULAR ORIGIN OF TROPHIC ULCERS AND APPLICATION OF ULTRASOUND AS PREOPERATIVE TREATMENT TO PLASTIC SURGERY

A. B. GALITSKY, S. I. LEVINA

The number of patients suffering from trophic ulcers is quite high. After World War II they make up 4 to 12% of the entire number of surgical patients (Yazyckov, Petrova). Rufanov has shown that 10 to 15% of all peace-time wounds remain permanently unhealed [quoted according to Podlyashuke and Shlapobersky].

Disputes about the pathogenesis of trophic ulcers, which continued for many years, have not yet fully elucidated this problem. The theory of Pavlov about the interaction between the nervous and vascular systems to explain the trophicity of tissues, still remains in the lead. Rejecting the conception that the severing of special trophic nerves would improve the healing of wounds (Molotkov), Orbeli developed the theory of the leading role of the sympathetic nervous system in the process of regeneration. Vishnevsky objecting in principle to the application of gross, mechanical force to any parts of this system, suggests a combination of therapeutic measures aimed at altering the trophicity of tissues by means of weak irritants. In connection with this, Vishnevsky and his school proceed for the assumption that "in torpid wounds it is a nervous factor which constantly acts upon the trophic processes in and the reactivity of tissues" (Protopopov).

Many authors have pointed to the significance of changes in the vessels, particularly in veins. Allen, Barker and Hines (1947) assume that in varicose enlargement of veins, chronic congestion and thrombosis of venules and the venous arms of the capillary loops play a part in the pathogenesis of chronic venous insufficiency and trophic disorders. The increased pressure, sluggish flow and stagnation of venous blood in the lower limbs makes the situation worse. Birger (1941) assumes that 33% of all trophic ulcers are due to thrombophlebitis, Wiener (1941) estimates 41%, Bauer (1942) even 87%, but Becker and Obermayer (quoted by Gilje) stated in 1946 that practically all ulcers develop on the basis of thrombophlebitis and insufficiency of the lymphatic



system. Varicose veins and thrombophlebitis of the deep veins in the leg predispose to the development of ulcers far more than disorders of the superficial veins.

The investigation carried out by Krowze permits the assumption that inhibition of the regenerative process depends not only on neurotrophic disorders, but also on the degree and nature of vascularization in the developing scar. He reduces the pathogenesis of trophic ulcers to the principles of connective tissue development in the organism and recommends directing treatment towards a change of structure in the scar. Davidovsky says that after protracted suppuration, large areas of sclerosis develop, a great number of vessels are obliterated and the local, but sometimes even the general regeneration potential decreases. Vayl assumes that local sensitization of connective tissue and vessels takes place, provoked by the products of tissue decomposition and followed by a hyperergic reaction expressed in the fibrinoid necrosis of vessel walls.

Popoff (1936), Schorn (1959) and Levina (1961) pointed to the possible role played by the glomic anastomoses of the skin in the development of trophic ulcers. Glomic anastomoses of the skin are usually situated in the stratum papillare. On histological examination this anastomosis consists of three sections: the afferent artery which has the structure of an endartery, the anastomosis proper and that of the efferent vessels (Clara 1953, Masson 1935). In the anastomosis proper the wall is formed of a fibroelastic membrane over which a few layers of glomus-cells are spread separated from the lumen of the vessel only by one layer of endothelial cells. The anastomosis proper is very long and usually extremely tortuous, wound up in a kind of coil, thence the name glomic anastomosis, and on current histological examination (stained with haematoxylin-eosin) it strongly resembles a recanalized thrombus.

According to present knowledge, glomic anastomoses are regarded as organs with a complex action upon the peripheral circulation, possessing both chemodynamic and interoceptive (chemo- and pressoreceptive) functions. It has been proved (Portugalov et Yakovlev 1953, Grigoryeva 1954) that the glomus-cells excrete both acetylcholine and adrenalin.

In the literature the pathology of glomic anastomoses has only been dealt with in a few papers, mainly of foreign authors.

In the Soviet literature this subject has been touched upon in the paper of Levina (1961). In various vascular disorders, the walls of the anastomosis undergo fibrosis and hyalinosis followed by rapid narrowing of lumina. The process of fibrosis is accompanied by a replacement of the active glomus-cells by fibrous tissue. Schorn (1959), who has studied the changes of glomic anastomoses in the skin under various pathological conditions of the cardiovascular system, points out that all processes described above, such as fibrosis, hyalinosis and also shortening of the section of the anastomosis proper, are concomitant with every disorder leading to a change in vascular tonus; analogous changes take place in physiological involution characteristic for the different age groups (Schorn 1959).

The peculiarities in the structure of these anastomoses (the presence of an arterio-venous shunt), their relative functional autonomy, i.e. the independ-

ence of their rhythm and pulse of the heart beat, the lack of parallelism between the blood flow in the capillaries and that in the anastomosis (Clark et Clark 1934—1935, Dansker 1956), can explain the clinical picture seen when their function has been affected. Sittenko (1951), describing the pathophysiological picture in endarteritis obliterans, stresses that in this disease acceleration and not, as may be assumed, retardation of the blood flow takes place in the affected limb, due to the larger difference between arterial and venous blood pressure. It seems that this difference is connected with an impairment of the chemo- and pressoreceptive functions of glomic anastomoses (a conception which will have to be verified by further and special investigations).

The above, with regard to both the physiology and pathology of glomic anastomoses, permits us to suggest that in many cases trophic ulcers actually develop on a vascular base (in the narrow sense of the word).

On histological examination of chronic ulcers of various aetiology, we were unable to show clearly any morphological peculiarities in the actual structure of the ulcer which could have been connected with the presence or absence of varicose veins or severe atherosclerosis of arteries. Usually the ulcer presented as a deep varyingly sized defect in the skin (sometimes down to the muscle or even bone). The floor of the ulcer consisted, in most cases, of granulation or connective scar tissue with a superficial layer of necrosis. This zone is only very broad in recent ulcers; in chronic ulcers of very long duration it is narrow. The necrotic tissue is densely infiltrated with leucocytes. Under the necrotic layer lies the zone of granulation tissue which, too, is rarely broad.

A distinct feature of granulation tissue in chronic ulcers is fibrosis of its stroma and the presence of broad areas of scar formation in the periphery. Sometimes this process is so advanced that the entire floor of the ulcer is formed by a layer of collagenous scar tissue. The epithelium, on the other hand, shows broadening of the Malpighian layer, and deep invasion of epithelial projections into the underlying layers could be observed at the edge of the ulcer; there were also changes in the nature of the hyper- and parakeratosis and frequently marked reticular degeneration of the cells of the stratum basale.

The granulation tissue in chronic ulcers often has the character of that in any chronic suppurative inflammation, i. e. in any markedly dystrophic processes. Typical of granulation tissue developing on the basis of inflammation is its dense infiltration with leucocytes not infrequently forming little abscesses and large areas of fibrinoid necrosis in the vessel walls. Dystrophy is accompanied by oedema of the granulation tissue due to lymphostasis which, in the papillary zone, leads to formations resembling cavernous lymphangiomata and, in the epithelium, to a reticular texture of the stratum basale and, sometimes, even the stratum corneum. On picrofuchsin staining the granulation tissue shows coarse collagenous stroma and the vessels (independent of the duration of the ulcer), usually not differentiated, are formed by tubes of a thin wall of smooth muscle tissue without any elastic fibres. Larger arteries and veins of the subcutaneous tissue (usually few in number) show extensive atherosclerosis and myelastofibrosis and often have the character of end-arteries.

It ought to be stressed that only in very few ulcers of traumatic or varicose origin did we find glomic anastomoses. As a rule, neither on the floor, nor in the epithelized marginal zone nor along the edge of the ulcer did we ever see any glomic anastomoses. In a few cases where glomic anastomoses had been detected,

they either represented newly formed vessels of the granulation tissue (maybe somewhat differentiated towards a glomic anastomosis) or transitory formations, i.e. little differentiated vessels of granulation tissue or small arteries of sub-cutaneous tissue in whose walls we sometimes saw atypical muscle or glomus-cells.

Considering the treatment of trophic ulcers, most authors are, up to the present, of the opinion that the method of choice is coverage of the defect with a skin graft. Free skin grafts have a great many advantages over pedicle flaps. The methods of preparing the ulcerated surface for skin grafting, are manifold.

Bearing in mind the above-described characteristics of the structure of chronic trophic ulcers, we employed ultrasound therapy as a preoperative measure to coverage with skin grafts.

With its stimulating effect on the nervous system and its deranging and absorption stimulating effect on fibrous scar tissue, ultrasound acts like the stimulator of the mesenchyme and leads to quicker granulation and epithelization of ulcers. It must also be taken into account that ultrasound possesses evident antiphlogistic properties based on the fact that the wave pressure produces an increase in diffusion and a decrease in acidosis of the affected tissues.

Application of ultrasound of a 900 Kc/s frequency causes no pain to the patient, because the tissues lying between the ulcer and the periosteum and the periosteum itself are cicatrized and the acoustic resistance is the same in all of them. In addition, ultrasound of this frequency also has an effect on the bone arteries which participate in the blood supply of the skin on the anterior aspect of the leg (Walker), thus improving conditions favourable to healing of the ulcer. Application of ultrasound must be carried out through the medium of water, because direct contact of the vibrator head with the ulcer is painful.

Plastic coverage of trophic ulcers with free skin grafts after preoperative ultrasound treatment was carried out in 45 patients, in three of whom twice, for new ulcers developing in the neighbourhood of those which had healed after the first treatment. There were 22 women and 23 men; 12 patients were of an age up to 40, 19 patients between 41 and 60, 13 patients between 61 and 80 and one patient was over 80. Twenty-three patients suffered from varicose veins and chronic thrombophlebitis of the leg, three from obliterating atherosclerosis of the lower limbs and in 19 the ulcers developed as a result of various injuries including burns, frost bites, etc. In 32 patients the ulcers were situated in the lower third of the leg, in the remaining at other sites of the leg, the thigh, the feet and the forearm. In 15 patients the ulcer was of one-year's, in 19 of one-to ten years', in 7 of 11 to 20-years' and in 4 over 20-years' duration.

Preoperative ultrasound treatment was carried out in the following way: With the UZU-I apparatus a frequency of 2.5 mc/s or 900 kc/s at an intensity of 1.5 Watt/cm<sup>2</sup> were applied to the ulcer through water under constant couplings. These applications were repeated daily for 3 to 10 minutes. After application the ulcer was covered with a gauze pad soaked in sterile vaseline. At the same



time the skin of the donor area, usually the anterolateral aspect of the upper and middle third of the thigh, was treated by contact application through vaseline with a frequency of 900 kc/s and an intensity of 1.5 Watt/cm<sup>2</sup> under an impulse regime.

In the first five patients the ulcers were treated with a 2.5 mc/s frequency. This frequency, however, did not ensure the required depth of effect. The ulcers in these patients showed slow elimination of necrotic masses and at the end of the treatment almost complete absence of profibroblasts and fibroblasts in their cytograms. The capillaroscopic picture hardly differed at all from that prior to treatment.

The method of treatment was, therefore, changed. The ulcer was subjected to a frequency of 900 kc/s at an intensity of 1.5 Watt/cm<sup>2</sup>. In this way elimination of necrotic masses started after 3 to 5 applications. After 3 to 4 applications pain ceased completely, the cytogram showed active phagocytosis, and at the end of the course of treatment the appearance of polyblasts, profibroblasts and fibroblasts. Protracted local treatment of these ulcers by other means prior to the application of ultrasound resulted in a retarded appearance of cell elements of the active order. On capillaroscopy carried out before transplantation, the background had become lighter and in the foreground the number of capillary loops had increased 4 to 6 fold.

At the end of the course of ultrasound treatment the ulcer was completely cleared of necrotic masses and pus, its floor was covered with granulation tissue and along its edge there was a band of epithelium.

The operation consisted in excision of the granulation tissue and the marginal zone of the ulcer. The floor of the thus created wound was then formed of moderately bleeding scar tissue.

A skin graft of 0.3 mm. thickness was taken from the anterolateral surface of the thigh with a dermatome (the hand-driven dermatome made by the Kazan factory for Medical Appliances). This thickness of the graft was chosen, because it does not require much nutrition which, during the first period, is provided for by the absorption of plasma oozing from the interstitial spaces (Janos). For the time required for excision of the ulcer, the skin graft was placed into concentrated plasma. This made the graft stick firmer to its bed and ensured reliable haemostasis. The operation field was then covered with gauze strips soaked in vaseline and layed like roof tiles. The dressing was removed on the tenth day.

Out of 48 operations, carried out in the above way, 43 resulted in a complete take of the skin graft. In three patients the graft sloughed off. One of these patients, who had trophic ulcers on the dorsal aspect of the foot due to obliterating atherosclerosis, had received preoperative ultrasound treatment of a frequency of 2.5 mc/s. In the other two patients the trophic ulcers were of traumatic origin and situated in the region of the Achillis tendon. Here the skin graft become necrotic after they had been permitted to walk. In this location the employment of a split skin graft is most probably contraindicated. In two patients the graft epidermis peeled off and the graft showed slight marginal necrosis, but the end result was, nevertheless, complete epithelization.

On histological examination of tissue excised from trophic ulcers after ultrasound treatment and in a favourable course of healing, we observed regular structural changes in all layers indicating increased proliferative and reparative processes.

The zone of superficial necrosis usually broadened (sometimes very considerably) in the same way as that of granulation tissue. An obligatory feature of ulcers treated by ultrasound was marked widening of superficial and congestion of the deep blood vessels of the granulation tissue, accompanied by large haemorrhages. Together with these changes accumulation of haemosiderin in the papillary layer of the marginal zone of the ulcer, on its floor under the granulation tissue or in the granulation tissue itself, was noted. The regularity with which haemorrhages occurred in ulcers after ultrasound treatment justifies our considering this to be a specific feature of the ultrasound effects. Particularly often fibrinoid necrosis in the walls of vessels of granulation tissue and fibrinoid swelling of collagenous fibres of the scar tissue in the surroundings of the ulcer, were observed. In large cicatrized areas on the floor of the ulcer mucoid oedema, homogenization and derangement of collagenous fibres was seen in most cases after ultrasound treatment; analogous changes were also registered in the walls of vessels in granulation and subcutaneous tissue, where swelling of the walls and the endothelium led to narrowing of the lumina. The cellular reaction expressed by inflammatory infiltration of granulation tissue and the tissues surrounding the ulcer evidently intensified after ultrasound treatment, whereby the infiltrates acquired a more acute character by an increase in the number of polymorphonuclear leucocytes and a decrease in tissue elements and lymphocytes. In many cases a distinct giant-cell reaction with proliferation of foreign body giant cells was observed on the border between the zone of granulation and the broad layer of necrotic tissue.

In the skin of the donor area, which had been treated by ultrasound, swelling and oedema of collagenous fibres were observed together with a moderate perivascular lymphoid infiltration of the papillary zone and the dermis.

After preoperative ultrasound treatment of trophic ulcers the skin transplant took well in 45 out of 48 cases.

Preoperative ultrasound treatment, therefore, may be used as a method of improving the results of plastic coverage of these ulcers.

In connection with the employment of ultrasound, hyperaemia, large haemorrhages and broadening of the necrotic zone can usually be observed which, by all the evidence, resulted in stimulating the growth of granulation tissue. Afterwards quick cleaning of the ulcer surface sets in which is due to both the rapidly increasing infiltration by leucocytes and giant cells and improved granulation and epithelization.

The morphogenesis of the healing of ulcers after preoperative ultrasound treatment and coverage with a free graft of skin also treated with ultrasound prior to transplantation, can be explained on the basis of the present conception of the lability of collagen (Rusakov, Sarkissov, Arutunov, Strukov). The healing of ulcers proceeds via the improved granulation which is based on activation of connective tissue elements on the floor and at the edges of the ulcer, and is evidently evoked by the employment of ultrasound treatment. The morphological features of these processes are the regular appearance of mucoid oedema, derangement and homogenization of collagenous fibres in the fibrotic

areas of the ulcer and the same processes in the skin exposed to ultrasound treatment. The latter changes bear witness to a progressive decollagenization (Sarkissov, Arutunov 1963).

Vascular origin of trophic ulcers is proved by the invariable absence of glomic anastomoses both in the stratum papillare of the marginal zone of the ulcer and in the deep layers of the tissues surrounding it. This leads to disturbances in the haemodynamic and neurotrophic processes thus impeding healing of the ulcer.

#### SUMMARY

The authors present a method of preoperative ultrasound treatment in trophic ulcers preceding plastic coverage with an autogenous skin graft. By this method they performed a total of 48 operations with good results. A description of the histological structure of ulcers prior to and after ultrasound treatment is also given. The authors express their opinion that the pathogenesis of ulcers is vascular in relation to the glomic anastomoses of the skin.

#### RÉSUMÉ

##### **L'origine vasculaire de l'ulcère trophique et l'application des ultra-sons comme traitement pré-opératoire en chirurgie plastique**

A. B. Galitsky, S. I. Levina

Les auteurs présentent une méthode de traitement pré-opératoire par ultra-sons des ulcères trophiques qui précède la couverture plastique à l'aide d'un greffon cutané autogène. Ils ont réalisé ainsi 48 opérations avec de bons résultats. Une description de la structure histologique des ulcères avant et après le traitement par ultra-sons est donnée. Les auteurs sont d'avis que la pathogénèse des ulcères est vasculaire par rapport aux anastomoses glomiques de la peau.

#### ZUSAMMENFASSUNG

##### **Ueber den vaskulären Ursprung trophischer Narben und die Möglichkeit, sie durch Ultraschallbehandlung für die plastische Deckung vorzubereiten**

A. B. Galizkij, S. I. Lewina

Die Verfasser beschreiben die Methodik, trophische Narben durch Ultraschall für die plastische Deckung durch ein gespaltenes Hautautotransplantat vorzubereiten. Mit Hilfe dieser Methodik wurden 48 Operationen mit günstigem Ergebnis durchgeführt. Die histologische Struktur der trophischen Narben vor und nach Ultraschallbehandlung wird beschrieben. Es wird die Vermutung ausgesprochen, dass die Narben vaskulären Ursprungs sind und in Zusammenhang mit den Glomus-Anastomosen der Haut stehen.

#### RESUMEN

##### **El origen vascular de las úlceras tróficas y la aplicación del ultrasonido como un tratamiento pre-operatorio en cirugía plástica**

A. B. Galitsky, S. I. Levina

En este trabajo los autores presentan un método del tratamiento pre-operatorio por ultrasonido en úlceras tróficas que preceden la cubierta plástica con el injerto de piel autogéneo. Por medio de este método ellos efectuaron 48 operaciones en total con



buenos éxitos. Los autores también presentan una descripción de la estructura histológica de las úlceras antes y después del tratamiento por ultrasonido. En la conclusión los autores presentan su opinión de que la patogénesis de las úlceras es vascular en relación con la anastomosis glómica de la piel.

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## ATTACHMENT OF DIAPHRAGM FLAP TO CARDIA IN THE SURGICAL TREATMENT OF CARDIOSPASM

(According to Petrovsky)

O. D. FEDOROVA

The problem of the surgical treatment of cardiospasm or achalasia of the cardia has received great attention from surgeons in the past ten years. The first attempts to treat cardiospasm surgically were made at the beginning of this century. In the last 60 years a great number of methods of surgical treatment of cardiospasm have been developed, many of which have been abandoned, such as operations on the nervous system, and some others which, at present, are but of theoretical interest. Up to 1950 the operations of Heller and Hejrovsky were used most frequently. The late results, however, showed that neither operation was ideal, because both led to a great number of immediate or late complications.

Heller's operation has won many supporters for its simplicity, it is, however, often accompanied by mediastinitis, pleurisy and peritonitis due to injury of the mucous membrane, and is frequently followed by recurrence of the cardiac disorder. We have collected the results of 243 Heller's operations, carried out between 1920 and 1960; 12 patients died and the dysphagia recurred in 42 cases. The shortcomings of this operation have induced many Soviet surgeons (Petrovsky, Kazanovsky, Zivert, Berezova) to abandon it. Foreign authors (Hart-horne, Nemir, Giglielmini, Caluzzi, Santy), however, continue to use Heller's operation on a wide scale in despite of its shortcomings.

Hejrovsky's operation was performed much more often than any other for a long period. In the literature (since 1960) available to us, we have collected reports on 519 such operations, 292 of which were carried out by the trans-abdominal and 227 by the transthoracic approach. The death rate after Hejrovsky's operation is higher than that after Heller's. Early results are reported good by most authors, later observations, however, disclosed a large number of severe late complications, such as severe peptic oesophagitis with constant occult bleeding resulting in anaemia or with periodic massive haemorrhages. As a result of scar formation in the lower part of the oesophagus, stenosis of the cardia and recurrence of dysphagia often develop.

At our Clinic, where, up to 1956, 25 cases of cardiospasm were treated by making a transthoracic anastomosis, the immediate results were good: dysphagia ceased, the patients began feeding normally and gaining weight. Check-up after 18 to 24 months, however, disclosed that one-third of the patients developed reflux oesophagitis. The large number of complications and recurrences forced the surgeons to abandon operations leading to disorders in the function of the cardia.

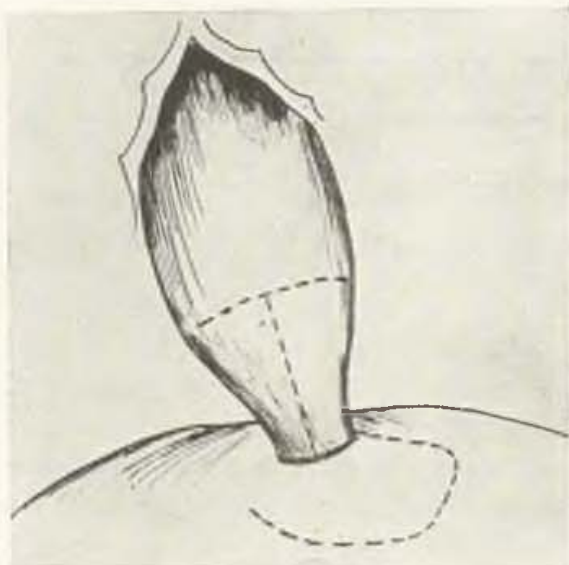


Fig. 1.



Fig. 2.

Fig. 1. First stage of operation: T-shaped incision through musculature of oesophagus, cardia and stomach. — Fig. 2. Second stage of operation: Excision of musculature and coverage of tissue defect with diaphragm flap sutured to edges of musculature defect on medial aspect.

In 1956, Petrovsky first performed a plastic operation on the cardia using the diaphragm pedicle flap in a patient with cardiospasm and both the immediate and late results were good. This operation is carried out as follows: Under combined intratracheal anaesthesia and with the patient lying on his right side, an incision is made along the seventh intercostal space and extended to cut through the costal arch opening up the left thoracic cavity. The mediastinum is then entered above the diaphragm and the oesophagus exposed by blunt dissection with the fingers. When pulled forward by a gauze loop, it can be ascertained whether stenosis of the cardia is present and how far it extends. Then the oesophagus is fixed and on its anterior aspect, laterally to the forking of the vagus, a T-shaped incision is made through the musculature of its lower third, the cardia and fundus of the stomach (Fig. 1). Part of the peeled off muscle layer is then excised which results in a muscle defect of the cardia and oesophagus involving approximately half of the circumference. Now a transverse muscle flap measuring 4×8—10 cm. with its base lying medially, is excised from the diaphragm (Fig. 2). After bleeding has been controlled the flap



is sutured to the oesophagus in the transverse position with thin silk sutures. Thus the flap, consisting of serosa and muscle, fully replaces the defect in the wall of the oesophagus, cardia and stomach (Fig. 3). The operation is concluded by closing the opening in the diaphragm with silk sutures and by suturing the thoracic wall leaving a rubber drain in the IXth intercostal space for two days. The basic principle of postoperative treatment is the active nursing of the patient in bed, i.e. breathing exercises. Twenty-four hours after operation the



Fig. 3. Last stage of operation: Suture of diaphragm flap to musculature defect completed and donor defect in diaphragm closed by simple suture.

patient is permitted to take fluids by mouth and after 48 hours he takes gruel. If the postoperative course is uneventful, the patient is allowed to get up on the seventh day.

The immediate results of this operation are good: Already when taking the first portions of fluid and food, the patients note the free passage through the oesophagus. Three weeks after operation, good function of the cardia can be ascertained on X-ray; both fluid and solid contrast material passes freely through the widened canal of the cardia into the stomach. The lumen of the oesophagus appears narrower than prior to operation. The following case history illustrates well the above: Patient Sh. was admitted to the Clinic on Oct. 28, 1957, with complaints lasting over a period of 20 years. She had suffered from a difficult passage of food through the oesophagus, stoppage of the swallowed morsel behind the sternum, regurgitation of undigested food and considerable loss of weight. On examination we found malnutrition but otherwise the internal organs were without any evident changes. On X-ray the oesophagus appeared grossly widened and filled with fluid, the barium was held up in the widened and lengthened cardial section of the oesophagus. Only a small amount of contrast substance got into the stomach. The wall of the oesophagus appeared smooth (Fig. 4). We diagnosed IVth degree cardiospasm. On Nov. 4, 1957, the operation, cardioplasty with a diaphragm flap according to Petrovsky, was performed.

The postoperative course was uneventful. The swallowing of food became free. During her stay in hospital she gained 4 kg. in weight. X-ray examination three weeks after operation showed the oesophagus lengthened to the same extent as prior to operation, but considerably narrowed. Both fluid and solid contrast substance passed freely through the oesophagus into the stomach (Fig. 5). In the Trendelenburg position, function of the cardia was also normal (Fig. 6). On check-up four years later we found the patient's condition to be good, swallowing was without difficulty and her fitness for work unrestricted; the X-ray showed the cardia to be fully patent.

Cardioplasty with a diaphragm flap according to Petrovsky has a number of advantages over all hitherto employed methods of operation.

1. It is easier to perform and less traumatizing, and can be carried out under aseptic conditions, since neither the lumen of the oesophagus nor the stomach is opened.

2. It is well tolerated by the patient, because it allows early fluid and food intake by the natural route.

3. The diaphragm flap placed on the prolapsing mucous membrane of the oesophagus is a reliable cover preventing the mucous membrane from tearing and also acts as a sort of bar keeping the edges of the incised oesophagus musculature apart and this prevents the formation of scars which might lead to a recurrence of stenosis.

4. The cardinal advantage of cardioplasty with a diaphragm flap lies in that it is most physiological, because the cardiac sphincter is preserved both anatomically and functionally. This prevents reflux oesophagitis which usually develops after operations interfering with the sphincter mechanism of the cardia.

In the years between 1948 and 1960, 200 patients with cardiospasm were treated at the clinics headed by Prof. B. V. Petrovsky. Cardioplasty with a diaphragm flap was performed in 84 of them. Both the immediate and late results (1 to 6-years after operation) were good. This operation has received universal recognition both in the Soviet Union and abroad, and a great number of surgeons use it with good results.

#### CONCLUSION

1. The operations of Heller and Hejrovsky employed in the treatment of cardiospasm, give unsatisfactory results because of recurrence of stenosis or development of peptic oesophagitis.

2. Cardioplasty with a diaphragm flap represents a new and original method in the treatment of cardiospasm.

3. Cardioplasty with a diaphragm flap is a most physiological operation, because it not only restores passage through but also preserves the sphincter mechanism of the cardia.

#### SUMMARY

The report starts with a short history of the surgical treatment of cardiospasm, and the various methods of operation are described and criticized. In 1956, Prof. B. V. Petrovsky introduced a new surgical method in the treatment

of cardiospasm by using a diaphragm pedicle flap. The muscle layer of the cardia and the adjoining parts of the oesophagus and stomach are incised and partly excised, and the thus created defect covered with a pedicle flap of diaphragm muscle of a corresponding size. Since that date, 84 patients have been treated at the Clinic by the new method with good early and late results. The cardinal advantage of this method is that it is most physiological, because it leaves the sphincter mechanism of the cardia unimpaired.

#### R É S U M É

### **L'attachement d'un lambeau du diaphragme au cardia dans la thérapie chirurgicale des cardiospasmes (méthode de Petrovsky)**

O. D. Fedorova

L'auteur rappelle tout d'abord brièvement l'histoire du traitement chirurgical des cardiospasmes, pour donner ensuite un aperçu critique des méthodes opératoires diverses. En 1956, le Prof. B. V. Petrovsky a introduit une méthode nouvelle dans le traitement des cardiospasmes, en utilisant un lambeau pédiculé du diaphragme. Les couches musculaires du cardia et les parties avoisinantes de l'oesophage et de l'estomac sont incisées et en partie excisées, puis la défectuosité ainsi créée est couverte d'un lambeau pédiculé prélevé du muscle du diaphragme, de taille appropriée. Jusqu'à présent, 84 malades ont été traités à la Clinique par cette méthode nouvelle, avec de bons résultats immédiats et tardifs. L'avantage essentiel de cette méthode consiste dans le fait qu'elle est plus physiologique, car le mécanisme du sphincter n'est pas lésé.

#### Z U S A M M E N F A S S U N G

### **Plastik der Kardia mittels eines Zwerchfellappens in der chirurgischen Behandlung des Kardiospasmus nach B. W. Petrowskij**

O. D. Fjedorowa

Die vorliegende Arbeit bringt einen kurzen Überblick über die Geschichte der Therapie des Kardiospasmus sowie eine Beschreibung der verschiedenen Operationen und deren Kritik. Im Jahre 1956 schlug B. W. Petrowskij eine neue operative Behandlungsmethode des Kardiospasmus, eine Plastik unter Benützung eines gestielten Zwerchfellappens vor. Nach Inzision und Abtragung der Tunica muscularis der Kardia und der benachbarten Abschnitte des Magens und der Speiseröhre wird der so entstandene Defekt durch einen gestielten Lappen aus dem Zwerchfell von entsprechender Grösse gedeckt. Seit dem Jahre 1956 wurden an der Klinik 84 Patienten nach der neuen Methode mit günstigen Früh- und Spätresultaten operiert. Einen prinzipiellen Vorzug der neuen Methode stellt ihr physiologisches Vorgehen dar, das die Funktion der Kardia aufrechterhält.

#### R E S U M E N

### **La ligatura del colgajo diafragmático al cardias en el tratamiento quirúrgico del cardioespasmo (Según Petrovski)**

O. D. Fedorova

El artículo empieza con una historia breve del tratamiento quirúrgico del cardioespasmo y los varios métodos de la operación están descritos y criticados aquí. En 1956, el profesor B. V. Petrovski introdujo un nuevo método quirúrgico en el tratamiento



del cardioespasmo empleando un colgajo de pedículo diafragmático. La capa muscular del cardias y las partes vecinas del esófago y estómago son cortadas y extirpadas y el defecto formado de esta manera está cubierto por el colgajo de pedículo del músculo diafragmático del tamaño correspondiente. Desde aquel tiempo 84 pacientes fueron tratados en la Clínica por medio del nuevo método dando buenos resultados tempranos tanto como tardíos. La ventaja principal de este método consiste en el hecho de que resulta como el más fisiológico porque deja el mecanismo del esfínter del cardias intacto.

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ATTACHMENT OF DIAPHRAGM FLAP TO CARDIA IN THE SURGICAL TREATMENT OF CARDIOSPASM

(According to Petrovsky)

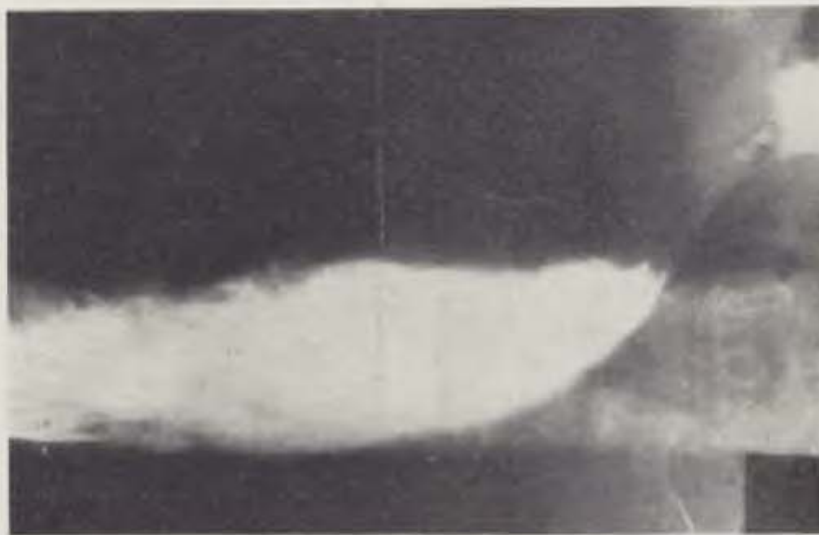


Fig. 4.



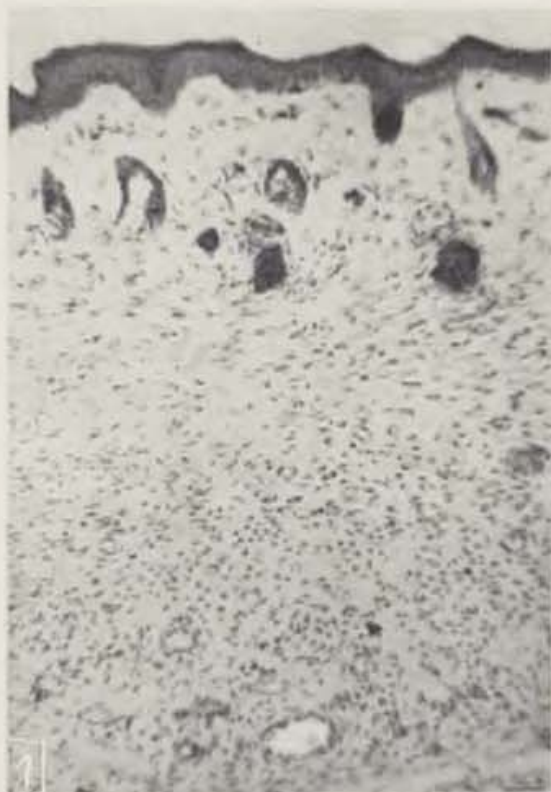
Fig. 5.



Fig. 6.

Fig. 4. Radiogram of patient Sh. prior to operation. — Fig. 5. Radiogram of patient Sh. three weeks after operation. — Fig. 6. Radiogram of patient Sh. in Trendelenburg position: Contrast fluid, which has reached the stomach, does not re-enter oesophagus.

INFLUENCE OF PREVIOUS NUTRITION OF THE DONOR ON THE  
BEHAVIOUR OF SKIN HOMOGRAFTS IN RATS



Plates 1—4. Grafts from intermittently starving rats (plates 1, 3) and ad lib. fed rats (plates 2, 4). Plates 2 and 4 are examples of the higher extent and degree of cellular infiltration. These grafts also have more advanced regressive changes of the skin adnexa and corium.



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## INFLUENCE OF PREVIOUS NUTRITION OF THE DONOR ON THE BEHAVIOUR OF SKIN HOMOGRAFTS IN RATS

M. SLAVÍK, P. FÁBRY, R. KRAUS

The biological approximation of the graft and recipient can be promoted by acting on the donor, the graft or the recipient. In the majority of publications which deal with this problem the metabolism of the graft or the metabolism of the recipient are influenced in different ways. It is, however, known that the physiological condition of the donor — his age, health, species-specificity, degree of differentiation of his tissues — can have a significant influence on the survival of skin homografts (Burian 1929, 1931, Peer 1955, Woodruff 1960, Klen 1955, Bedrna 1955). In the available literature we found no evidence on the influence of the previous nutrition of the donor.

In the present work we investigated the behaviour of skin homografts from rats subjected before the skin graft was taken to periodic or continuous restriction of the calorie intake. As criteria of the vitality of the grafts we used the average temperature of the graft during the first five days after operation and the rejection rate. In another series of experiments we investigated the histological and histochemical properties of grafts from intermittently starved and from ad libitum fed rats on the fifth day after operation.

### METHOD

**Experimental animals and dietary regimen.** Mature young female rats, Wistar strain were used for the experiments. In the first series grafts from ad lib. fed donors were compared with grafts from animals adapted for ten weeks to intermittent starvation, i.e. alternating periods of starvation with days of free access to food. The intermittently starving rats were fed three times a day during the first three weeks and subsequently for some time only twice a week. The caloric deficit of thus fed animals is to a certain extent com-

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With the technical assistance of Z. Vrzalová and J. Koubková.

pensated by hyperphagia on the days of free access to food (Holečková and Fábry 1959).

In the second series of experiments we compared the behaviour of grafts from intermittently starving animals with grafts from rats subjected for ten weeks to continuous caloric restriction by reducing the daily food intake to 10 g. per animal which corresponded to roughly half the normal intake. All groups received a standard laboratory diet (Larsen mixture — Fábry 1959) and had throughout the experiment free access to water.

**Removal and transplantation of grafts.** Skin grafts 1.5 X 1.5 cm. were taken from the back of the donors under light ether anaesthesia. The entire width of skin was taken from which adipose tissue was removed mechanically. The grafts were then transferred immediately to the recipient (Wistar strain rats of another breed) which were anaesthetized by the intraperitoneal administration of pentobarbital, 50 mg./kg. body-weight. The transplantations were carried out in such a way that every recipient received two grafts each from differently fed donors, i.e. from an intermittently starving and an ad libitum fed animal in the first series and from an intermittently and continuously starving animal in the second series. The grafts were applied to beds at both sides of the vertebral column in the lumbar region and fixed by 8—10 fine silk stitches which were removed on the fifth day after operation.

**Criteria of vitality of grafts.** Macroscopic separation of one side of the graft from the bed was considered to be the beginning of rejection. The end of rejection was considered to be necrosis of more than 50% of the surface of the graft. The temperature of the graft was assessed daily always at the same time by means of a contact thermistor thermometer.

**Histological and histochemical examination of the grafts** was carried out on the fifth day after operation on grafts of ad libitum fed donors which were compared with grafts from intermittently starving donors. After removal the material was fixed in 10% cooled formol and after immersion into paraffin, series of histological slides were prepared. For staining different methods were used (Haematoxylin-eosin, Weigert-v. Gieson, etc.). As to histochemical examinations, alkaline phosphatase and non-specific esterase were estimated by azocoupling methods.

## RESULTS

Both methods of dietary restriction used obviously lead to a lower final body-weight of the donors as compared with ad libitum fed animals. This difference was less in intermittently starved animals (average weight 212 g. in series I and 192 g. in series II as compared with 282 g. in ad libitum fed controls). In animals subjected to chronic continuous starvation the average final weight was 118 g.

The values of rejection of skin grafts and the average skin temperature five days after operation are listed in table 1. From the table it is apparent that both the beginning and end of rejection are statistically significantly delayed

Tab. 1. Influence of previous diet of donor on rejection and skin temperature of homografts (average  $\pm$  S. D.)

Group	No. of grafts	Beginning of rejection (days after operation)	End of rejection (days after operation)	Average skin temperature $^{\circ}\text{C}$
Series I intermittent starvation fed ad lib.	11	$9.45 \pm 0.41^{**}$	$22.18 \pm 1.40^{**}$	$32.71 \pm 0.23$
	11	$7.54 \pm 0.47$	$18.45 \pm 1.23$	$32.44 \pm 0.23$
Series II intermittent starvation continuous undernutrition	11	$10.63 \pm 0.71$	$21.27 \pm 1.91^{*}$	$33.80 \pm 0.21$
	11	$10.72 \pm 0.70$	$24.18 \pm 2.08$	$33.75 \pm 0.18$

\*) Difference of averages in groups evaluated by Student's t-test is statistically significant for  $P < 0.01$ .

\*\*) Statistically significant for  $P < 0.001$ .

in skin grafts from intermittently starving animals as compared with grafts from individuals fed ad libitum. Marked differences between the two groups in series I were also found in the skin temperature of the grafts. When the pairs of grafts in which the difference in temperature was more than  $0.5^{\circ}\text{C}$ , were compared in 56 pairs (77.8%) a higher temperature was found in grafts from intermittently starving animals, while only in 13 pairs (18%) was the position reversed. In three pairs (4.2%) the difference was less than  $0.5^{\circ}\text{C}$ . The higher temperature of grafts from intermittently starved animals manifested itself also in the average value of all measurements taken during the first five days after operation, though the difference evaluated by means of the t-test is only on the borderline of statistical significance: When, however, another method of evaluation was used, i.e. the comparison of daily averages of the skin temperature of grafts of all animals for a period of 10 days after operation, the difference between grafts from intermittently starving and control animals was statistically significant ( $P < 0.01$  using the paired t-test).

In the second series of experiments we compared grafts from animals subjected either to intermittent or continuous starvation. As apparent from the table the beginning of rejection of the grafts was practically equal in both groups. The end however, was statistically significantly protracted in animals subjected to chronic continuous starvation. The differences in skin temperature between grafts from both types of animals was also less marked. Out of 81 estimations 44 times the graft from intermittently starving animals had a higher temperature (54.4%), 29 times (35.8) the graft from continuously starving animals, and in eight pairs (9.8%) the difference was less than  $0.5^{\circ}\text{C}$ . The average temperature of both groups of grafts during the first five days after operation was practically equal (table 1).

The histological examination of grafts from intermittently starving and ad libitum fed animals which was carried out in a special series suggests that in



grafts from intermittently starved animals the regressive changes are slighter than grafts from donors with an *ad libitum* food intake. When investigating these regressive changes we took into consideration in particular cell infiltration, atrophic changes of the skin adnexa, changes in the fibrous portion of the corium and possibly the degree of necrotic changes found in the graft. Previous findings confirm the results of the histochemical examination as the activity of alkaline phosphatase (in the capillary endothelium) and specially of non-specific esterase (in glands and hair follicles) was higher in grafts from intermittently starving animals than in grafts from *ad libitum* fed rats.

## DISCUSSION

From our experiments it is apparent that a change in the metabolism of the donor caused by chronic undernutrition leads to longer survival of skin homografts. Evidence of the different biological condition of these grafts after their transplantation to the recipient is also provided by the skin temperature and a smaller extent of regressive changes assessed histologically and a higher activity of some enzymes investigated by histochemical methods.

It is known that in experimental animals chronic continuous food restriction leads to a prolongation of the life span and a later onset of pathological changes typical for old age (McCay 1947, Berg 1960, Berg and Simms 1960, 1961). In some parameters, e.g. the chemical contractility and relaxation of collagen fibres, undernourished animals respond like biologically younger animals (Chvapil and Hrůza 1959). Similarly, intermittent starvation also leads to a prolongation of the life span (Carlson and Hoelzel 1946) and some changes by which thus fed animals resemble younger animals (Hrůza, Fábry, Chvapil and Holečková 1962, Fábry et al. 1962 b). Particularly interesting from this aspect is the substantially higher growth and migratory activity of liver and muscle explants from intermittently starving animals investigated in tissue cultures (Holečková, Poupa and Fábry 1959). So far it is not clear whether the above two effects of chronic undernutrition on manifestations of biological age have the same mechanism, as intermittently starving animals differ considerably in some metabolic parameters from continuously undernourished animals (Fábry et al. 1962 b), though a reduced caloric intake is the common denominator in both instances.

From the work of many authors it is known that the time of survival of homografts is indirectly proportional to the age of the donor (Woodruff 1960, Peer 1955, Klen 1955). It is assumed that younger individuals are immunologically less defined and that thus grafts from these individuals cause a less marked immunological response in the recipient. We can thus imagine that the results obtained, i.e. a longer survival of grafts as well as other criteria suggesting its greater vitality when a graft from an undernourished animal was used, could be the more general consequences of caloric restriction shifting the animal (in our instance the graft donor) towards a biologically younger age showing, under our experimental conditions, no substantial difference in relation to the type of undernutrition.

We do not think that our results were influenced by possible differences in fat content of the transplanted tissue. In the description of the method we mentioned that subcutaneous fat was removed mechanically from the grafts. Moreover, it is important to emphasise that the biological effect did not depend on the size of the original adipose tissue layer which showed almost equal development macroscopically in intermittently starving rats and animals fed ad lib. (in keeping with a higher lipogenesis found by Fábry et al. 1962 a), while in continuously underfed animals which were much lighter, the subcutaneous fat had almost disappeared.

The results indicate that the survival of skin grafts can be influenced not only by the preparation of the graft or recipient but that it also depends on the nutritionally induced metabolic state of the donor.

#### SUMMARY

An investigation was made in albino rats of the influence of chronic undernutrition of the donor on the survival, skin temperature and histological and histochemical picture of skin homografts. It was found that grafts from donors, subjected for ten weeks to intermittent starvation survived statistically significantly longer, had a higher skin temperature and showed fewer regressive changes in the histological picture than grafts from donors fed ad libitum. Histochemically a higher activity of alkaline phosphatase and non-specific esterase was found in these grafts.

The grafts from continuously underfed animals did not differ in the above parameters from those of intermittently starved rats except for an even later rejection of the graft.

#### RÉSUMÉ

##### **L'influence de l'alimentation préliminaire sur le comportement des homéogreffons cutanés, implantés à des rats**

M. Slavík, P. Fábry, R. Kraus

Sur des rats albinos, on a étudié l'influence de la sousalimentation chronique du donateur sur la durée de survie, la température cutanée et l'image histologique et histo-chimique des homéogreffons cutanés. On a constaté que les greffons prélevés de donateurs ayant été soumis, pendant une période de 10 semaines, au régime du jeûne intermittent, présentaient par rapport aux greffons prélevés de donateurs nourris ad libitum une survie prolongée de façon statistiquement significative, ainsi qu'une température cutanée plus élevée; les préparations histologiques montraient des changements regressifs à un degré moins intense. Par des méthodes histo-chimiques, on a pu mettre en évidence, dans les greffons en question, une activité plus intense de la phosphatase alcaline et de l'estérase non-spécifique.

Les greffons prélevés sur des animaux continuellement sousalimentés ne différaient pas, en ce qui concerne les paramètres mentionnés, des greffons prélevés sur des animaux au régime du jeûne intermittent, à l'exception du fait que le détachement se terminait encore plus tard.

## ZUSAMMENFASSUNG

### Der Einfluss der vorangegangenen Ernährung des Sponders auf das Verhalten von Hauthomotransplantaten bei Ratten

M. Slavík, P. Fábry, R. Kraus

Bei albinotischen Ratten wurde der Einfluss von chronischer Unterernährung des Sponders auf Lebensdauer, Hauttemperatur, histologisches und histochemisches Bild von Hauthomotransplantaten untersucht. Es ergab sich, dass Transplantate von Spendern, die während 10 Wochen einem intermittierenden Hungern unterworfen waren, im Vergleich mit Transplantaten von Spendern, die ad libitum gefüttert worden waren, eine statistisch signifikant längere Lebensdauer, höhere Hauttemperatur und im histologischen Bild einen geringeren Grad von regressiven Veränderungen aufwiesen. Histochemisch wurde in diesen Transplantaten eine höhere Aktivität der alkalischen Phosphatase sowie der unspezifischen Esterase festgestellt.

Die von kontinuierlich unterernährten Tieren stammenden Transplantate unterschieden sich in den erwähnten Parametern keineswegs von den Transplantaten, die von intermittent hungernden Ratten herrührten, bis auf eine noch mehr verzögerte Eliminierung.

## RESUMEN

### La influencia de la previa nutrición del donante sobre la conducta de los homoinjertos en ratas

M. Slavík, P. Fábry, R. Kraus

En ratas albinóticas fue observada la influencia de la desnutrición crónica del donante sobre el período de la supervivencia, de la temperatura cutánea y el cuadro histológico y histoquímico del homotransplante de piel. Se mostró que los injertos de piel tomados de los donantes sometidos por el período de 10 semanas al régimen del hambre intermitente en comparación con los injertos de los donantes alimentados al libitum tuvieron el período de la supervivencia notablemente más alto desde el punto de vista estadístico, la temperatura cutánea más alta y su cuadro histológico indicaba el grado más bajo de los cambios regresivos. Desde el punto de vista histoquímico estos injertos de piel poseían la actividad más alta de la fosfatasa alcalina y de la esterasa no específica.

Los injertos de piel tomados de los animales mal alimentados continuamente en parámetros mencionados hasta el período más tardío de la separación no diferían de los injertos de piel tomados de las ratas hambrientas intermitentemente.

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## POSTTRAUMATIC SCAR STENOSIS OF PHARYNX

E. U. FOMITCHEVA

Scar stenosis of the pharynx interferes with the vital functions of breathing and swallowing to such an extent that the patient becomes an invalid. Breathing through a tracheotomy opening leads to inflammation of the respiratory tract and the lungs. Nutrition of the patient, too, is grossly impeded and in most patients necessitates a permanent gastrostomy. A patient with a permanent tracheotomy and gastrostomy is not only deprived of the possibility of working, but also of mixing with people which has severe repercussions on his mental state.

One of the main causes of scar stenosis of the pharynx, next to burns, is trauma to the neck. Only a few papers in the literature deal with this problem (Khitrov, Bokshteyn, Ogura et Roper). That is why we are reporting on our experience in the treatment of these patients at the Department of Surgical Stomatology.

During the period of ten years, between 1952 and 1962, a total of 12 patients, seven women and five men, with scar stenosis of the pharynx caused by injury, were treated at the Department of Surgical Stomatology. These patients can be divided into the following age groups: Up to 20 — 3 patients, between 21 and 30 — 3 patients, between 31 and 40 — 4 patients and over 40 — 2 patients.

There were two main mechanisms of injury: Strangulation of the neck by a scarf catching into a machine and cut-throat injuries with a knife penetrating into the pharyngeal cavity. The local changes in these patients depend, to a certain extent, on the mechanism of the injury. After cut-throat injuries, because of severance of the thyro-hyoid muscles and thyro-hyoid membrane and the pull of the sternothyroid muscles, most patients show a displacement of the larynx downwards and rotation of the thyroid cartilage around a fronto-horizontal axis resulting in its upper margin being brought forward and downward. On the surface this shows as a prominence of the anterior aspect of the neck below the scar and a depression above it (Fig. 1). The hyoid bone is found lying considerably higher than its normal position. On palpation the cartilages of the larynx appear unchanged.

On laryngoscopy the epiglottis proved unscathed in most patients (5 out of 6); the pharynx, however, was constricted into a more or less conical funnel or narrowed by scar folds and membranous septa. In some patients the lumen was narrowed to an opening 0.3 to 0.5 cm. in diameter, situated in the centre or the posterior part of the scar constriction, leading into the lower section of the pharynx. Changes within the larynx were determined on operation. No anatomical changes were found in the laryngeal cavity in five out of six patients.



Fig. 1a.

After strangulation, too, the larynx drops to a lower level due to severance of the thyro-hyoid muscles and membrane and the pull of the sternothyroid muscles. However, in these cases also the tissue — and in some patients even the cartilages of the larynx — were crushed which prevented the larynx from rotating around its fronto-horizontal axis and thus the development of the conspicuous prominence of the larynx on the neck surface and the depression of the region above it, described in the previous paragraph as typical for cut-throat injuries.

In these patients — unlike those of the previous group — fractures and deformation of the thyroid cartilage were found. As a rule, we also detected anatomical changes in the laryngeal cavity resulting in its narrowing, deformation of the rima glottidis, displacement of the arytenoid cartilages and scar deformation of the vocal folds. These changes were also due to fractures of cartilages and displacement of their fragments as well as to tears and crushing of soft tissues. The laryngoscopic picture was the same as that described above.





Fig. 1b.



Fig. 1c.



Fig. 1d.



Fig. 1e.

Fig. 1. Dropping of larynx and rotation of thyroid cartilage around its fronto-horizontal axis in patients after cut-throat wounds: a) patient G. prior to operation, b) patient K. prior to operation, c) after operation, d) patient S. prior to operation, e) after operation.

The disorders in function in the patients with scar stenosis of the pharynx manifested themselves in dyspnoea, dysphagia and a change in the timbre of the voice. On admission, all patients had a tracheotomy tube, seven were fed through a permanent gastrostomy and the rest could only take gruel.

#### TREATMENT

Scar stenosis of the pharynx with marked disorders in function must be treated surgically. The operation consists in excision of the scars, reconstruction of the pharyngeal cavity and the anatomical relationship between the

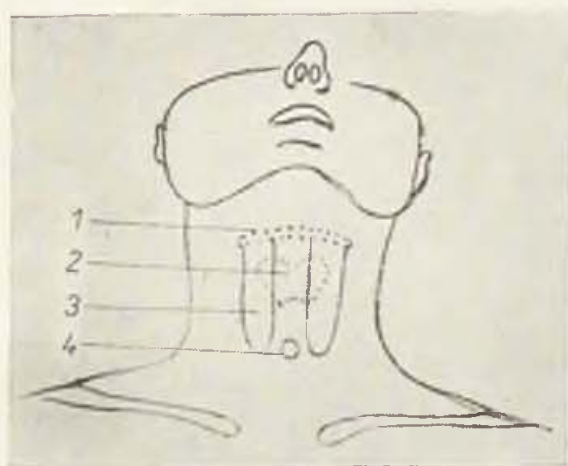


Fig. 2. Formation of fat-and-skin flap. 1 - hyoid bone, 2 - thyroid cartilage, 3 - fat-and-skin flap, 4 - tracheotomy opening.

larynx and the hyoid bone. After the disappearance of the disorders in function, the tracheotomy and gastrostomy openings are closed.

We employ the method of Prof. F. M. Khitrov. Several variants of the operation have been elaborated in connection with the various types of stenosis.

##### 1. Repair of scar stenosis of the pharynx with fat-and-skin pedicle flaps:

On the right side of the anterior aspect of the neck a vertical fat-and-skin pedicle flap is formed, 2 to 2.5 cm. wide, with its tips at the base of the neck and its pedicle at the level of the hyoid bone. After mobilizing the flap, the donor site is closed by simple suture. A similar flap is then formed on the left side (Fig. 2). Subhyoid pharyngotomy is now carried out by an incision made between both fat-and-skin flaps undercutting their pedicles. The scar stricture of the pharynx is found above this incision (Fig. 3). Through the lumen of the stricture two vertical incisions are made, one on the right and one on the left pharyngeal wall, completely severing all scars. When the mucous membrane has been smoothed out on both side walls, two mucosa defects appear on the posterolateral wall (Fig. 4). To cover these defects the fat-and-skin flaps are introduced into the pharyngeal cavity and sutured to the wound edges (Fig. 5). On swinging the flaps in the pharyngeal cavity, their pedicles cover the upper brim of the pharyngotomy openings; the lower brim is covered by suturing the skin to the mucous membrane over a stretch of 2 to 2.5 cm. The rest of the

pharyngotomy is closed by suture in layers (Fig. 6) and, at the same time, the thyroid cartilage is brought up to its normal level by six catgut sutures anchored to the perichonrium and the adjacent tissues and fixed to the hyoid bone.

In deep scar changes of the pharyngeal mucosa with practically no possibility of shifting it, so that the skin and mucosa cannot be sutured together along the brim of the pharyngotomy opening, two more flaps are formed, one on each side of the neck, whose pedicles come to lie at the level of those of

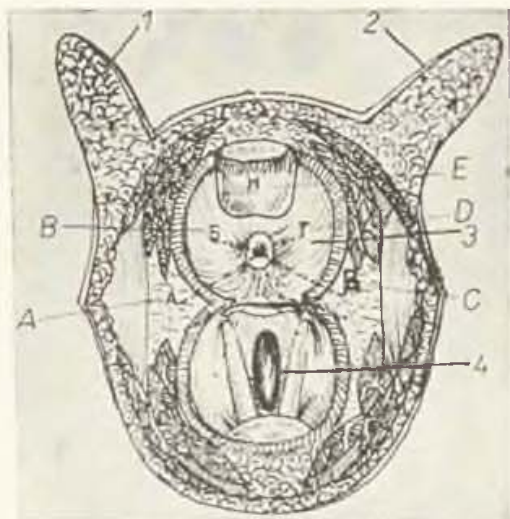


Fig. 3.

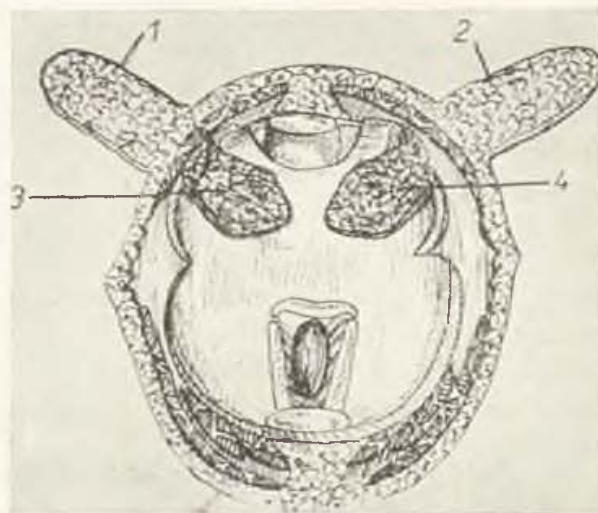


Fig. 4.

Fig. 3. Diagram of pharyngeal stenosis seen through subhyoid pharyngotomy opening enlarged by pulling the wound edges apart. 1, 2 - fat-and-skin pedicle flaps, 3 - scar stenosis of pharynx with central opening and accretion with scars of epiglottis (E), 4 - larynx, A—B and C—D = lines of incisions. (Drawing of Khitrov.) — Fig. 4. View after division of scars in pharynx. 1, 2 - fat-and-skin flaps, 3, 4 - mucosa defect after division of scars.

the first flaps, but lateral to them, and their tips at the mandibular angle on either side (Fig. 7). Each of these flaps has a width of 2.5 cm. After mobilization, they are swung down to the lower brim of the pharyngotomy on either side and sutured to the edge of the mucosa (Fig. 8).

Thus, at the end of the operation, an opening remains patent at either corner of the pharyngotomy, leading into the pharyngeal cavity from either side (Fig. 6). Two weeks later, after the fat-and-skin flaps have taken, these openings are closed; an incision is made along the brim of the pharyngotomy opening on each side, the wound edges are mobilized towards the pharynx to an average width of 1 cm., i.e. the flaps are mobilized and partly excised to an extent corresponding to that of the thickness of the neck tissue, and the openings closed by suturing each layer separately.

We used this method to operate on two patients with a conical scar stenosis of the pharynx.

## 2. Repair of scar stenosis of the pharynx by using local tissue.



This method is employed, if the stenosis does not involve a large area in a longitudinal direction. It diminishes the extent and thus the traumatizing effect of the entire operation.

Pharyngotomy is carried out as described above. Then the constricting membranous septum is split into two lamellae; an upper and a lower one. The upper lamella is now divided into three sections by two incisions, one to the right the other to the left of the midline, and the lower lamella by a midline



Fig. 5. Mucosal defect in pharynx covered by fat-and-skin flaps.

incision into two sections (Fig. 9). The median section of the upper lamella is swung down and sutured into the gap opening between the divided two sections of the lower lamella and the two sections of the lower lamella are swung up and sutured into the wound gaps between the median and both lateral sections of the upper lamella. This repairs the pharyngeal stenosis.

Another two patients were operated on by this method; one with a concentric scar stricture, the other with a scar membrane bridging the posterior half of the pharyngeal cavity. Apart from these two cases we employed the method in a third patient with recurrent scar stenosis of the pharynx.

3. A combination of both methods was used in three patients with conical stenosis of the pharynx. After division of the scars by two vertical incisions, one on each side wall of the pharynx, the dorsal part of the stenosis did not smooth out and remained projecting into the pharyngeal cavity.

4. Exchange of two triangular mucosa flaps is used for the repair of stenosis caused by isolated scar projections or small membranous septa jutting into the pharyngeal cavity.

After pharyngotomy on the anterior aspect of the neck, the mucosa fold or membranous septum is incised along its free margin and then split into two lamellae. From either end of this incision another incision is made running at

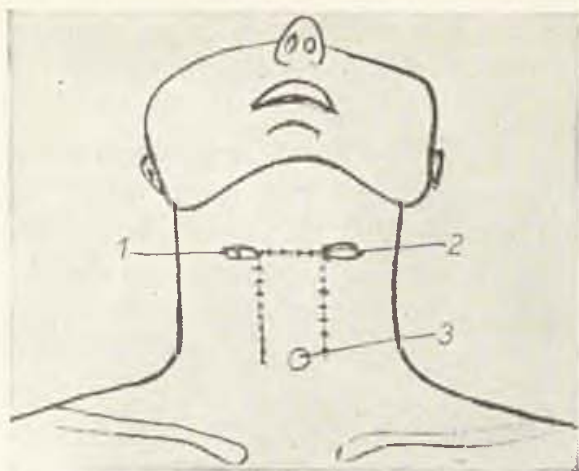


Fig. 6.

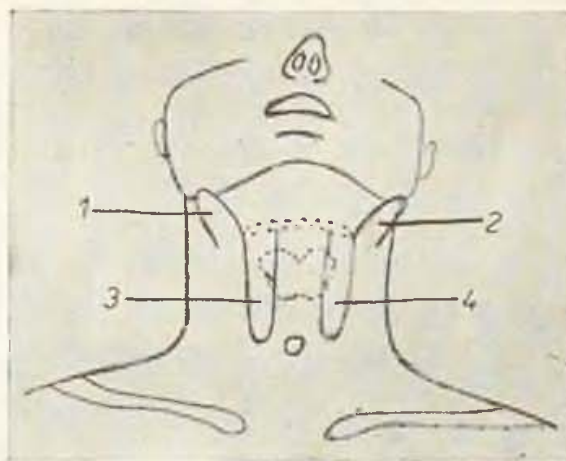


Fig. 7.

Fig. 6. View on conclusion of operation. 1, 2 - pharyngotomy openings in region of fat-and-skin flap pedicles, 3 - tracheotomy opening. — Fig. 7. Diagram of formation of two pairs of fat-and-skin flaps. 1, 2 - second [lateral] pair of fat-and-skin flaps, 3, 4 - first pair of fat-and-skin flaps as described above.

angles of  $60^{\circ}$  to the former, one through the upper, the other through the lower lamella (Fig. 10). The thus formed two triangular flaps are exchanged with each other. This repairs the scar fold.

This method was used in one woman with pharyngeal stenosis caused by isolated scar folds. Another six patients were operated on in the same way for recurrent isolated scar folds which had developed after the surgical repair of pharyngeal stenosis.



Fig. 8. View after implantation of fat-and-skin flaps. 1, 2 - first pair of flaps sutured to mucosa defect left after division of scars, 3, 4 - second pair of flaps covering the wounds at lower circumference of each pharyngotomy opening and sutured to free margin of mucosa.

In four of these patients, at a time when the surgical technique of this operation had not yet been elaborated, we divided and excised the scars and covered the resulting wound defect by sutures in various directions. In all four patients stenosis recurred and had to be operated on again by the second and fourth variant of the method described above. The ultimate results were good in all of them.

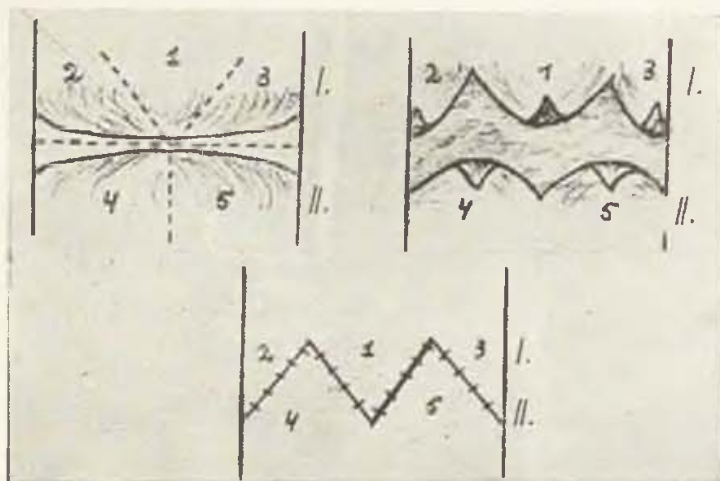


Fig. 9. Diagram of division of membranous scar septum in pharynx and transposition of thus formed flaps. I - upper lamina of scar membrane, II - lower lamina of scar membrane, 1 - median section of upper lamina, 2, 3 - lateral sections of upper lamina, 4, 5 - the two sections of lower lamina.

On pharyngotomy, carried out in order to reach the pharyngeal stenosis, the thyro-hyoid muscles and membrane had to be divided. We, therefore, sutured the larynx to the hyoid bone in all 12 patients; in eight the larynx had dropped as the result of the original injury, in the remaining four we carried out fixation of the larynx as a matter of routine after pharyngotomy. We replaced the larynx to its natural position and fixed it to the hyoid bone with catgut sutures anchored to the underlying soft tissues and the perichondrium of the thyroid cartilage and slung underneath and round the hyoid bone.

In four patients this operation had to be carried out separately for a second time, because the larynx had dropped again. The causes of this might have been the cutting through of the sutures at their anchorage to the thyroid cartilage or too quick absorption of the catgut. The scars, which had developed in place of these sutures, were too fresh to be strong enough to maintain the larynx in its new position.

The shortened and partly cicatrized muscles as well as the scars developing around it, pull the larynx down to the position it occupied immediately after the trauma.

Two to three weeks after the operation we started dilating the pharynx with Khitrov bougies. These bougies are shaped like a goose beak with a handle attached at an angle of  $120^{\circ}$ . The bougie is introduced into the pharynx and left there for some time; the procedure is repeated several times a day by the patient himself.



Among the complications arising in the postoperative period, suppuration resulting from cutting through of stitches should be mentioned; we experienced it in one patient. It led to the development of two apertures into the pharyngeal cavity which had to be closed by operation. One of the complications of the later period was recurrence of pharyngeal stenosis caused by isolated scar folds developing 6 to 12 weeks after operation. Seven patients required operation for the

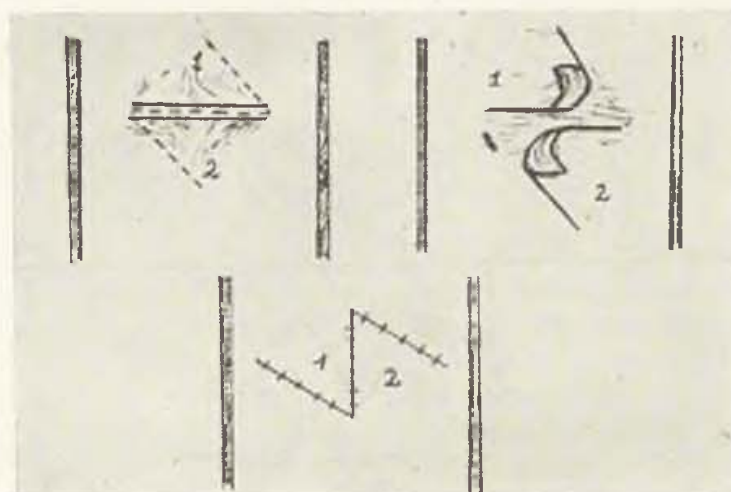


Fig. 10. Diagram of division of membranous scar septum and transposition of thus formed flaps. 1 - upper lamina of scar membrane, 2 - lower lamina of scar membrane.

removal of these folds. It was carried out according to the second or fourth variant of the method described above.

When respiration and swallowing had been restored the tracheotomy, pharyngotomy and gastrostomy openings were closed by twostage operation.

During the treatment of patients with pharyngeal stenosis the greatest difficulties arose on restoration of the normal act of swallowing. After repair of scar stenosis, choking gradually ceased in all patients, but some of them required both surgical and persistent conservative treatment. Adaptability of a patient, i.e. his ability to elaborate new deglutition reflexes, is of great importance. The exceptional complexity of the act of swallowing makes it difficult to find the cause of the disorder in every single patient.

Results of treatment: scar stenosis of the pharynx was repaired in all patients. However, in three, although passage of the pharynx and oesophagus is free, severe choking frequently occurs, the cause of which remains unclear. These patients are under our constant observation and treatment.

#### SUMMARY

Stenosis of the pharynx after trauma is caused either by a more or less conical constriction or by isolated scar folds or membranous septa. Not infrequently the larynx is torn off the hyoid bone and drops to a lower level. In strangulation injuries, fractures of laryngeal cartilages are found.

Surgical treatment of pharyngeal stenosis consists in division of the scars followed by plastic transposition of local tissue or skin pedicle flaps formed on the surface of the neck. The method of choice depends on the type of stenosis.

## R É S U M É

### **La sténose cicatricielle post-traumatique du pharynx**

E. U. Fomitcheva

La sténose du pharynx, à la suite d'un traumatisme, peut être causée ou bien par une constriction plus ou moins conique, ou bien par des plis cicatriciels isolés, ou encore par des cloisons membraneuses. Il arrive même assez souvent que le larynx se déplace de l'os hyoïde et se trouve à un niveau plus bas. Lors des blessures par étranglement, on rencontre des fractures du cartilage du larynx.

Le traitement chirurgical des sténoses du pharynx consiste dans une division de la cicatrice, suivie de la transposition plastique du tissu local, ou bien de lambeaux pédiculés cutanés, prélevés de la surface de la nuque. La méthode choisie dépend du type de la sténose.

## Z U S A M M E N F A S S U N G

### **Narbige posttraumatische Kehlkopfstenosen**

Je. U. Fomitchewa

Narbige posttraumatische Kehlkopfstenosen treten als mehr oder weniger ausgeprägter Konus oder als isolierte Falten und Semimembranen in Erscheinung. Nicht selten findet man, dass der Kehlkopf vom Zungenbein abgerissen und herabgesunken ist. Bei Kompression des Halses kann man Brüche der Kehlkopfknorpel beobachten.

Der operative Eingriff zur Beseitigung der Kehlkopfstenose beruht in der Dissektion der Glottisverwachsungen und in der plastischen Korrektur der Glottis unter Verwendung lokaler Gewebe oder gestielter Hautlappen von der Halshaut (je nach Art der Stenose).

## R E S U M E N

### **Estenosis cicatrizal post-traumática de la faringe**

E. U. Fomitcheva

Estenosis de la faringe después del trauma está causada sea por una constricción más o menos cónica sea por un pliegue cicatrizal aislado o un septo membranoso. No con frecuencia la laringe está arrancada del hioides y desciende al nivel más bajo. En heridas de estrangulación se hallaron fracturas de los cartílagos laríngeos.

El tratamiento quirúrgico de la estenosis faríngea consiste en la división de las cicatrices seguidas de la transposición plástica del tejido local o los colgajos de pedículo de piel formados en la superficie del cuello. La selección del método depende del tipo de la estenosis.

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## TRAUMATIC DEFECTS OF THE AURICLE AND METHODS OF THEIR REPAIR

N. M. ALEXANDROV

The auricle would appear to be of little importance to the life of a person, yet patients who have sustained an injury to it usually seek the advice of a surgeon for its reconstruction or repair. The auricle is considered to have protecting (Kopecky) and sound-collecting functions. However, the patient seeks medical advice on account of the cosmetic defect and not for the functional disorder. In the last 10 years, 109 patients were treated in our department for various deformities and lesions of the auricle, the causes of which are shown in Tab. 1.

Tab. 1

Burns	Sequelae of burns	Bites	Gunshot wounds	Other injuries	Lopears	Microtia	Tumours
34	27	7	5	10	10	10	6

This paper is concerned with injuries to the auricle. Congenital deformities, such as microtia, lopears, etc. will not be dealt with.

The most frequent injury to the auricles is burns. The unusual susceptibility of the auricular cartilage to microbial contamination entails the danger of perichondritis, resulting in necrosis of the cartilage and leading to shrinkage of the entire auricle. That is why the wounds must be carefully watched even in second-degree burns. We have found that the quality of the treatment is of decisive importance for the healing of the wound. In deep burns with exposure of the cartilage, we treat the wound with ointment dressings to avoid exposure of the cartilage to the air. This not only prevents perichondritis, but even checks it at an early stage of development. In the latter case, apart from covering the wound with vaseline gauze soaked with 5—10% Synthomycin, the patient is given antibiotics in a 0.5% solution by injection under the skin of the dorsomedial aspect of the auricle.

Our series consists of 18 patients with burns of second degree and 16 with burns of third and fourth degree. Perichondritis only developed in three of these patients, but even in them the necrosis of the cartilage and subsequent shrinkage



of the auricle was prevented by the use of antibiotics, early necrotomy, excision of exposed parts of cartilage and coverage of the wound surface by free skin grafts.

Apart from the susceptibility of auricular cartilage to bacterial contamination, its resistance to the development of circulatory disorders should be noted. Suslov (1898) evidently based his recommended repair of nasal defects by tissue



Fig. 1a.

taken from the auricular cartilage on this latter quality. This also explains why torn off pieces of auricle take readily when re-implanted.

We treated two patients in our Clinic with a completely torn off auricle, admitted one and a half to two hours after the accident. The surgeon on duty sutured the auricle in its place without delay. Local intramuscular injections of antibiotics were started immediately afterwards. The auricle was covered with ice bags for a comparatively long period. Local hypothermia induced in this manner makes it easier for the tissues to survive the period of insufficient blood supply, because cooling sharply decreases metabolism. In both cases the auricle took completely and the ultimate result was satisfactory.

In all injuries to the ear every effort must be made to preserve the auricle or parts of it, because reconstruction is associated with great difficulties and does not always lead to the desired result.

In partial loss of the auricle we endeavour to carry out reconstruction — or at least its first stage — during the primary surgery of the wound.

To illustrate this point, here is an example:

Patient N., a man aged 25 (casepaper No. 4080), was admitted to the Clinic on the morning of March 9, 1963, with a bite wound of the right auricle. The

patient had been bitten by a drunkard eight hours previously (Fig. 1a). On the day of admission the wound was cleansed and a solution of antibiotics (penicillin plus streptomycin) in 0.5% novocain solution were injected under the skin around it. It was then covered with a dressing with a thick layer of Synthomycin ointment. Two days later a tube flap was formed on the right arm and its lower



Fig. 1b.

pedicle implanted into the defect in the auricle at the same stage (Fig. 1b). Two more operations were performed: formation of the auricle and its correction. On the 35th day the patient was discharged after reconstruction of the auricle had been completed, with a satisfactory cosmetic result (Fig. 1c).

In partial defects of the auricle, due to burns or other injuries, we employ either the method of Converse or that of Proskuryakov, using tissue of the retroauricular region, or we transfer a Filatov flap in the manner described above. A total of 15 such reconstructions were performed at the Clinic on 11 patients, since in four patients both auricles were affected by partial defects.

The problem of reconstructing a totally or subtotally lost auricle deserves the greatest attention. This constitutes the most difficult section of reconstructive and plastic surgery. In our Clinic reconstruction was carried out by various methods and all their possible variants.

Reconstruction of a totally or subtotally lost auricle was performed in 36 patients (not including those with congenital microtia), one woman and 35 men. In five of these patients both ears were reconstructed thus making a total of 41 auricles.

It is hardly necessary to deal with the difficulties encountered by the surgeon planning the reconstruction of an auricle. He is naturally faced with choosing material for the skeleton to resemble the auricular cartilage; he must decide where to obtain skin of similar appearance and properties to those of the skin covering a normal auricle; how to give the reconstructed auricle the required shape; how to get the proper cranio-auricular angle, etc.

The opinion is widespread that the Italian surgeon Tegliacotius achieved great perfection in the technique of reconstructing auricles as early as the

XVIth century. The description of his method has been preserved but the data about his results have not, and therefore many authors (Zeise, 1863; Converse, 1958, and others) dispute this opinion. A great many methods of forming and reconstructing the auricles have been recommended, but the complicated shape of this organ and the specificity of its tissues (particularly of the auricular



Fig. 1c.

Fig. 1. Repair of partial defect in auricle with Filatov flap. — a) Patient N. on admission. — b) Patient N. after transfer of lower pedicle of "acutely" formed Filatov flap into the auricle defect. — c) Patient N. on conclusion of treatment lasting 35 days.

cartilage] make it impossible to achieve results fully satisfactory to the surgeon or patient. In spite of the almost perfect methods of Yarchuk, Converse and Tanzer, the search for still better ones continues. Even the problem of partial deformities of the auricle, whose repair is incomparably easier, cannot yet be considered completely solved.

It is known from the literature that ivory, metals (Tantalum or vitallium meshes), various plastic materials, autogenous or homogenous cartilage (solid pieces or minced) have been used as material for the formation of the auricular skeleton. The question of whether to begin otoplasty with the reconstruction of its soft-tissue covering or its skeleton, has also been investigated.

At the Clinic of Faciomaxillary Surgery of Kirov Military Medical Academy investigations of the problem were undertaken along lines of employing a Filatov flap from the very beginning. Great progress was made in this direction by the method of Mukhin (1954) which gives quite well shaped auricles. Nine auricles were reconstructed at the Clinic by this method, not including congenital



deformities. We then started to look for new and better methods of reconstruction. During these trials combinations of the methods of Mukhin, Solntsev, Pierce and others were employed in the reconstruction of another nine auricles. Finally, we adapted the method which permits the formation of the auricle from

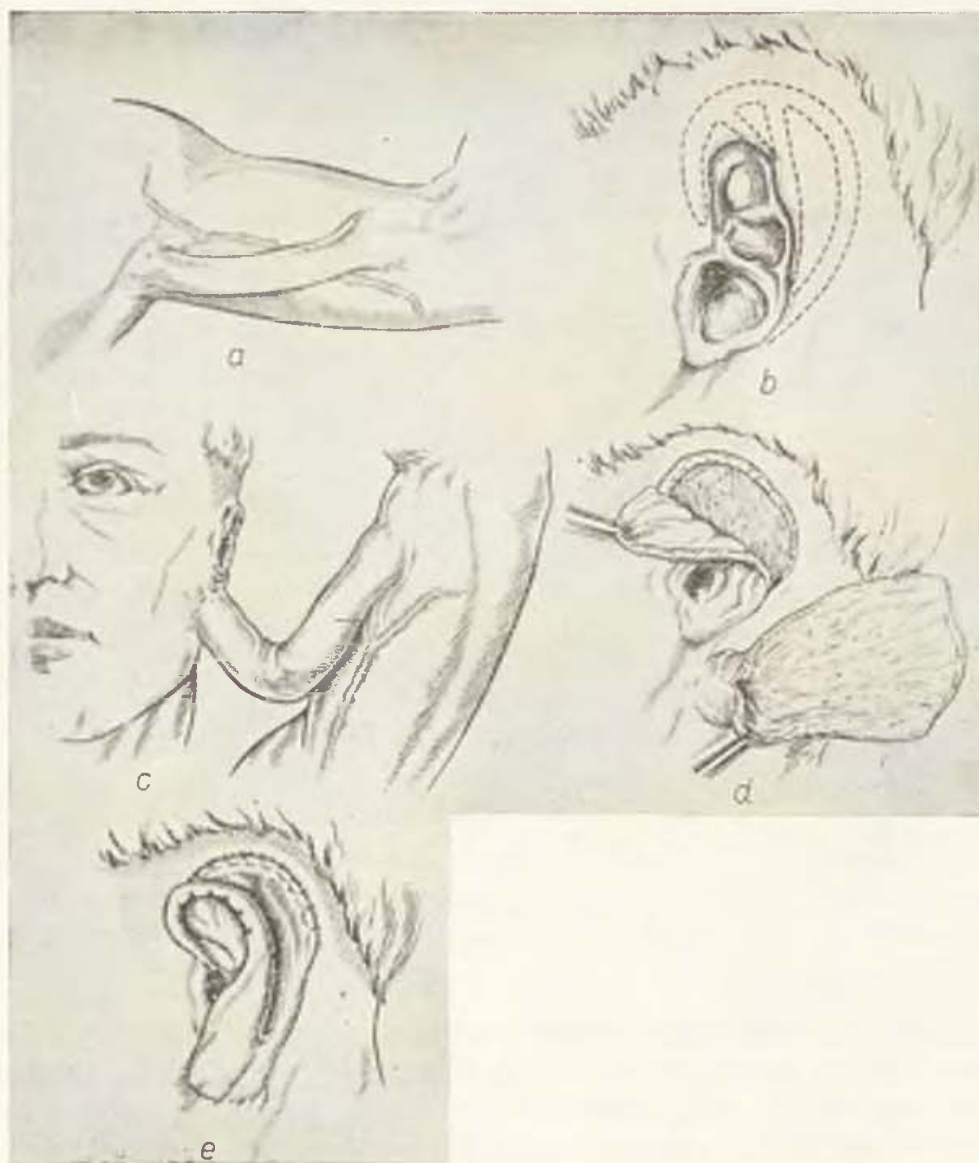


Fig. 2. Reconstruction of auricle with skin of Filatov flap, minced cartilage and tissue of periauricular region: a) Tubed flap formed from skin-and-fat band measuring 7X14 cm. on inner aspect of arm. — b) Injection of minced homogenous cartilage under skin of periauricular region. The cartilage is introduced along the contour of the future helix, anthelix and Y-shaped groove. — c) Not less than 4 weeks after formation of the tubed flap its lower pedicle is transferred to the periauricular region. This pedicle is implanted 1 cm. below the future ear lobe. — d) Incision made along hair line which usually corresponds to the contours of healed-in minced cartilage. The periauricular tissues together with the healed-in homogenous cartilage are mobilized. The tubed flap has been opened on a  $\frac{3}{4}$  stretch and its fatty tissue excised. — e) Dorso-medial surface of reconstructed auricle and wound in periauricular region are covered with skin of tubed flap.

a Filatov flap taken from the inner aspect of the arm, whose fatty tissue has been removed, with subsequent implantation of the skeleton from autogenous or homogenous costal cartilage, modelled into the shape of the auricular cartilage. Five auricles were reconstructed by this method.

In six reconstructions of the auricle (according to Mukhin and by our own method) a skeleton of plastic material was used; the soft material EG-mass-12 was employed in three, in two AKR-9, in one AKR-7 and also in one Ftoroplast-4. Employment of these materials brought very good early results, but seven months



Fig. 3a.



Fig. 3b.

to two years later all these inlays were eliminated; Ftoroplast was even sequestered in the third week after operation. These failures forced us to abandon the use of plastic materials and employ autogenous or homogenous costal cartilage exclusively for the formation of the auricular skeleton.

In 1958, Converse suggested the forming of the skeleton from autogenous costal cartilage in the region around the ear before the actual reconstruction of the auricle. In the same year, Yarchuk published his paper on the use of minced cartilage for the skeleton, implanted under the periauricular skin. This he then used together with the healed-in cartilage for the reconstruction of the auricle covering its dorso-medial surface with a free skin graft.

Ever since, the method of Yarchuk has found wide usage at our Clinic. We have used it to reconstruct eight auricles and the cosmetic results have satisfied all patients. The technique of the method is simple and it takes comparatively little time. But it must be borne in mind that the thus reconstructed auricle grows smaller in time due to the shrinkage of the free skin grafts and that it does not ensure the proper cranio-auricular angle which should be sym-

metrical with that on the healthy side. In view of this we use this method only in cases of bilateral loss of the auricle. In unilateral defects we employ a new method which is a modification of the method of Yarchuk.

This method consists of the following (see Fig. 2):

**F i r s t s t a g e :** Formation of the auricular skeleton and of a Filatov flap (Fig. 2a and b).

A plaster cast is taken from the healthy ear and with it a model of the auricle made from soft plastmass. A hole is made into the model at the site of



Fig. 3c.



Fig. 3d.

the auditory meatus. At operation the outer surface of this model is stained with methylene blue. A round rod is then introduced into the hole in the model and the auditory meatus and around it the model is centred into correct position (corresponding to that of the auricle to be reconstructed) and pressed against the skin. Thus a contour imprint of the future auricle is obtained on the skin. Along the line of this imprint minced homogenous and lyophilized cartilage is injected under the skin with a revolving syringe. Then a Filatov flap is formed on the inner aspect of the ipsilateral arm from a skin-and-fat band measuring 7×14 cm. If the wound edges of the donor site cannot be approximated without tension, the residual defect is covered with a free skin graft.

**S e c o n d s t a g e :** Four weeks after the first operation one pedicle of the tubed flap is transferred and implanted into the skin of the periauricular region. For this purpose the lower pedicle is separated from its root on the arm and sutured to a broad implantation bed prepared by a semilunar incision made just below the site of the future ear lobe (Fig. 2c).



**Third stage:** Five weeks after the second operation the upper two thirds of the auricle are reconstructed. Prior to this stage, satisfactory blood supply to the tubed flap through the pedicle implanted into the periauricular skin must be ensured by proper "training" of the flap. This is the most important stage (Fig. 2d and e). The proximal pedicle is separated from the arm and the wound of the donor site is closed by simple suture. A deep incision down to the periosteum is made along the outer margin of the implanted and healed-in auricular skeleton and the skin, together with the skeleton adhering to it, is



Fig. 3e.

mobilized thus forming a flap shaped like an auricle. The wound surface on the dorso-medial aspect of this flap and on the skull is covered by a band of skin obtained by opening the tubed flap along its scar and excising its fatty tissue according to Khitrov. The margin of this skin band is sutured to the wound edges of the newly formed auricle and those of the wound in the periauricular region. A gauze roll is placed into the retroauricular groove and fixed there with sutures approximating (but not to complete contact) the helix of the auricle and the edge of the wound in the mastoid region. This roll presses the skin band into the retroauricular groove and maintains reliable contact between it and the wound surface.

**Fourth stage:** The lower third of the auricle can be reconstructed two to three weeks after the third-stage operation. The pedicle of the tubed flap is separated from its implantation site in the periauricular region, the remaining tube is opened along its scar and the fatty tissue excised. The lower third of the auricle is reconstructed using local skin and the skin of the tube in the same way as described for the third stage.

Corrective operations, to give the proper relief to the anterior aspect of the reconstructed auricle, should be performed a few months after the tissues have got used to their new conditions. Not infrequently, however, the patients are so satisfied with the result already achieved that they refuse to submit to corrective operations.

The main advantages of the use of a Filatov flap in the reconstruction of an auricle are that its tissues hardly shrink and thus permanently maintain the shape once given to them, and that the skin fold in the retroauricular groove ensures a cranioauricular angle corresponding to that of the healthy side.

A considerable shortcoming of the method is that it requires a great amount of time and a series of operations. In this respect the method of Yarchuk is better. That is why we have lately employed Yarchuk's method for bilateral reconstructions; but in unilateral defects, where the auricle must stand at an angle



Fig. 3f.



Fig. 3g.

Fig. 3. Patient K., a man aged 26, with loss of both auricles as a result of burns. — a) View of auricle defect on the right. — b) View of auricle defect on the left. — c) View of patient *en face*. — d—g) Same patient after reconstruction of both auricles according to our method.

symmetrical to that of the healthy side, we prefer our own method. We have reconstructed nine totally or subtotally unilaterally lost auricles by this method. This does not include the reconstruction of congenital deformities in which we also exclusively employ our method augmented by some devices adopted from the method of Tanzer (1959).

To illustrate the above we demonstrate the photograph of a patient (Fig. 3) with an almost complete loss of both auricles resulting from burns.

The left ear was reconstructed from local tissue and a Filatov flap taken from the abdomen, because the skin of the left arm, which had also been burned, was covered with scars. Reconstruction of the right ear was carried out using local tissue and a Filatov flap taken from the right arm. The skeleton of both auricles was formed by minced homogenous cartilage. In this case the bilateral

defect was repaired with Filatov flaps on the patient's request, since he had observed the results of the various plastic method in his fellow patients while being treated for burns of the hands and face.

### CONCLUSION

1. In the various injuries to the auricle including deep burns, it is imperative to protect any exposed auricular cartilage immediately from bacterial contamination and contact with the air. For this purpose every wound of the auricle should be treated with ointment gauze. Better results are achieved with an ointment containing 5—10% Synthomycin.

2. All efforts should be made to prevent necrosis of the auricular cartilage, since reconstruction of a shrunken auricle entails unusual difficulties. In third-degree burns and in the various mechanical injuries the exposed cartilage must be covered, as soon as possible, with the tissues of a Filatov flap "acutely" formed on the inner aspect of the arm or the damaged parts of the cartilage must be excised and the wound surface covered with free skin grafts.

3. Reconstruction of a totally or subtotally lost auricle must begin with the formation of the ear skeleton in the periauricular region by one of the existing methods (Yarchuk, Converse or others).

4. Formation of the soft parts of an auricle is carried out from the skin of the periauricular region plus free skin grafts (Yarchuk, Converse) or the skin of a Filatov flap formed on the inner aspect of the arm.

5. In loss of both auricles the method of Yarchuk is preferable, in unilateral defects we use the method developed at the Clinic of Faciomaxillary Surgery and Stomatology of the Kirov Military Medical Academy, holder of the Lenin Order.

### SUMMARY

In order to prevent perichondritis following injury to the auricle the wound must be covered by a vaseline dressing containing 5—10% Synthomycin, and necrotomy followed by free skin grafting or coverage with an "acutely" formed Filatov flap should be carried out as soon as possible. In reconstruction of both auricles the method of Yarchuk is best. In unilateral loss of an auricle it is better to employ the method developed at the Clinic of Faciomaxillary Surgery and Stomatology of the Kirov Military Medical Academy, which consists in the formation of the auricle from local tissues and a Filatov flap whose fatty tissue has been excised, and of minced homogenous cartilage.

### RÉSUMÉ

#### **Les déficiences traumatiques du pavillon de l'oreille et les méthodes de leur thérapie**

N. M. Alexandrov

Pour prévenir la développement éventuel d'une périchondrite à la suite de lésions diverses du pavillon de l'oreille, il faut appliquer sur la plaie un onguent, renfermant de 5—10% de Synthomycine et réaliser une nécrotomie précoce, suivie de la plastie par greffon cutané libre ou bien à l'aide du lambeau cylindrique «aigu» de Filatov. S'il s'agit



de la reconstruction des deux pavillons, la méthode d'après Jartchouc s'est montrée efficace. Au cas où il ne s'agit que d'une défectuosité unilatérale, il semble mieux de se servir de la méthode élaborée dans la Clinique de chirurgie faciale et maxillaire et de stomatologie, de l'Académie Médicale Militaire de Kirov, lauréat de l'Ordre de Lénine: cette méthode est basée sur le principe de la formation du pavillon de l'oreille à partir de tissus locaux, du lambeau cylindrique de Filatov dépourvu de tissu adipeux et de tissu cartilagineux broyé.

#### ZUSAMMENFASSUNG

### Traumatische Defekte der Ohrmuscheln und die verschiedenen Arten ihrer Behandlung

N. M. Alexandrow

Um einer Perichondritis nach den verschiedenen Verletzungen der Ohrmuscheln vorzubeugen, muss die Wunde mit einer Salbe gedeckt werden, die 5 bis 10% Syntomycin enthält, weiters ist eine frühzeitige Exzision nekrotischer Gewebsteile vorzunehmen, worauf eine Plastik mit freien Hauttransplantaten oder mit dem „akuten“ Tubuluslappen nach Filatow durchgeführt wird. Bei der Rekonstruktion beider Ohrmuscheln ist die Methode nach Jartschuk am vorteilhaftesten. Bei einseitigen Defekten bewährt sich besser die Methode, die an der Klinik für Kiefer- und Gesichtschirurgie und Stomatologie der Kirow-Akademie für Militärmedizin ausgearbeitet wurde, die in der Bildung einer Ohrmuschel aus örtlichen Geweben beruht, und zwar aus einem von Fettgewebe befreiten Filatowschen Tubuluslappen und aus zermahlenem homogenem Knorpel.

#### RESUMEN

### Los defectos traumáticos de los pabellones auriculares y los métodos del tratamiento

N. M. Alexandrov

Para evitar pericondritis surgiendo después de varias lesiones del pabellón auricular, es necesario cubrir la herida por un ungüento que contiene el 5—10% de Sintomicina y efectuar muy pronto necrotomía con plastia subsiguiente por medio del injerto de piel libre o por el colgajo cilíndrico „agudo“ de Filatov. En la reconstrucción de ambos pabellones el método más eficaz es el de Jarchuk. En defectos unilaterales es mejor utilizar el método elaborado en la Clínica de la Cirugía Maxilar-Facial y en la Clínica de la Estomatología de la Academia de Medicina Militar, condecorada por el Orden de Lenin, el que se basa en la reconstrucción del pabellón auricular con ayuda de los tejidos locales, del colgajo cilíndrico de Filatov privado del tejido lipoideo y del cartílago homogéneo pulverizado.

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## EVALUATION OF FUNCTIONAL ADAPTATION OF SKIN GRAFTS TO THE HAND BY TACTILE DISCRIMINATION

F. MARIŠ

A skin graft only becomes a component of full value in its new site when its functional powers are renewed. This is closely dependent on reinnervation.

The reinnervation of free and flap skin grafts proceeds gradually over a long period [10]. When completed all types of sensitivity and also vegetative innervation are renewed. A number of authors have dealt with the reinnervation of skin grafts both in animal experiments and in clinical practice [1, 5, 7, 8, 9, 10, 11, 12].

We were interested in the question from the important practical aspect of how the level of innervation of the taken skin graft compares with that of its donor and recipient area. This is of greatest significance when using skin grafts in sites of functional importance.

### MATERIAL AND METHODS

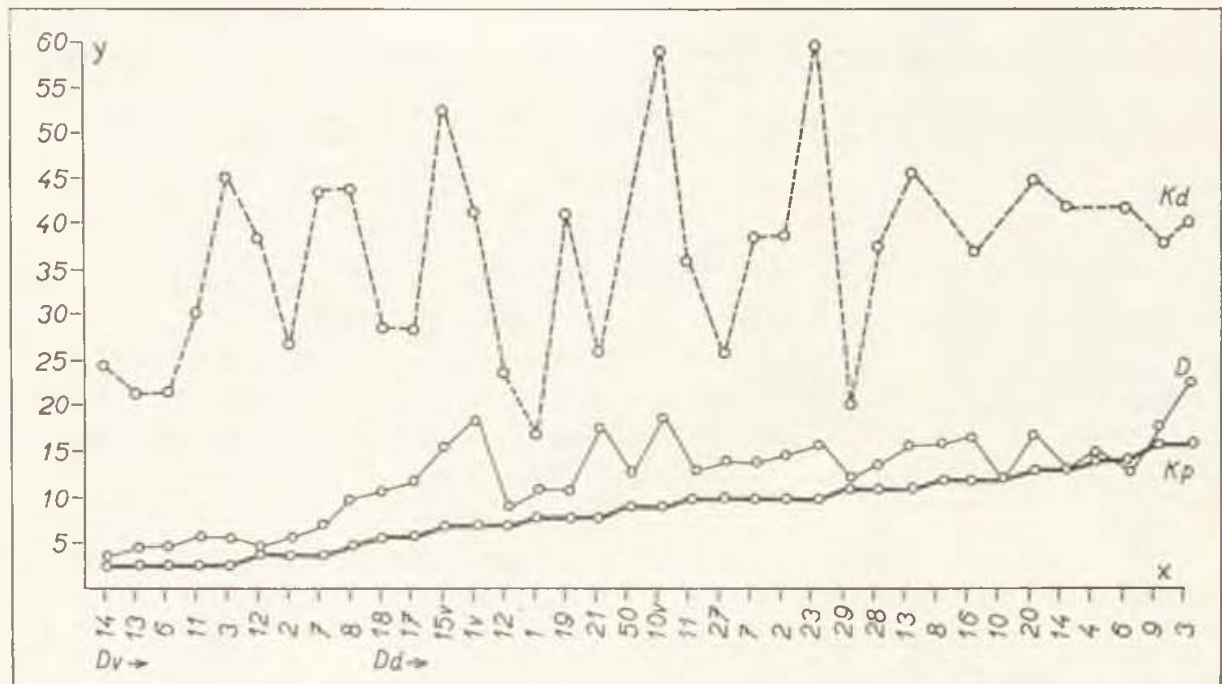
These relationships were investigated in 104 patients with skin grafts from various parts of the body to the hand for loss of skin tegumen due to injury. They comprised a total of 121 different grafts, including dermo-epidermal transplants, full-thickness free skin grafts, direct flaps from the dorsal or dorso-lateral area of an adjacent finger and different types of pedicle flaps from various parts of the body.

Tactile discrimination was investigated in addition to the basic types of sensory and vegetative innervation.

Tactile discrimination is the power to distinguish two points on the surface of the body, i.e. the differentiate simultaneous touch at two points of minimal distance from each other. The level of sensibility is different in various parts of the body. In the hand, especially on the finger tips it is highly developed. This makes the hand the organ of touch and perception. In other parts of the body, where the grafts were taken, tactile discrimination is much less acute.

The comparison of tactile discrimination of the graft, a control recipient area and the donor area, permits an assessment of the adaptation of the graft to the level of innervation of its new site.

Weber calipers were used for the test, permitting simultaneous touch at two points whose distance can be altered at will. The stimuli were applied 10 times for each distance between the points at every site investigated. The position of the two points was altered at the same site so that they were parallel to the course of a nerve and along the axis of the limb and finger or at various angles to this axis. The value of tactile discrimination was taken as the smallest distance between two points in mm. recognized correctly in 7 out of 10 applications.



Graph 1. Tactile discrimination of dermoepidermal graft as compared with control site in recipient area [Kp] and control site in donor area [Kd]. x = No. of graft, y = distance between two points in mm., D = dermoepidermal graft, Dv = dermoepidermal graft on volar aspect of hand, Dd = dermoepidermal graft on dorsal aspect of hand, Kp = control site in recipient area, Kd = control site in donor area.

## RESULTS

In all sufficiently large and innervated grafts tactile discrimination was assessed concretely.

It was interesting that when the two points were applied in the direction of the long axis of the fingers or parallel with the course of the nerves, the distance of two points distinguished correctly was greater than when applied diagonally or at right-angles to the long axis of the finger.

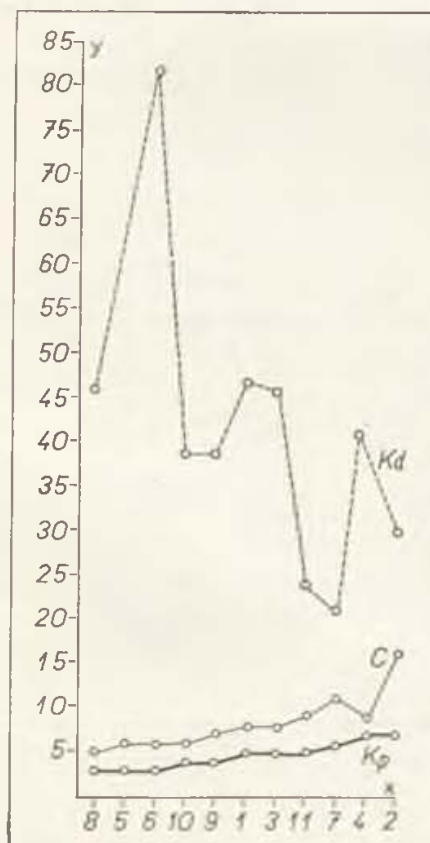
In the hypaesthetic zone of the grafts the correct distinguished distance of the two points was greater than in well innervated parts. In the patient M. R., for example, the smallest distance at which two points could be correctly distinguished in the proximal third of a flap covering the thumb was 18 mm. and in the distal part it was 39 mm. In accord with this observation, the per-



ception of the basic sensory stimuli, pain, tactile and thermal, was also decreased, and vegetative reinnervation, as assessed by the sweating test, was inadequate.

The tactile discrimination of two points could not be evaluated in anesthetic zones.

In all grafts values were obtained which testified to the adaptation of the graft to the recipient area in the index evaluated. This can be judged from



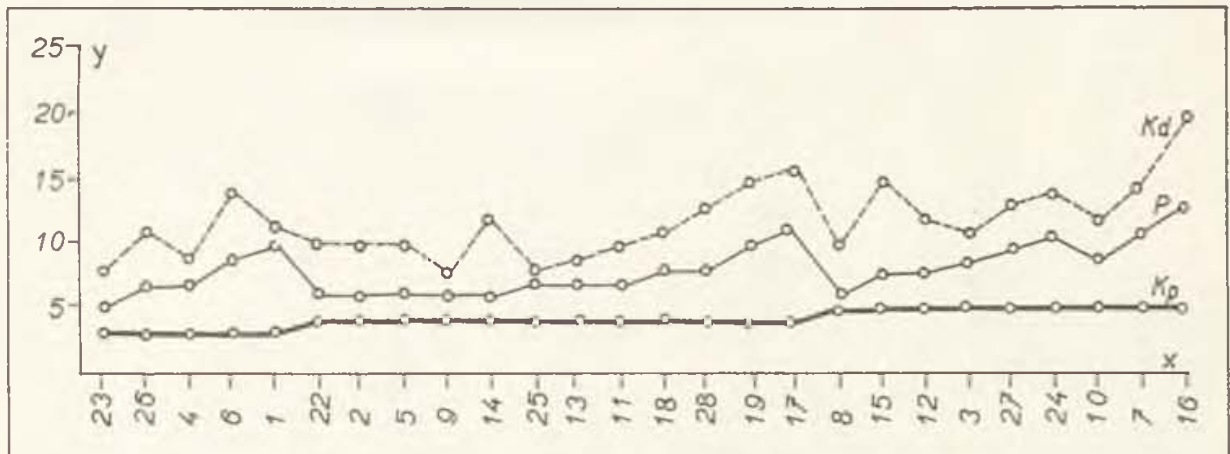
Graph 2. Tactile discrimination of free full-thickness skin graft as compared with Kp and Kd. x = No. of graft, y = distance between two points in mm., C = free full-thickness skin graft, Kp = control site in recipient area, Kd = control site in donor area.

comparing values plotted in graphs from grafts and control recipient and donor sites.

The graphs for the different type of grafts investigated (Graph 1, 2, 3, 4) give the tactile discrimination measured in millimeters in the grafts and in the corresponding donor and recipient areas. They show the approximation of the tactile discrimination of the grafts to the values of the control sites in the recipient areas. In free dermoepidermal transplants, free full-thickness skin grafts and flaps from distant areas, this approximation was considerable in relation to the level of tactile discrimination in the donor area. In direct flaps from the dorsal surface of the fingers this approximation is about half-way between the values of the control recipient and donor sites, since tactile discrim-

ination is quite well developed on the dorsal surface of the fingers, much better in fact than in the more distant parts of the body where the other types of grafts were taken.

In Graph 5 the average values of tactile discrimination in millimeters of the different types of graft and the corresponding control sites, are depicted in columns. This again demonstrates the close approach of tactile discrimination in the grafts to the level of that in the control recipient site.



Graph 3. Tactile discrimination of direct flap from dorsal surface of finger as compared with Kp and Kd. x = No. graft, y = distance between two points in mm., P = direct flap from dorsal surface of finger, Kd = control site in donor area, Kp = control site in recipient area.

The results of this method can be influenced by the subjective reactions of the patient. However, with good cooperation between the patient and the examiner and the repeated checking of results, reliable values can be obtained. Thus this quantitative method is in fact the most reliable for evaluating the functional power of skin grafts.

## DISCUSSION

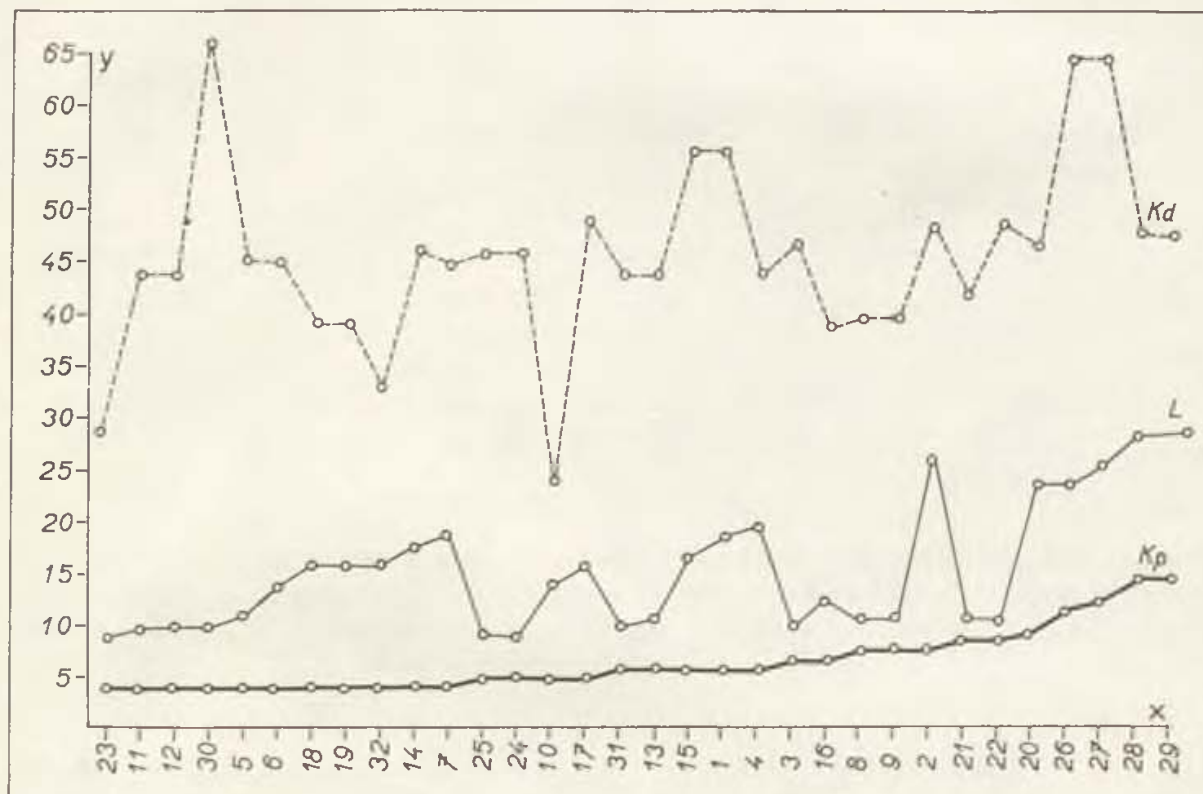
The curves of the values obtained in investigating tactile discrimination clearly demonstrate the adaptation of the functional powers of grafts to the characteristics and conditions of the new site in approximate numerical values.

This fact arouses interest in the morphological basis of these changes. A given area of the body has a definite level of tactile discrimination but a graft from this area shows a much higher development of this functional power in its new site in the hand. It can be assumed that this change in perception must be conditioned by quantitative changes in the nerve supply of the taken and reinnervated graft.

Boeke and Dijkstra demonstrated experimentally that the specific nerve endings persist in the new location. On spontaneous healing after excision of skin and subcutaneous tissue new nerve fibres grow into the space and form

new nerve endings. G u t t m a n n confirmed these findings. K a d a n o f f found that nerve fibres were more numerous in the graft than in the donor site.

These findings from experimental work provide an explanation for the functional changes found on transplantation. This, of course, suggests that the growing nerve fibres do not necessarily use the existing sheaths of Schwann in the graft, as asserted by Davis, Kitlowski and Napier, but that



Graph 4. Tactile discrimination of flap from distant part of body as compared with Kp and Kd. x = No. of graft, y = distance between two points in mm., L = flap from distant part of body, KD = control site in donor area, Kp = control site in recipient area.

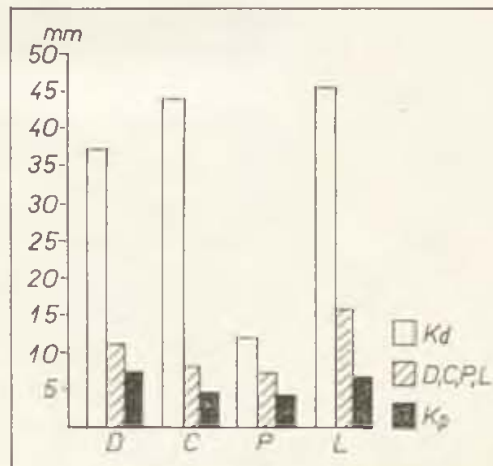
neurofibrils enter the graft independently. The newly formed vessels probably act as guides for the growing nerve fibres.

On the volar surface of the hand and particularly at the finger tips, the nerve supply is much better than at the donor site of the transplant. The interrupted nerve fibres grow from the bed into the graft and branch in it. Some reach the smaller number of existing corpuscular endings but the others do not disappear, they become incorporated functionally. This forms the morphological substrate for the improvement in the functional power of healed and reinnervated skin grafts in the hand.

As thought to be the case with the Moberg test, the tactile discrimination of two points applied at the same time demonstrates the tactilognostic capacity of the area investigated. From the observations made it can be assumed that the level of function renewed or even perfected in the graft is better than that of the donor area of the transplant.



Tactile discrimination is a manifestation of central nervous function. It is developed differently in the various parts of the body and is highly developed at the finger tips. On loss due to injury, e.g. of the finger tips, the basis of this power remains unchanged. A graft to the finger tip from an area where tactile discrimination is little developed becomes adapted to form receptors of tactile discrimination at a much higher level after reinnervation. We assume that



Graph 5. Average values of tactile discrimination to touch at two points. D = dermo-epidermal graft, C = free full-thickness skin graft, P = direct flap from dorsal surface of next finger, L = flap from distant part of body, Kd = control site in donor area, Kp = control site in recipient area.

it is this increase in nerve supply of the graft which is responsible for the tactile discrimination almost reaching that of the normal skin at the site of injury.

This fact is important for directing longterm postoperative care, in assessing the influence of work and in recommending work with varying demands on the functional capacity of the reconstructed skin cover of the hand.

#### SUMMARY

In hand wounds with skin loss the skin cover is reconstructed with free or flap skin grafts. These only acquire full value in the new site when their reinnervation is completed. The functional capacity of such grafts can be tested by examining tactile discrimination.

121 different types of grafts in 104 patients were evaluated in this way. The results showed that tactile discrimination is renewed on the graft or is developed to a higher level than that of the donor site. The level of innervation is evidence of the adaptation of the grafts to the properties and conditions of the new location. The functional adaptation of grafts is expressed graphically by plotting the tactile discrimination of the graft and the corresponding donor and recipient areas.

The author considers the basis of the functionally higher level of grafts transplanted from other areas to the hand, to be an increased nerve supply and integration under the control of the corresponding area of the central nervous system in the new site on the hand.

## RÉSUMÉ

### **Adaptation fonctionnelle des greffons cutanés de la main, évaluée à l'aide du teste de la sensibilité discriminante**

F. Mariš

En présence des blessures de la main avec des pertes, on se sert de greffons cutanés libres et en lambeaux pour la reconstruction de la couverture cutanée. Ceux-ci deviennent des éléments de valeur complète dans leur localisation nouvelle lorsque leur re-innervation s'est terminée. La capacité fonctionnelle de ces greffons peut être vérifiée à l'aide de l'examen de la sensibilité discriminante.

De telle façon, 121 greffons différents ont été examinées sur 104 malades. Ces épreuves ont montré que la sensibilité discriminante se renouvelle ou bien se développe à un niveau supérieur qu'il ne l'était à l'emplacement primitif du greffon. Le niveau de l'innervation témoigne en faveur d'une adaptation du greffon aux propriétés et aux conditions de la localisation nouvelle. L'adaptation fonctionnelle est exprimée par une représentation graphique de la sensibilité discriminante des greffons et des endroits de contrôle, choisis dans les régions correspondantes du donateur et de l'hôte.

On considère comme base de cette élévation du niveau fonctionnel des greffons, prélevés d'autres régions et transférés sur la main, leur innervation et leur soumission au contrôle des zones compétentes du système nerveux central, dans leur nouvelle localisation dans la main.

## ZUSAMMENFASSUNG

### **Bewertung der funktionellen Adaptation von Hauttransplantaten der Hand mittels des Tests der Diskriminationsempfindlichkeit**

F. Mariš

Bei mit Gewebeverlusten verbundenen Handverletzungen verwendet man zur Rekonstruktion der Hautdecke freie und tubuläre Hauttransplantate. Diese Transplantate werden in ihrer neuen Lokalisation erst dann ein vollwertiger Organbestandteil, bis ihre Reinnervierung beendet ist. Die funktionelle Tüchtigkeit dieser Transplantate kann durch Untersuchung der Diskriminationsempfindlichkeit festgestellt werden.

Die derart durchgeführte Bewertung von 121 verschiedenen Transplantaten bei 104 Patienten ergab, dass die Diskriminationsempfindlichkeit in der übertragenen Haut wieder auftritt oder sich sogar in höherem Masse ausbildet, als sie vor der Transplantation in der ursprünglichen Lokalisation bestanden hatte. Der Grad der Innervierung weist auf die Adaptation der Transplantate an die Bedingungen am neuen Wirkungsort hin. Die funktionelle Adaptation der Transplantate ist in der vorliegenden Arbeit durch graphische Wiedergabe der Diskriminationsempfindlichkeit der Transplantate sowie der ihnen entsprechenden Kontrollstellen im Spender- sowie im Empfängergebiet ausgedrückt.

Als Ursache dieser erhöhten Funktionstüchtigkeit der von anderen Gebieten auf die Hand übertragenen Transplantate wird die reichere Nervenversorgung und die Eingliederung unter die Kontrolle der der neuen Lokalisation an der Hand entsprechenden Abschnitte des Zentralnervensystems angesehen.

## RESUMEN

### **La adaptación funcional de los injertos de la piel de la mano evaluada por medio de la prueba de la sensibilidad de discriminación**

F. Mariš

En las lesiones con pérdida de las manos se emplean para la reconstrucción de la cubierta cutánea los trasplantes de piel libres y los de lóbulo. Estos forman partes integrantes de la nueva localización en aquel tiempo cuando se termina su reinervación. Es posible examinar y verificar las capacidades funcionales de aquellos trasplantes por medio de la examinación de la sensibilidad de discriminación.

Tal evaluación de 121 varios trasplantes en 104 pacientes demuestra que la sensibilidad de discriminación de los trasplantes se restaura o se forma en el nivel más alto la cual posee la localización original del trasplante. El nivel de la inervación comprueba la adaptación de los trasplantes por lo que se refiere a las propiedades y condiciones de la nueva localización. La adaptación funcional de los trasplantes la presenta el autor con un gráfico que señala la sensibilidad de discriminación de los trasplantes y los puestos de control correspondientes de la regiones de donador y de receptor.

Como la base de este nivel funcional elevado de los trasplantes transferidos de otras regiones de la mano se considera el enriquecimiento de su abastecimiento de nervios y la incorporación bajo el control de la región respectiva del sistema nervioso central en la nueva localización de la mano.

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## A CONTRIBUTION ON THE TECHNIQUE OF TAKING LARGE FREE SKIN GRAFTS

M. CHYTILOVÁ, H. RÖDING

This annotation is for the assistance of surgeons working in departments which are not equipped with modern instruments for the taking of large skin grafts. Instruments, such as dermatomes, vacutomes and electrodermatomes are only available to a few surgeons, whereas all surgeons may be faced with the necessity for covering a large skin defect with a free graft.

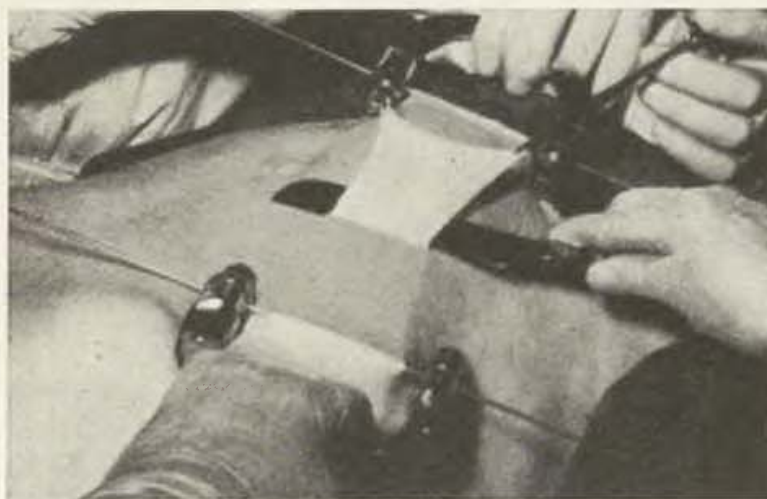


Fig. 1.

All surgical departments, however, have a Thiersch or Humby knife. The technique of taking grafts with these two instruments is now a routine matter and does not require any special training. The difficulty, however, is that although long grafts can be obtained by the Thiersch or Humby knife, their width does not usually exceed 6—7 cm. Moreover, these instruments are not suitable for utilizing the skin of the abdomen which, especially in large burns, is often unaffected and affords a large amount of transplantation material.

We have attempted to take free skin grafts with a Thiersch knife combined with a Kirschner wire extension for the epithelization of large areas. Flick drew attention to this method of taking skin grafts in 1930.

**Technique:** Under local or general anaesthesia, a Kirschner extension wire is introduced immediately under the corium to the width of the required graft. A second wire is introduced in the same way, parallel with the first, at a distance corresponding to the length of graft required. The two wires are tightened with Kirschner clamps. Pulling on the two clamps raises a rectangle of skin from which a graft 10 to 12 cm. wide can easily be taken with a Thiersch knife. The thickness of the graft can to some extent be regulated by the degree to which the skin is stretched. With greater stretching a thicker graft is obtained, with less stretch the graft is thinner (Fig. 1).

Attention is drawn to this method of taking free skin grafts for the following three reasons:

1. Only the simplest surgical instruments are needed, i.e. a Thiersch knife and Kirschner set. These are certainly available in every surgical department.
2. Grafts can be taken of the length and width required and even their thickness can to some extent be regulated.
3. Grafts can be taken from the abdomen.

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## ANNOUNCEMENTS

ANNOUNCING THE DATES  
of the

**Tenth Congress of the Pan-Pacific Surgical Association:**

Part I — September 20—28, 1966

in

Honolulu, Hawaii

\* \* \*

**Second Mobile Educational Seminar:**

Part II — September 28—October 10, 1966

in

Japan and Hong Kong

\* \* \*

Part III — September 28—November 1, 1966

in

Japan, Hong Kong, The Philippines, Thailand, India,  
Singapore, Australia and New Zealand

The Board of Trustees of the Pan-Pacific Surgical Association is pleased to announce the dates of the Tenth Congress of the Association and the Second Mobile Educational Seminar to countries bordering on the Pacific basin.

Part I, the Honolulu portion of the Congress, will convene at the Princess Kaiulani Hotel in Honolulu, Hawaii, on September 20, 1966 and continue to September 28. Part II and Part III will depart from Hawaii on September 28 and travel to Japan and Hong Kong, with Part II returning to San Francisco, California, on October 10 in time for the opening of the American College of Surgeons, and Part III continuing on to the Philippines, Thailand, India, Singapore, Australia and New Zealand, returning to Hawaii on November 1, 1966.

The Tenth Congress offers an extensive scientific program presented by more than 300 leading surgeons from all parts of the world in nine different surgical specialties and related specialties: General Surgery, Ophthalmology, Otolaryngology, Thoracic Cardiovascular Surgery, Neurosurgery, Obstetrics and Gynecology, Orthopedic, Plastic Surgery, Urology, Anesthesiology and Radiology. We extend this invitation to all physicians to attend and participate in these meetings.

For further information, please write: Pan-Pacific Surgical Association, Room 236, Alexander Young Building, Honolulu, Hawaii 96813.



**The Section of Anaesthesiology of the Czechoslovak J. E. Purkyně Medical Association** is organizing an International Symposium in Prague from September 17—20, 1965 on the subject:

"Problems of Respiration in Anaesthesiology and Resuscitation". The official languages will be Czech, Slovak, Russian, English and German.

Preliminary notifications of papers should be sent to the scientific secretary of the Symposium (Dr. Pavel Scheck, Department of Anaesthesiology, Bulovka Hospital, Praha 8, Budínova ul.), before December 1, 1964. A working conference of the Section of Anaesthesiology will be held on April 16, 1965 where all papers sent in will be submitted. This conference will make a selection of papers to be included in the program of the International Symposium.

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The members of the new Executive Committee of **The Argentine Society of Plastic Surgery** for the period 1964 — April, 1965 are as follows:

President: Dr. Luis J. Monti

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