

ACTA CHIRURGIAE PLASTICAE

35-1993

INTERNATIONAL JOURNAL
OF PLASTIC SURGERY

35 • 1-2

1993

Národní lékařská knihovna
2530017197



A3021/155940

Galen

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Published four times a year by Galén Prague, Czech Medical Press, Nádražní 116, Prague 5

Editor in Chief prof. M. Fára, M. D. DrSc.

Layout and Print Gradior

Adress of the Editorial Office: Acta Chirurgiae Plasticae, Šrobárova 50, 100 34 Prague 10

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Prof. Miroslav Fára M.D., D.Sc.
- to his jubilee

Prof. Miroslav Fára M.D., D.Sc., a prominent representant of the Czech Plastic Surgery celebrated in full professional activity his 70th anniversary.

As a pupil of Prof. Francis Burian he devoted all his efforts to the continuation of Burian's legacy and thus provided a major contribution to the persisting world-wide good reputation of the Czech Plastic Surgery.

Prof. M. Fára was born on July 29, 1923, in Pelhřimov where he attended also the primary and secondary school which he finished in 1941. In 1949 he graduated at the Medical School of Charles University in Prague. From 1949 to 1955 he worked at the General Hospital in Jindřichův Hradec, for a shorter period of time at the Medical Department and subsequently at the Surgical and Gynecological Departments. In his opinion these six years of work in a general hospital, formerly consisting only of two departments, represented for him the most valuable training for his future clinical practice. He learned to look at the patient in a complex way and to make independent medical decisions.

In August 1955 he applied for a post and started to work as a member of the staff of the Department for Plastic Surgery in Prague. Thus had the opportunity to work for ten years under the guidance of Prof. Francis Burian and subsequently under Prof. Karfík and Prof. Pešková. In 1964 he was appointed a lecturer, in 1965 he was granted the degree of a Candidate of Science, in 1966 the degree of Associate Professor; in 1970 the degree of a Doctor of Sciences and was appointed as Professor in Plastic Surgery in 1976.

His professional skills were further supplemented during his two long-term visiting studies in Sweden and in the USA. He had the opportunity to visit well-known departments for Plastic Surgery abroad where he was invited to held lectures. Thus he visited Mexico, Peru, Brazil, Japan, Thailand, Singapur, Australia, India and repeatedly the United States and Canada.

In 1975 he became the head of the Department of Plastic Surgery which he headed up to 1992. In 1978 he was also appointed the Head of the II. Department of the Institute of Experimental Medicine of the Czechoslovak Academy of Sciences consisting of five laboratories dealing with problems of inborn malformations and of burns.

He published 200 scientific papers dealing with a variety of problems of plastic surgery and he participated in 11 monographies. The number of papers presented by Prof. Fára at Congresses and Symposia, both in our country and abroad, as well as on universities in foreign countries attains 300 lectures.

Of particular importance are his studies dealing with clefts which have a world-wide priority. Prof. Fára wrote chapters on the anatomy of facial clefts at the request of editors of



the most prominent international textbooks and year-books, as e.g. "Recent Advances in Plastics Surgery". He is the first author who described a new syndrome "Dysmorphia Otofacio-cervicalis".

Prof. Fára is a honorary member of the Czech Society of Plastic surgery and he is also a honorary member of several international medical societies. A tribute to his accomplishment in the field of plastic surgery was the invitation to held a Memorial Maliniac lecture at the Congress of the ASPRS in 1992.

We would like to wish to Prof. Fára on the occasion of his jubilee many years of good health and professional activity as well as a happy personal life.

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THE RADIAL FOREARM FLAP: EXPERIENCES WITH THE EXTRAORDINARY PROCEDURE

A. GOVILA

Radial forearm flap, also known as "Chinese flap", after its description in 1981 by Yang Goufan et al (1), gained worldwide popularity owing to more than one reason. This thin, pliable predominantly hairless skin of the forearm based on large vessels of great length at either end and having a potential to supply large and irregular fasciocutaneous requirements and virtually tissues of all kinds such as skin, fascia (2), tendon (3, 4), nerves (1, 3, 5, 6) and bone (5) was found to be highly reliable and of great use, equally by reconstructive surgeons of all kinds including microvascular surgeons, head and neck surgeons, hand surgeons and those working on lower extremity.

Initially, after its description its mode of transfer was limited to microvascular free tissue transfer or to a local island flap. After the description of "Extracorporeal tissue transfer" in July 1988 by the author (7) and by its later publication (8), the flap now has an additional mode of transfer for distant defects and its uses extended to almost any part of the body. We have been using this flap in some form or the other since 1984 for all kinds of problems including intra-oral, intra-thoracic, cranial, hand foot, leg and for the reconstruction of nose, ear, penis and oesophagus.

Author has on several occasions employed not only permutations and combinations of tissues of different kinds for some of the most difficult defects to reconstruct but also combined modes of transferring it. With increasing experience it has also been possible to reduce the time of immobilization for extracorporeal tissue transfer, to ten days. So far we have employed this flap in forty patients and present over collective experience of past 7 year. Design and the technique of flap elevation and transfer other than standard radial forearm flap are elaborated.

MATERIAL AND METHOD

In seven years period during 1984 to 1991 forty radial forearm flaps have been raised and transferred by one surgeon (author) for a variety of reconstructive problems. The age of the patients ranged from 10 to 60 years with the mean age of 26.1 years. Twenty-nine of them were male and only eleven of them were female patients.

Of the total area of the flaps raised (7221 sq. cm) only 304 sq. cm was raised as fascia alone and rest 6917 sq. cm was raised as fasciocutaneous flaps. Minimum size of the flap raised was 7x4 cm (28 sq. cm) and the maximum size was 18x25 cm (450 sq. cm) with the mean size of 180.5 sq. cm.

In 77.5 % of patients (31 flaps) the size of the flap used was of or over 100 sq. cm and in 42.5 % (17 flaps) it was over 200 sq. cm, while in 15 % (6 flaps) the size was well over 300 sq. cm. In three patients flaps as large as over 400 sq. cm have been raised.

Thirty-seven of total number of flaps were fasciocutaneous and in rest 3 other composite tissue combinations were used. In one patient fascia alone was used. In another patient a combination of fascia and fasciocutaneous element and yet another fascio-myo-cutaneous flap was used, including brachioradialis muscle in the radial forearm flap muscle which was raised with the RFF.

Of all the cases performed ECTT RFF (Extracorporeal tissue transfer, Radial forearm flap) formed the largest group of 22 patients which is more than 50 % of all the flaps. This was followed by island flaps in 11 patients and free flaps in 6 patients. Only in one patient it was used as septocutaneous rotation flap.

Most of the flaps (33 flaps) were based distally on a retrograde blood flow and only 6 flaps were based proximally on a orthograde blood flow. One flap had through and through blood flow and yet another flap had "simbiotic circulation" (which meant that the flow was such that segments of two different composite flaps helped each other). Of all the vascular pedicles of the flaps based on retrograde circulation only three pedicles were without inclusion of cephalic vein. All vascular pedicle included radial artery its both venae comitantes and some amount of fibro-fatty tissue around them.

Most of the ECTT RFF (17 patients) were used for head and neck reconstruction and only in 3 patients the technique was employed for upper extremity. It was also employed for penile reconstruction in one patient and yet another patient it was used for oesophageal reconstruction (intrathoracic use).

Commonest cause for it's use was after trauma (19 patients) which was followed by 13 patients of burn. Five flaps were used for reconstruction after cancer extirpation and two were for congenital and benign lesions while only one each was used for iatrogenic and post infective tissue loss. Among burn patients flame burn (5 patients) and high voltage electric burn (5 patients) shared equally while two severe burn problems were following acid burns and only one patient had epileptic flame burn. All malignancies were squamous cell carcinomas of head and neck. Benign lesion included hairy naevus of face and cavernous haemangioma of maxilla one patient each.

Fifty percent of all flaps (20 patients) were used for secondary reconstruction while in 15 patients it was used primarily and rest 5 as a delayed primary procedure.

Use of this flap for head and neck defects formed the largest group (18 patients) which was closely followed by its use in upper extremity (16 patients). Five flaps were used for lower extremity and one each for penile and oesophageal reconstruction.

Among head and neck reconstructions the distribution was fairly equal among cranium forehead and neck with two patients each while cheek and mandibular region defects were the commonest reasons for its use (6 patients). It was used intra-orally in three patients which included defects of the soft and the hard palate maxilla, oro and laryngopharynx.

All radial forearm flaps in this group were transferred by ECTT technique except for one which was lost was transferred as a free flap.

In lower extremity all flaps (5 patients) were transferred by microsurgical means as a free flap, and all survived completely.

In upper extremity most of the flaps were transferred as Island flap (13 patients) except for 3 flaps which were transferred by extracorporeal tissue transfer (ECCT) technique. All flaps survived completely except one that suffered from 50 % flap necrosis.

In two patients out of all, the organ to be reconstructed was prefabricated on the forearm before its transfer. The organs included nose and the penis.

The uncommon organs reconstructed by this flap using ECTT included ear, nose, penis and the oesophagus.

Twenty-five percent of all the flaps used (10 patients) were sensory flaps. Eight of them were used in the upper and two in the lower extremity. All flaps regained protective sensations only. Two point discrimination was never less than 2.5 cm. Both flaps for lower extremity were used for reconstruction of the sole. Both remained trouble free until three years after reconstruction when they were last seen.

In fifty percent of the patients (20 flaps) skeletal support in some form or the other sooner or later was provided. Of all cases requiring skeletal support 12 patients were treated with biological tissue and 8 with synthetic material. Most common material used was methyl methacrylate (cold cure) which was used in 6 cases and only in one patient marlex mesh and yet another "K" wire was used. Out of all the patients with bone graft rib was the commonest choice (7 patients) and iliac crest was used in one and second metacarpal was used in another.

Of 6 free radial forearm flaps there was one total loss following severe post-operative wound infection resulting in anastomotic blowout and secondary haemorrhage, necessitating ligation of the feeding vessel, no such disaster was observed in ECTT RFF or with island flaps. Fifty percent flap loss was observed in one patient of island RFF and this was purely for technical reasons, this being our first flap of the series. Thirty percent flap loss occurred in one patient with ECTT RFF and that was related to severe post operative wound infection leading to septicemia.

Most common position used for immobilization was position A and C (7 patients each) while position B was used in 3 patients. Position D and E were used in one patient each.

Most common material used for immobilization was elastoplast, in 13 patients, while plaster of Paris was used in rest of the 6 patient.

TECHNIQUE

Enough of designing and the technique of flap elevation of the standard radial forearm flap has been published. Only modified designs and special methods of flap transfer will be elaborated.

Donor upper limb is selected on the basis of negative Alen's test. Left forearm is preferred so that patient can help himself by right hand during hospitalization. However if the right upper limb is more comfortable during rehearsal immobilization then that limb is used.

In males for non hairy requirements such as for intra-oral defects ulner border of the forearm is used which is relatively non-hairy. We have never confined our flaps to the earlier described territories of the flap to be between medial and lateral epicondyl proximally and between 2nd and 6th extensor compartments distally. On several occasions flaps much larger then these defined limits have been harvested. In females the forearm is almost non-hairy and these criterias for selection do not apply. When Larger flaps are required - may be total circumference of the forearm, then the proximal ulner side of the forearm if possible should be avoided since its prominent blood supply is from the ulner artery and therefore at time show venous engorgment of arterial insufficiency and may have healing difficulties.

When fasica alone is used then the forearm skin is opened like a book page based on the ulner or radial border. Through a straight or zig zag incision, the vascular pedicle is dissected and the fascia without any overlying fat, along with the septum of the required dimensions, is raised.

When brachioradialis muscle is to be included with the flap the skin island is planned on the muscle belly. When radius to be include skin island and the bone could be at different levels depending upon the requirements. The bone is harvested from the area where the flexor policis

longus muscle fibres take origin from the radius and the perforators entering into the muscle and thereby supply the bone, are left intact.

For penile reconstruction a longitudinally placed skin pattern on the forearm is used. Neo-urethra is designed on the ulnar non-hair bearing segment and about 2 cm wide strip is enough to provide a 7 mm diameter urethra. Next to it one cm wide strip of de-epithelized skin segment is planned and further radial to it is the area of the skin about 10 cm in width which is used for the covering of the penile skin. The length of the reconstructed penis we planned was 18 cm (to provide as 6 cm diameter of the penis). Distal part of the forearm skin forms the glans penis and therefore the shape of the skin pattern is rounded in this area.

For oesophageal reconstruction a longitudinally placed skin pattern over the vessels in the forearm is used. About 10 cm of width of skin is required to reconstruct a 3 cm inner diameter of the oesophagus. The length of the skin tube is decided by the required length of the oesophagus. In our case we used a 12 cm long tube.

For maxillary and palatal reconstruction a pattern of defect has to be taken very carefully after cancer extirpation and a bilobed flap - one for the palate and the other for the lateral nasal wall, is planned on the proximal forearm and its position in relation to the vascular pedicle after immobilization of the limb is rehearsed by planning in reverse otherwise it may be very difficult to fit in the flap into the defect rightly.

For nasal reconstruction the skin pattern for the nasal cover is identical to the old conventional patterns where the length of the pattern from the bridge of the nose to the tip is kept to be 6 cm; from tip of the nose to the columellar base to be 4 cm and a similar length is used for the tip to the alar base. For the lining of the nose a pattern of slightly smaller size than the skin is used and is kept next to it on the side and in continuity with the nasal cover.

In tripod reconstruction of the hand the technique of "Symbiosis of flaps" was used for the first time and in this a skin pattern of 4 cm in width and 8 cm in length was so placed on the line of the vessels that a vascular pedicle of at least 8 cm is available distal to the skin pattern and about 6 cm proximal to the skin pattern. Distal length is used to rotate the flap to the thumb on the fixed point of the distal wrist. Proximal length of the vessels is used for the easy anastomosis of the vessels of the toes which are going to be transferred based on these vessels. For other combinations and possibilities which this technique promises, any size of radial forearm flap in combination with any other free flap can be used or several other reconstructive problems and 6 cm of the length of vessels proximal to the skin pattern is not a must.

Since the skin over the distal third of the forearm is not recommended for use, owing to the fear of exposure of tendons and delayed wound healing, this part of the limb is used to harvest the vascular pedicle. Almost 10 cm of the vascular pedicle could be developed.

All flaps are raised under tourniquet. Single tourniquet time of 90 minutes is generally enough however in the initial flaps we did require more time for flap elevation. In these flaps the tourniquet was released for 15 minutes and then reinflated for the maximum second period of 90 minutes, (total time of 3 hours).

Flap elevation is begun from any of the borders of the forearm and having tagged the deep fascia with the dermis the fasciocutaneous flaps are undermined toward the septum that lies between the brachioradialis and the flexor carpi radialis. Brachioradialis is identified as the most developed muscle belly of all. Flexor carpi radialis is much sleeky and is not difficult to identify. However if it is found difficult the vascular pedicle should be dissected first and traced proximally, which invariably leads to the septum. For the exposure of the radial artery and the cephalic vein (which we include in all our flaps for added safety) a straight or a zig zag incision located between the two is placed and both sides skin flaps are undermined close to the dermis. Some fibrofatty tissue is left intact surrounding the vessels and at no stage the vessels are di-

rectly handled by any instruments. Fibrofatty tissue is always used for handling of the vessels. This avoids vascular spasm which could be very trouble some. At the junction of the distal and middle third of the forearm the radial artery runs stuck close to the undersurface of the brachioradialis tendon and it is here a knife is used for dissection running tangentially on the under surface of the tendon. Rest of the dissection is carried on by the help of Kilners dissecting scissors.

Proximally the vessels run in greater depth in males than in females since the muscle bellies are well developed. In females more fat is seen surrounding the vessels specially near the junction of the bifurcation of the radial and the ulnar artery. This bifurcation is commonly seen between 2 to 3 cm below the elbow joint crease line but we have seen it as low as 6 cm and beware the young surgeon to keep this anomaly in mind. Division of radial artery then has to be performed at a much lower level than expected. It however does not harm the flap.

Radial nerve is saved by separating it from the septum. This is easily performed by running a scissors longitudinally close to the nerve. When a neurosensory flap has to be raised the median antebrachial nerve is identified entering the flap in almost in the middle of the forearm in the subcutaneous tissue when the proximal skin incision for the flap is made. If additional length is required then the incision is carried on the arm in the direction of the nerve and nerve harvested.

When brachioradialis is to be included with the flap (myo-fasciocutaneous flap) then the perforators entering the muscle belly from the radial artery are kept intact and the dissection is carried deeper to them and to the muscle belly which is separated circumferentially. At least two well defined perforators of good size are identifiable. This muscle could also be used for active motor unit transfer and in that case the branch of the median nerve entering the muscle belly is to be preserved.

Having raised the flap the displayed muscled bellies are approximated by cat-gut stitches. The retracted skin edges are retrieved and catgut stitches are applied between the dermis and the muscle fibres to hold them in their normal position and donor area of the forearm is skin grafted. The incision over the distal forearm is closed. Now the vascular pedicle which is only attached at the most radial side of the distal part of the wrist, is wrapped in a sheet of split thickness skin graft. Few tagging stitches are applied on the either end to hold the sheet in place. The flap is now ready for the transfer.

Donor limb is brought to the recipient site in most comfortable position and the inset of the flap completed which is almost 100 %. The limb is immobilized using elastoplast or plaster of Paris fixation.

Post operatively this flap behaves just like a free flap and becomes markedly oedematous. However the capillary filling and the colour are maintained. If all is well then on 7th day a soft clamp of transparent PVC sheet which has been designed for the purpose is applied. The condition of the flap and the pedicle is assessed during next day morning round and the screws of the clamp are further tightened. This is repeated every day until on the 10th day in the dressing room a thick silk ligature is applied on the pedicle on the either side of the clamp and clamp removed. A knife is run on the site of the clamp and after removing the elastoplast fixation the limb is separated. On the next operation day the ends of the pedicle are revised under local anaesthetic. During our earlier case when the clamp was not designed we used to tie a dry gauze around the pedicle loosely initially and tightened the knot every day. Since the immobilization is for a very short period of 10 days there is hardly any discomfort over the joints involved on releasing the immobilization and therefore separation of the limb without any anaesthetic in the dressing room is quite reasonable.

Finger movements of the hand are not allowed for first 10 days since the contraction of

the muscle fibres may cause graft loss. Active and passive physiotherapy of all the joints in the limb is instituted once the graft is well taken usually from the 10th day. From now onward compression garments are used on the donor and the recipient area of the flap for atleast 3 months and if need be more. This is important in asian patients where grafts contract vigorously and scars hypertrophy. Additionally it contours the flap so well there no defatting procedures are required later.

During first 4 to 6 weeks diminished power in the forearm muscles is experienced by the patient owing to extensive dissection and mobilization of the muscle bellies but this gradually improves and should not be of concern. When the skin has been harvested right up to the elbow joint crease restricted extension at elbow joint is noticed for few weeks and that recovers with compression garments active and passive.

Aesthetic appearance of the forearm is like a skin grafted area any where else. With compression and massage this improves consistently and in next 6 months time it is acceptable. For extensive reconstructions of face which dictates the personality of the patient and his future life pattern, the price paid is negligible.

Case 1

A 19 year old male patient was admitted on 2nd of October 1989 having sustained severe homicidal acid burn to his face on 1st of January 1989. On admission (Fig. 1, 2) he was found to have ectropion of both the upper lids, severe ectropion of left lower eyelid and extensive disfiguring scarring of almost all his left lower face extending on to the neck and to the nose. Left eye brow too was lost in the burn. Additionally he had corneal opacity on left eye.

On 27th of October both upper lid ectropions were released and skin grafted. At the same sitting that part of the radial forearm flap that was planned for resurfacing the face which extended beyond the radial and ulnar borders of the forearm was delayed by undermining the flap in the plane deep to the deep fascia up to the radial and ulnar border and stitched back.

One week later entire fibrous tissue from the face was excised and the pull on various organs were released until they set to their normal position. This opened up an area as expected as large as 18x22 cm (Fig. 3, 4). The radial forearm flap of the similar size was then raised on a 5 cm long vascular pedicle and was transferred to resurface the face by extracorporeal method, (Fig. 5, 6) using position "C" for immobilization with the help of elastoplast. Post operative course was uneventful. On 5th day alternate and on 7th day all the stitches were removed. On 10th day a week plastic clamp was applied which was tightened every day for next 4 day. On 15th day the pedicle was excised, and both the ends were revised, and the limb was separated. Compression garments were worn for next 3 months and that resulted in a very acceptable contour and colour match (Fig. 7, 8).

Case 2

A 17 years old young boy was admitted on 1st of February 1988 having suffered deep burns on his lateral aspect of left leg after application of some home made medicaments for a long standing dermatitis in that region. He had a thick layer of dried crust of the medicine on a equally thick layer of eschar (Fig. 9).

Excision of this burn eschar exposed a large area on the lateral side of the leg with bare peroneal tendons and bare tendoachilis on its lateral aspect.



Figure 1 & 2. Pre-operative view following post-acid disfiguration of the face



Figure 3 & 4. Per-operative facial view showing extent of excision of burn scarring



Figure 5. Distally based radial forearm flap of 18x22 cm size was raised on a 5 cm long vascular pedicle



Figure 6. Extracorporeal transfer of the radial forearm flap. Notice the vascular leash wrapped in a sheet of split thickness skin graft entering the flap in the submandibular region



Figure 7 & 8. Post-operative appearance of the completely rehabilitated patient three months after the reconstruction

A radial forearm flap of 10x22 cm was harvested from the left forearm and was transferred as free flap by anastomosing radial artery end to side to the anterior tibial artery one venae communitentis of the radial artery was anastomosed end to end to the one of the anterior tibial artery and the cephalic vein was anastomosed end to end with the great saphenous vein (Fig. 10, 11).

His post operative course was uneventful and complete flap survived. Two years later when he was last seen he had nice contour and colour match on the leg (Fig. 12).

Case 3

A 13 years old female child lost her complete scalp including complete forehead both the eye brows and part of both upper lids through an avulsion injury which took place in a village in march 1989. Since scalp was not brought for replantation and pericranium was intact entire area was skin grafted (Fig. 13, 14, 15).

In December 1989 she was readmitted for the definitive reconstruction of her forehead. A flap of 10x21 cm size on a extracorporeal pedicle of 5 cm was required and therefore some skin had to be harvested from the distal arm (Fig. 16). Therefore on 19th Jan. 1989 the area on the arm in continuity with 3 cm below the elbow joint crease line on forearm was delayed by incising the flap and undermining in the plane deeper to the deep fascia and restitching it. On 2nd of February 1990 all the graft from the forehead was excised and the area covered by an extracorporeal radial forearm flap of 10x21 cm size on 5 cm long vascular leash by fixing the limb in modified position "A" with the help of elastoplast.

Postoperative course was uneventful and complete flap survived. Alternate stitches on 7th day and all stitches on 10th day were removed. Soft clamp was now applied and tightened every day until 15th day when the pedicle was excised and the limb was separated.

Compression garments for next 3 months resulted in a perfect colour and contour match (Fig. 17, 18).

DISCUSSION

Radial forearm flap is one of the choicest flaps used today by most reconstructive surgeons and its use is ever increasing. No doubt the simplicity of execution, surity of survival and the quantity and the quality of the tissue transferred are some of factors responsible for its universal popularity.

When ever the requirement dictates a thin pliable hairless skin such as in head and neck and in hand the surgeons choice goes for this option. Author had several additional reasons for its selection. One overriding factor was that in large number of patients treated there was a massive defect to reconstruct as is obvious by the mean size of the flap to be 180 sq. cm and over 42 % of the flaps were over 200 sq. cm in size and in 77.5 % of patients it was well over 100 sq. cm. Concerning such size requirements only radial forearm flap was most readily available. All these defects required a fasciocutaneous flap. Using almost all the forearm in three patients it was possible to reconstruct defects as large as 18x25 cm.

Another strong reason for it's selection was that in 42.5 % (17 patients) the reconstruction was called for facial, head and neck defects and for intraoral purposes where the requirements are for a thin pliable and hairless skin. This flap resulted in excellent colour and texture match for facial reconstructions. In this group all but one flap was transferred by extracorporeal technique and failed in none.

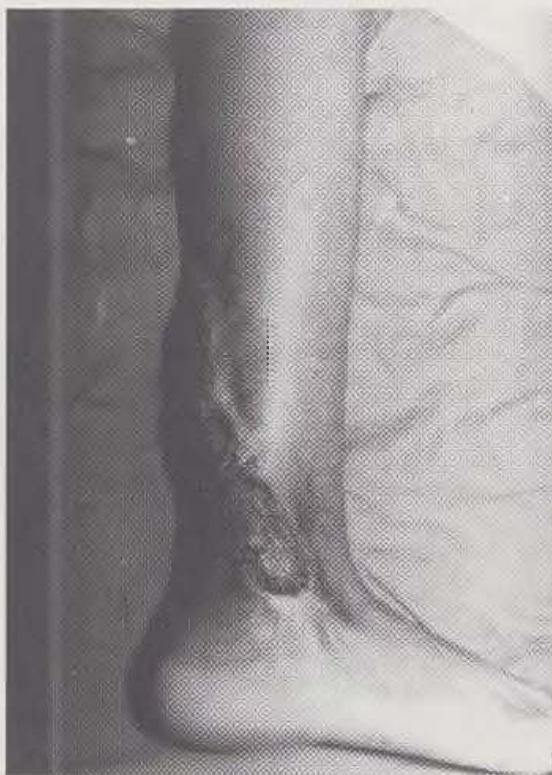


Figure 9. Pre-operative appearance of the leg after full thickness burn of iatrogenic origin

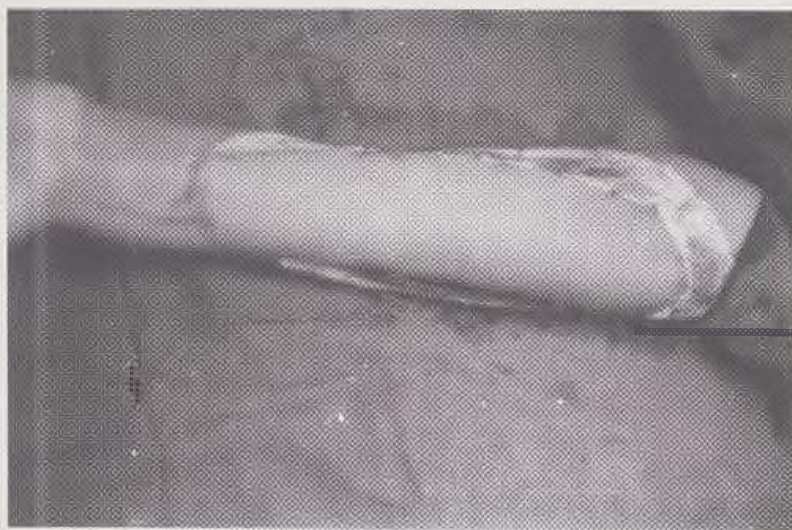


Figure 10. Free radial forearm flap during elevation

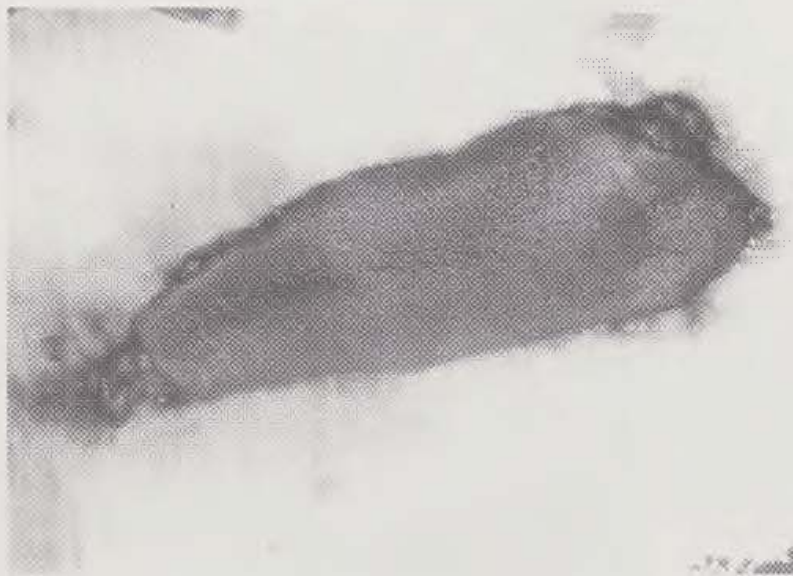


Figure 11. Close-up view of the free radial forearm flap

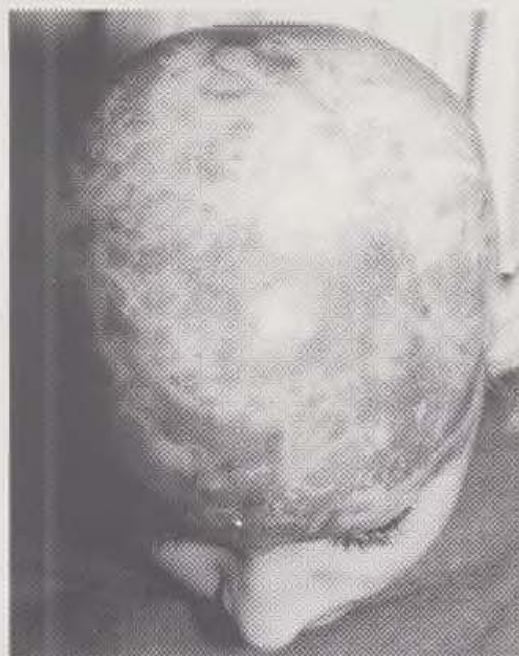
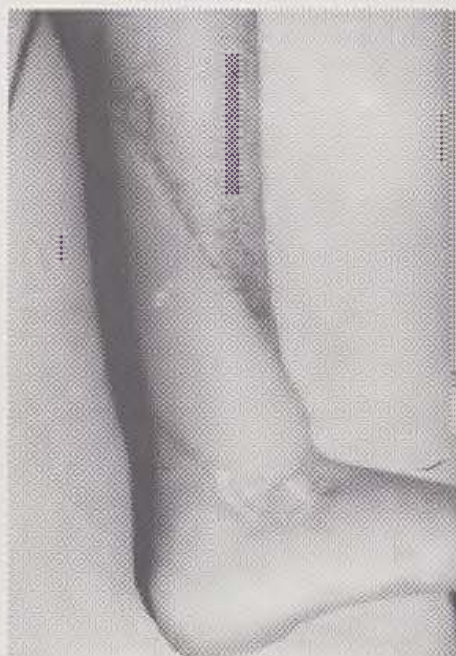


Figure 12. Post-operative view of the leg after 2 years of free radial forearm flap transfer
Figure 13. Complete scalp avulsion in a 13 years old girl which was unfit for replantation and was skin grafted (three months after the skin grafting)



Figure 14. Pre-operative profile view to show the anterior extent from the eyebrows to the nape of neck posteriorly



Figure 15. Posterior view of the grafted cranium

One additional reason for its selection was in patients with difficult reconstructions and where with either other methods some risk of failure was involved, such as for penile reconstruction or where other methods of reconstructions were not available such as in oesophageal reconstruction.

Use of this flap in lower extremity where all flaps survived completely (5 patients) helped improving the vascularity of the limb treated cured the pathology and provided an excellent contour to the leg.

Where some odd combinations of tissue such as muscle to fill the maxillary cavity but a soft and thin flap for palatal part of the same defect, radial forearm flap was a logical selection where brachioradialis filled the cavity well and the fasciocutaneous component provided a good tissue for the palate. This myo-fasciocutaneous radial forearm flap has not been described in the past. Since brachioradialis has been used in the past for active motor unit transfer and therefore is dispensable and we used it. It caused no significant morbidity to the patient.

For total penile reconstruction the requirements are that the organ should be aesthetically decent in size shape colour and texture, it should be firm in its resolve and possesses a functioning urethra and if possible should have some kind of sensations. At least the potential for orgasm felt in the depth of the perineum should be present. Most of the aesthetic requirements are met by fabricating the organ over forearm before its transfer where the surgeons and the patient can satisfy themselves and if need be minor procedures could be performed before its transfer to pubic region.

Similarly the oesophageal reconstruction for suicidal acid burn of the oesophagus in a young girl when other methods of reconstruction failed including colonic pullthrough and where free jejunal transfer was not possible because of severe intra-abdominal adhesions following multiple surgeries ECTT RFF was a handy answer and reconstructed organ survived completely. This further proves that it's a hardy flap and survives most adverse situations such as intra-cervical and intrathoracic congested areas of the body. Although this patient was lost 6 weeks after reconstruction because of irreversible shock which was precipitated after prolonged diarrhoea and metabolic imbalance.

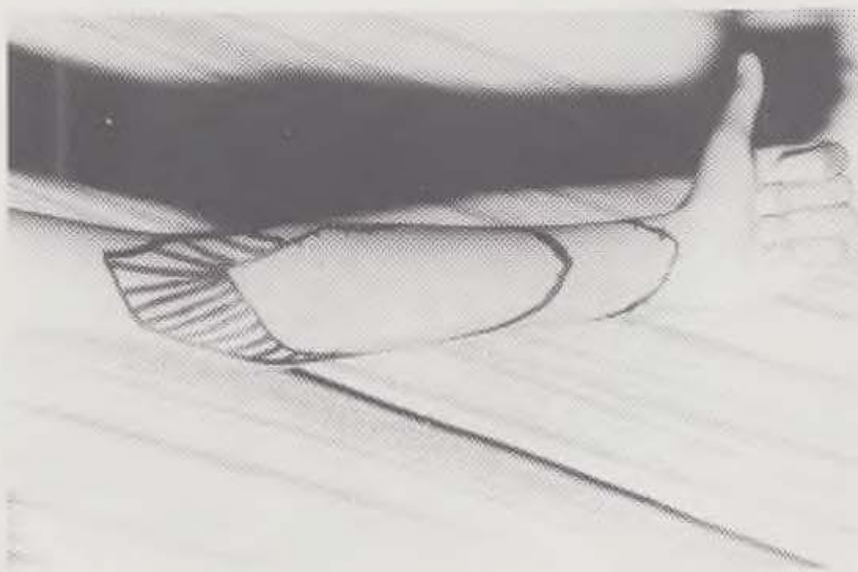


Figure 16. Radial forearm flap (10x21 cm) marked over the arm and the forearm for ECTT. Stripped area was delayed

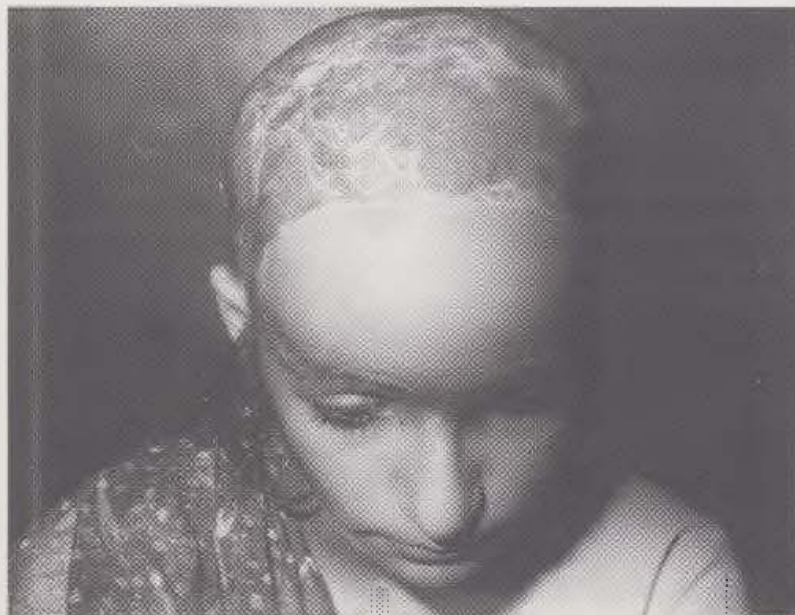


Figure 17 & 18. Three months after the extracorporeal radial forearm flap transfer

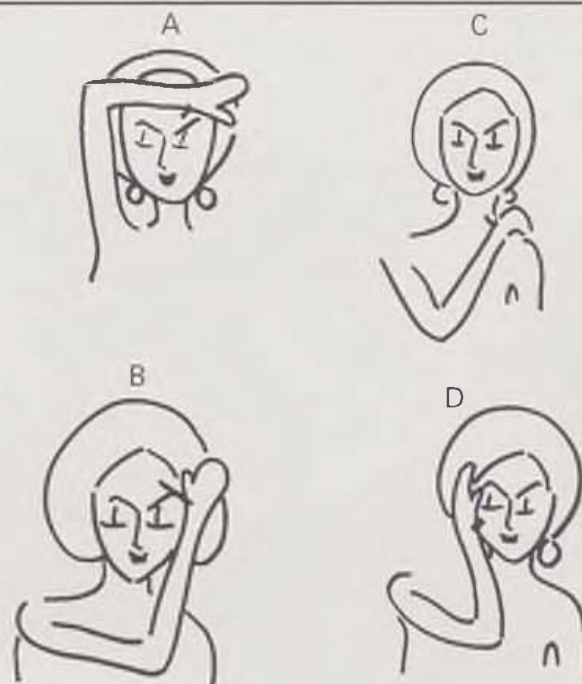


Figure 19. Drawing to show various positions used for immobilization

The flap provided a one-stage neurosensory reconstruction in the upper extremity and proved a good choice. Its use in case 32 raised a concept of "symboiosis of flaps" in reconstruction which is worth noticing. A distally based RFF on a retrograde blood flow was used to reconstruct thumb in a severely mutilated digitless hand and in the same stage two toes were transferred to this hand by using ends of the vessels of the radial forearm island flap, to reconstruct a tripod hand in a single stage. The arterial blood flow of the RFF supplied oxygenated blood to the composite tissue (great toe wrap around and complete second toe) and drained venous blood while the offshoot flap (toes) helped RFF by allowing through and through circulation in the flap which is always considered better for flap survival. This mutualism can only be termed as "Symbiosis" however any other suggestions about this terminology are welcome. This assemblage may find great many combinations of tissues in future and help the discipline in a unlimited manner.

The use of the flap for hard palate, oronasal and laryngopharyngeal reconstruction and for post maxillectomy defects adds another dimension to its use in the areas of difficult approach. Its interesting to note that the flap over the palate did not hang in the mouth and restored the speech to normal. In both the cases performed no revision or defatting of the flap was needed.

Its use as a bilobed flap and flaps with holes and cuts (patient, 13) for reconstruction of nose and upper lip is worthy of note. Not many flaps can boast this potential and therefore it finds a great place when three dimensional reconstruction is required such as for the nose.

Also the use of RFF ECTT in cases of HVEB primarily, delayed primarily and secondarily has a merit where the vascular damage to the surrounding tissue does not allow local or regional tissue to be utilized and distant tissue is the only answer.

On critical analysis of the Table 1 following facts surface.

1. Fasciocutaneous element of the RFF is very reliable.
2. Fascia alone is not a good choice since it may have patchy areas of necrosis although it leaves almost no donor area scar.

3. Radial forearm myo-fasciocutaneous flap using brachioradialis muscle is yet another innovation and dimension added to this flap in this work which may find greater use in future. No loss of function was observed in the donor limb.
4. Tubed RFF ECTT flaps with skin side out (Penis) and with skin side in (Oesophagus) are viable propositions since both have served their purpose well and has a simplicity of execution and reliability of results.
5. Bilobed flaps survived without difficulty and are of good use in difficult circumstances.
6. Prefabrication of organ to provide decent shape size and firmness such as for nose and penis is possible using this flap and its further use in future should be explored.
7. For reconstruction of sole of foot and for hand this flap is a good neurosensory option.
8. For leg the flap has added vascularity to the limb when used as a free flap, it treats the pathology which is commonly because of avascularity in the traumatised limb, and provides a perfect contour to the limb.
9. Immobilization for a period of 10 days was well tolerated by patients of all age group.
10. Soft plastic clamp designed for the purpose is a useful appliance and its transparency helps in visual monitoring of the effects of local pressure on the pedicle.
11. It is possible to use all the skin of the forearm as a flap.
12. Satisfactory cosmetic and functional forearm resulted at the end of 6 months after surgery even when most of the forearm skin has been used.
13. Compression garments helped all cases significantly, by achieving normal contouring avoiding suture line hypertrophy and graft contraction in the donor forearm.
14. No neurotrophic or vascular changes were observed in the donor limb.
15. Concept of "Symbiosis of flaps", put forward through patient 32 requires more investigative work however at the time of writing it seems to have potential for great use in future if this theory could be proved.
16. No doubt the flap has multifarious dimensions.

SUMMARY

Radial forearm flap has been increasingly used universally and is now a routine in most plastic surgery units. We developed the technique of Extracorporeal transfer of this flap for the benefit of those who do not have approach to the microsurgical methods. We at the same time used it as an Island flap and as a free flap depending upon the requirements and the feasibility of its transfer. Since 1985 till now we have used 40 such flaps for a variety of defects, such as for head and neck reconstruction including that of maxilla, for intraoral reconstructions, upper and lower extremity reconstruction, penile and oesophageal reconstructions. We present our experience of past 6 years on 40 flaps.

RÉSUMÉ

**Lambeau prélevé sur le côté radial de l'avant-bras:
expériences avec un procédé exceptionnel**

Govila A.

Le lambeau prélevé sur le côté radial de l'avant-bras est utilisé de plus en plus dans multiples applications et représente une méthode de routine dans la plupart des centres de la chirurgie plastique. Nous avons élaboré une technique de transfert extracorporel de ce lambeau afin que cette technique soit à la

porté de tous ceux qui sont privés d'accès aux méthodes microchirurgicales. Nous l'avons simultanément employé, en fonction des exigences et des possibilités de transfert, comme lambeau en îlot et lambeau libre. Depuis 1985 jusqu'ici, nous avons utilisé ce lambeau 40 fois pour les défauts différents, comme reconstruction sur la tête et le cou, y compris le maxillaire, pour des reconstructions intra-orales, reconstructions des membres supérieures et inférieures, du pénis et de l'oesophage. Nous présentons nos expériences collectives avec 40 lambeaux effectués dans la période de 6 années dernières.

ZUSAMMENFASSUNG

Der radiale Unterarm-lappen: Erfahrungen mit einer besonderen Technik

Govila A.

Ein radialer Lappen des Unterarms wird ständig häufiger angewandt und ist derzeit zu einer routinemässig applizierten Methode auf den meisten Abteilungen für Plastische Chirurgie geworden. Die Technik der extrakörperlichen Applikation und Übertragung dieses Lappens in Abteilungen in den mikrochirurgische Verfahren nicht angewandt werden können. Dieser Lappen wurde gleichzeitig als ein Insel-Lappen und zu freier Übertragung verwendet, die von den Bedürfnissen und der Durchführbarkeit der Transplantation abhängig waren. Von 1985 bis zur heutigen Zeit wurden 40 radiale Lappen bei einer Reihe von verschiedenen Defekten angewandt, z.B. zur Rekonstruktionen am Kopf und am Hals, einschliesslich des Oberkiefers, ferner auch bei Rekonstruktionen in der Mundhöhle, an den oberen und unteren Extremitäten, bei Rekonstruktionen von Penis und Oesophagus. Es wird über die Erfahrungen mit 40 Lappen in den vergangenen 6 Jahren berichtet.

REFERENCES

1. Yang G., Chen B., Gao Y., Liu X., Li J., Jiang S., He S.: Forearm free skin flap transplantation. Natl. Med. J. China, 6: 139, 1981.
2. Souter D. S., Tanner N. S. B.: The radial forearm flap in the management of soft tissue injuries of the hand. Br. J. Plast. Surg., 37: 18, 1984.
3. Foucher G., Von Genechten F., Merle N., Michon J. A.: Compound radial artery forearm flap in hand surgery: An original modification of the chinese forearm flap. Br. J. Plast. Surg., 37: 139, 1984.
4. Reid C. D., Moss L. H.: One stage flap repair with vascularized tendon grafts in dorsal hand injuries using the "chinese" forearm flap. Br. J. Plast. Surg., 36: 473, 1983.
5. Biemer E., Stock W.: Total thumb reconstruction: A one-stage reconstruction using an osteocutaneous forearm flap. Br. J. Plast. Surg., 36: 52, 1983.
6. Muhlbauer W., Herndl E., Stock W.: The forearm flap. Plast. Reconstr. Surg., 70: 336, 1982.
7. Govila A.: Island flaps for distant defect on extracorporeal vascular pedicle. Paper presented at the meeting of British Association of Plastic Surgeons, Durham, England, July 13-15, 1988.
8. Govila A.: Non microsurgical extracorporeal distant tissue transfer. Eur. J. Plast. Surg., 12: 99, 1989.

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„SYMBIOTIC TISSUE TRANSFER” - A NEW CONCEPT IN RECONSTRUCTIVE PLASTIC SURGERY

A. GOVILA

This work has been presented during first combined meeting of British Society for Surgery of the Hand and the Indian Society for the Surgery of the Hand, between 15-17th of November 1991 held at Goa, India

The term symbiosis has been defined as “The biological association of two individuals depending on the advantages derived from the relationship” by the Dorland’s Medical Dictionary. While the Collins English Dictionary defines it as “A close association of two animal or plant species that are dependent on one another”.

Reconstruction of a metacarpal hand by meand of transfer of two composite block of tissue (flaps) in such a manner that both survive on each other has been termed as “Symbiosis”, in this work. The concept of “Symbiosis tissue transfer” is a new one and will need greater study in future. However a preliminary report is presented.

This hypothesis of symbiosis has been utilized to great advantage for a single stage reconstruction of a tripod hand in an 11 years old male child who sustained a transmetacarpal amputation of right hand following trauma and lost all his fingers and thumb at the level of the heads of the metacarpals. The concept has helped us to sculpture a three dimensional organ (three fingers) in a single operation, which in this uneducated and underdeveloped area is highly desirable.

TECHNIQUE

It involves use of two or more flap interconnected in series. One of the flaps out of the two has to have a vascular system that runs through the entire length of the flap such as type C flaps of Cormack and Lamberty, as one primary block of tissue, secondary block of tissue, could be any island flap, of any type and of any composition. If more than two tissue blocks are to be united then primary and secondary tissue blocks should also be type C fasciocutaneous flaps and only the tertiary tissue block could be an island flap.

These flaps (tissue blocks) are interconnected (united) by anastomosing the terminal vessel ends of the primary flap to the feeding vessels of the secondary flaps. When more then two flaps are connected then arterial supply passes through first (primary) and the second (secondary) flap to terminate in the third (tertiary) flap. Return venous drainage takes place through the second and the first flap (Fig. 9).

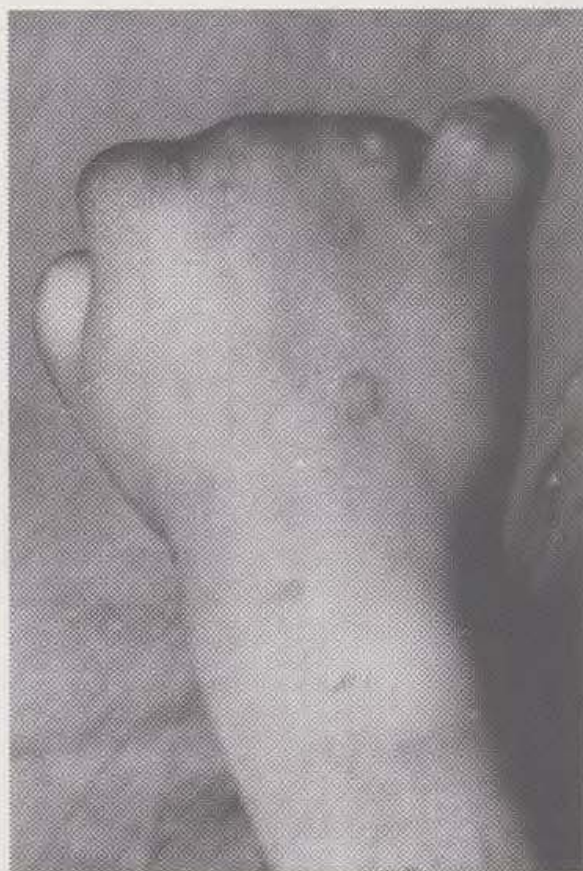


Fig. 1. Transmetacarpal amputation of right hand in a 11 years old boy

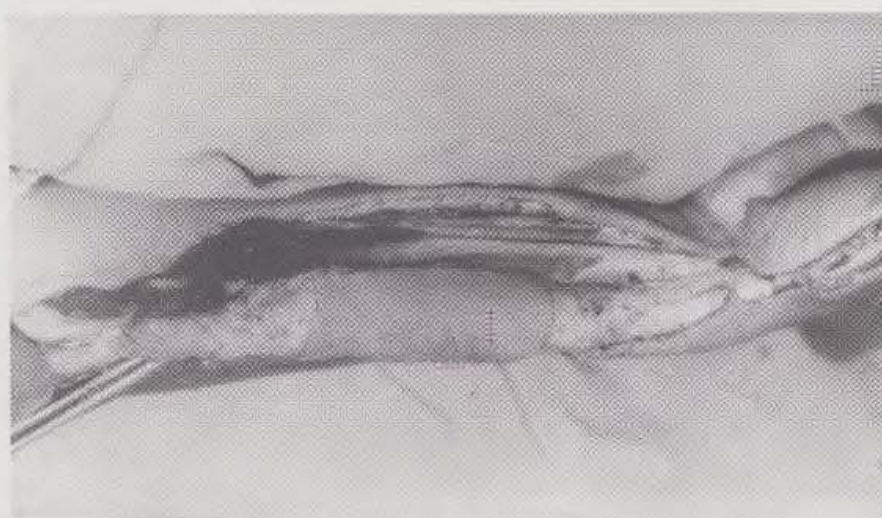


Fig. 2. Radial forearm flap (5x10 cm) is raised. Notice extra length of vessels harvested proximally

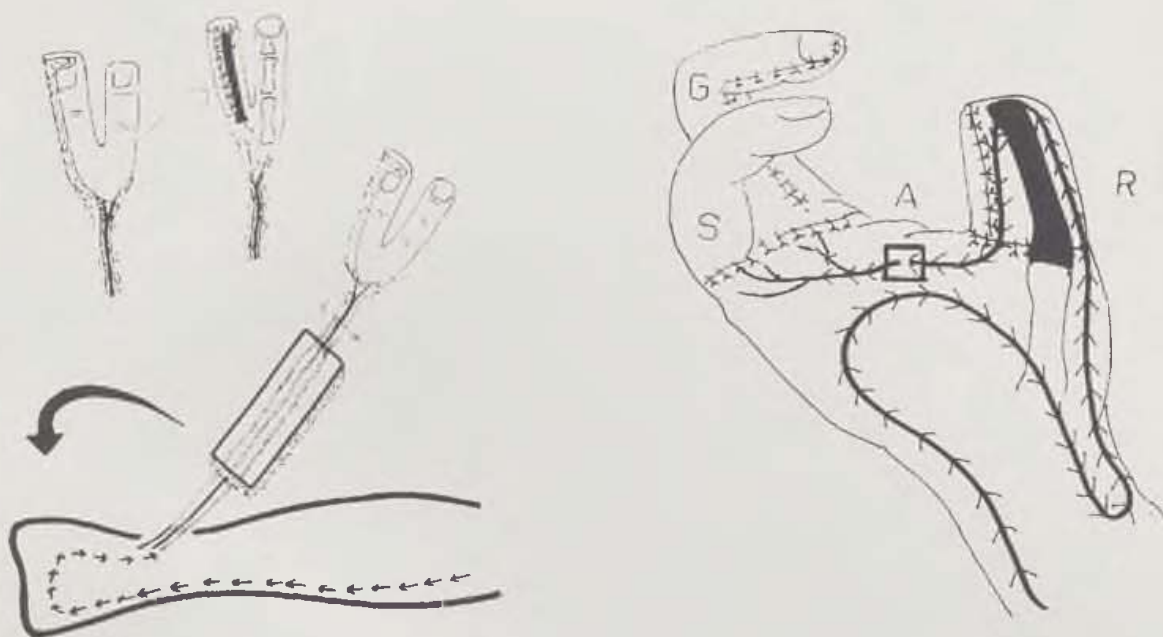


Fig. 3. Schematic drawing to show the method of assembly of various tissue components

Fig. 4. Schematic drawing of assembled tripod hand. R = Radial forearm flap,

G = Great toe, S = Second toe, A = Site of anastomosis.

Shown by a Square. Rearranged vascular anatomy is marked by arrows



Fig. 5. Immediately on the table, after completing the assembly

CASE REPORT

An 11 years old boy sustained a trasmetacarpal amputation with loss of his all the fingers of right hand and thumb while working on an electrical hay chopper (Fig. 1).

On 5th of February, 1991 with the patient under general anaesthesia and under tourniquet the big toe skin-nail flap (wrap around) and the complete adjacent second toe were harvested from right foot, based on dorsalis pedis artery, great saphenous vein and the common planter digital nerve, simultaneously, the second team raised a distally based radial forearm flap of 5x10 cm on the same forearm (Fig. 2).

A distally based radial forearm flap was so designed and raised on the forearm that the radial artery ran under it longitudinally in the center of the flap. Radial artery and venae comitantes were additionally dissected proximal to the flap for a distance of about 8 cm so as to provide extra length to the pedicle for anastomosis. Medial antibrachial nerve was harvested proximally to the similar distance.

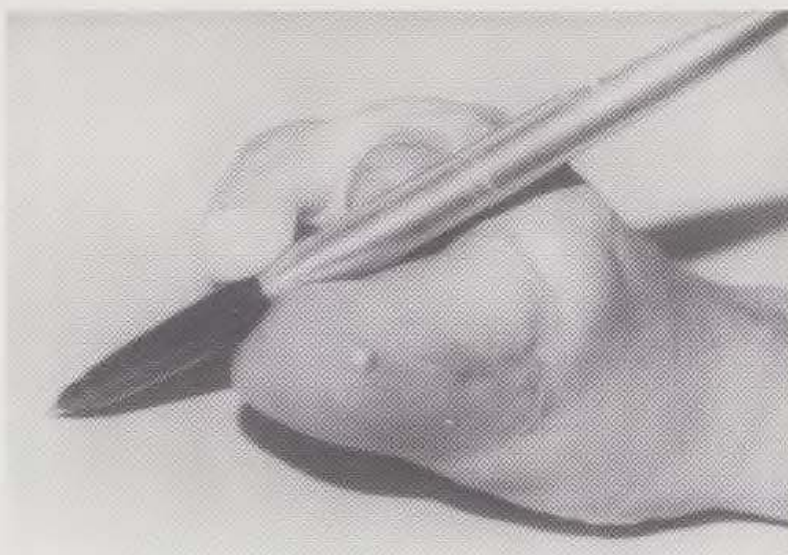


Fig. 6. Post operative result showing ability to write

Assembly of the various tissue components (Fig. 3, 4, 5) began by osteosynthesis of bone grafts for the skeletal support of the thumb and the wrap around digit to be placed on the fourth metacarpal. Half of the second metacarpal of the same hand, after splitting it longitudinally was used for this purpose. Now the radial forearm flap was swung to 180 degrees to reach the bone graft of the thumb and was wrapped around it to reconstruct the thumb. The terminal end of the radial vascular bundle was now made available on the dorsum of the hand. Medial antibrachial nerve was however left on the palmer side for co-optation with the common digital nerve of the thumb. Great toe segmental skin nail flap was wrapped around the bone graft for the third digit of the tripod hand under construction. Interosseous wiring and the "K" wire fixation were used for osteosynthesis. Second toe was now fixed to the fifth metacarpal and the joint capsule was repaired. Extensor tendon of the second toe was then connected to the extensor tendon on the little finger.

Dorsalis pedis artery was anastomosed end to end to the terminal end of the radial artery at the most distal end of the radial forearm island flap. Great saphenous vein was anastomosed end to end to one of the venae comitantis of the radial artery.

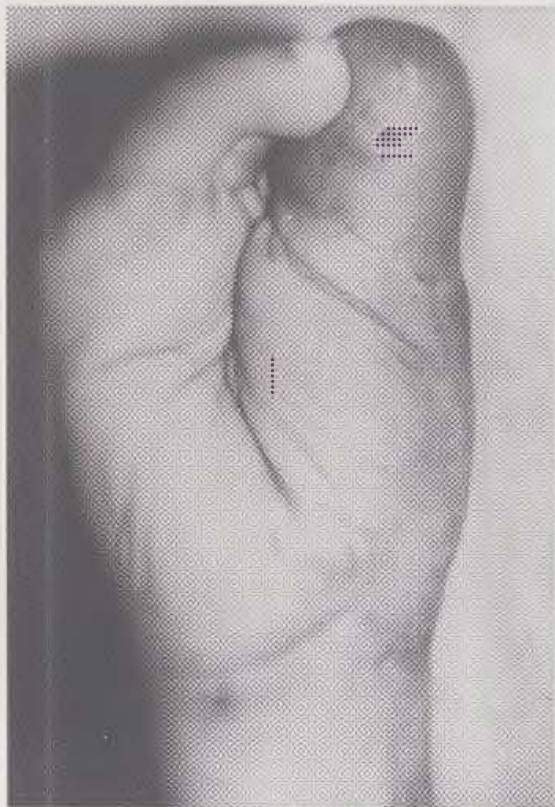


Fig. 7. Post operative result showing end to side pinch

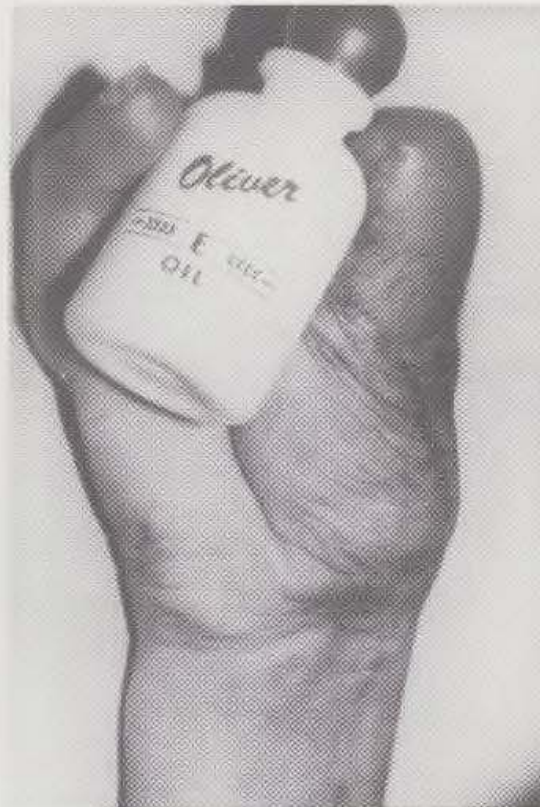


Fig. 8. Post operative result showing grasp



Fig. 9. Schematic drawing to illustrate the hypothesis of symbiotic tissue transfer

Except for the superficial necrosis of the terminal part of the great toe wrap round, which caused loss of pulp, that was removed and stump closed, post operative course was uneventful.

Nerve co-optation for thumb and two digits, between digital nerve of thumb and medial anterior tibial nerve and common planter nerve and common palmer nerve was carried on secondarily 3 months later. Similarly flexor tendon repair was performed secondarily 3 months later.

"K" wire pin fixations were removed after three weeks. Physiotherapy was instituted by passive mobilization of the joints of the 2nd toe. After 3 weeks of secondary tendon repair active physiotherapy was begun. Nine months later after the reconstruction, patient had good pinch (Fig. 6, 7) and grip (Fig. 8) and protective sensation in the reconstructed part.

DISCUSSION

Traumatic amputation of all the digits of one or both the hands is not uncommon since in attempt to save one hand the other is feed into the machine and both fall victim to the misfortune. Reconstruction in such a hand at its best at present can only be aimed to provide useful function since aesthetically totally acceptable reconstructed hand has so far been a dream of a hand surgeon, although in pursuation of this aim five toes (three from one and one from the other) have been transferred (Yu Zhong-Jia, 1987), but even this has its cosmetic limitations since the toes do not possess the same length and the look as the fingers.

Reconstruction of two digits in addition to a thumb creating a tripod hand in a digitless hand is considered sufficient to restore essential function such as pinch, grasp, and hook (Yu Zhong-Jia, 1987). To achieve this aim, osteoplastic methods of reconstruction is a story of bygone days. Use of distally based radial forearm island flap for the reconstruction of the thumb has been reported and is routinely performed at several centers. We reported the use of extracorporeal radial forearm flap for the reconstruction of several digits (Govila et al, 1990).

At microsurgical centers the story is different. Using microsurgical methods total and segmental hallux transfer (Cobbett, 1969; Buncke et al., 1973; O'Brien et al., 1975; May and Daniel, 1978) has been performed which could be supplimented by transplantation of second and the third toes (O'Brien et al., 1978; Tsai, 1979; Tsai et al., 1981; Biemer, 1984) to reconstruct a tripod hand. But sacrifice of three toes from foot in an Asian Patient is a significant disability since wearing of slippers (Hawai chapals) is not possible without a great toe. Therefore, patients refuse to consent for such a procedure. The technique presented evolved because of these limitation.

The hypothesis of symbiosis is an interesting one. The first flap is feeding arterial blood to the second flap for the survival of the later. And in return the second flap is feeding venous blood to the first (Fig. 9). Because of this venous rearrangement the first flap has been provided with a through and through venous circulation. Which is bound to do better then otherwise. This helps avoiding venous troubles and the resultant tissue loss in the first flap which in turn is the cause for the survival of the second flap.

This "cycle of symbiosis" between two flaps continues to build among other flaps as well, when more then two flaps are thus connected and flaps continue to help each other. Using this principle it should be possible in future to transfer large amounts of tissue for extensive defects.

SUMMARY

A new hypothesis of "symbiosis" in reconstructive surgery is introduced, which has been used for single stage reconstruction of a metacarpal hand. The concept, technique and its use, along with it's merits are detailed.

RÉSUMÉ

Transfert symbiotique des tissus - nouvelle conception en chirurgie plastique reconstructrice

Govila A.

Une nouvelle hypothèse de la "symbiose" en chirurgie reconstructrice, appliquée pour une reconstruction à un temps de la main, après l'amputation de tous les doigts. Conception, technique et application aussi que les avantages sont décrites.

ZUSAMMENFASSUNG

"Symbiotische Übertragung der Gewebe".

Ein neues Konzept der Rekonstruktion in der plastischen Chirurgie

Govila A.

Ein Bericht über die Hypothese einer "Symbiose" bei der chirurgischen Rekonstruktion. Diese Methode wurde bei der chirurgischen Rekonstruktion der Hand in einer Etappe, nach der Amputation der Finger, angewandt. Eine eingehende Beschreibung des Konzeptes, der Technik und günstigen Ergebnisse und Vorteile.

REFERENCES

1. Yu Zhong-Jia: Reconstruction of a digitless hand. *J. Hand. Surg.*, 12 A (2Pt 1): 726, 1987.
2. Govila A., Sharma D.: The radial forearm flap for reconstruction of upper extremity. *Plast. Reconstr. Surg.*, 86: 920-927, 1990.
3. Cobbett J. R.: Free digital transfer: Report of a case of transfer of a great toe to replace an amputated thumb. *Br. J. Plast. Surg.*, 51 B: 677-679, 1969.
4. Buncke H. J., McLean D. H., George P. T., Creech B. J., Chater N. L., Commons G. W.: Thumb replacement: Great toe transplantation by microvascular anastomosis. *Br. J. Plast. Surg.*, 26: 194-201, 1973.
5. O'Brien B. McC., MacLeod A. M., Sykes P., J., Donaboe S.: Hallux to hand transfer. *Hand*, 7: 128-133, 1975.
6. May J. W. Jr., Daniel R. K.: Great toe to hand free tissue transfer. In: Lucas G.(ed): *Clinical orthopaedics and related research*. J. B. Lippincott, Philadelphia No. 133, p. 140-153, 1978.
7. O'Brien B. McC., Brennen M., MacLeod A. M.: Simultaneous double toe transfer for severely disabled hand. *Hand*, 10: 232-240, 1978.
8. Tsai T. M.: Second and third toe transplantation to a transmetacarpal amputated hand. *Annals of Academy of Singapore*, 8: 413-418, 1979.
9. Tsai T. M., Jupiter J. B., Wolf T., Atasoy E.: Reconstruction of severe transmetacarpal mutilating hand injury by combined second and third toe transfer. *J. Hand Surg.*, 6: 319-328, 1981.
10. Biemer E.: Second and Third toe "en bloc" transfer. In: Buncke H., Furnas D.(eds): *Symposium on clinical frontiers in reconstructive microsurgery*. C. V. Mosby, St. Louis, 1984.

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PREFABRICATION OF A SKIN AXIAL FLAP IN EXPERIMENT

D. ŠTĚPÁN¹, J. VÁLKA², J. SAMOHÝL², V. E. MEYER³, J. ŠMAHEL³

Flap reconstruction is one of the basic surgical procedures in plastic surgery. In addition to classic skin flaps, axial pattern flaps (both on a vascular pedicle or free flaps) have been increasingly used recently. There are, however, some drawbacks and limitations to clinical use of these flaps. This explains the efforts in recent years to fashion electively these flaps surgically by vascular supply implantation into tissue. The term used to refer to tissue supplied by implanted vessels is a "prefabricated flap".

The parts of the body employed for prefabrication have included the intestine (14), the omentum (13), the muscle (15, 18), and, finally, blood vessels (1, 2, 4, 9, 15, 17). The vessels have been implanted into subcutaneous tissue (1, 2, 4, 9, 17), the bone (3, 19, 20), or into a corium graft (21). Research into this issue has been ongoing at the Department of Plastic Surgery in Brno since 1985 (21).

Here, attention should be drawn to the fact - which plastic surgeons may be ignorant of - that the same principle of neovascularization, referred to as Vineberg's operation, has been used in cardiac surgery to improve myocardial blood supply since 1946 (16).

In this study, we sought to develop our own experimental model, to determine the time relationship and other physiological variables regarding the neovascularization activity of an implanted vessel.

MATERIAL AND METHOD

In 74 female rats of the Wistar strain weighing 250-300 g were under general intramuscular anaesthesia (Rometar 0.4 ml/g, 5% Narkomann 1.5 ml/kg), a skin flap was obtained on the inner aspect of the thigh. The flap, 12 mm long, had a 20 mm pedicle (Fig. 1). The flap was lifted along with as much subcutaneous tissue and rare tissue underlying it as possible up to the surface of muscular fascia. Next, the femoral artery and vein were mobilized and raised between the branch and the a. epigastrica inferior superficialis almost to the level of the knee joint (Fig. 1). A "pocket" was subsequently created in the flap's subcutaneous layer and the femoral wessels was implanted therein while retaining its patency and not to interfering with blood supply distally to the flap. As the next step, the flap with the femoral wessels was again resutured into its bed.

Rats with flaps prefabricated as described above were divided into two groups.

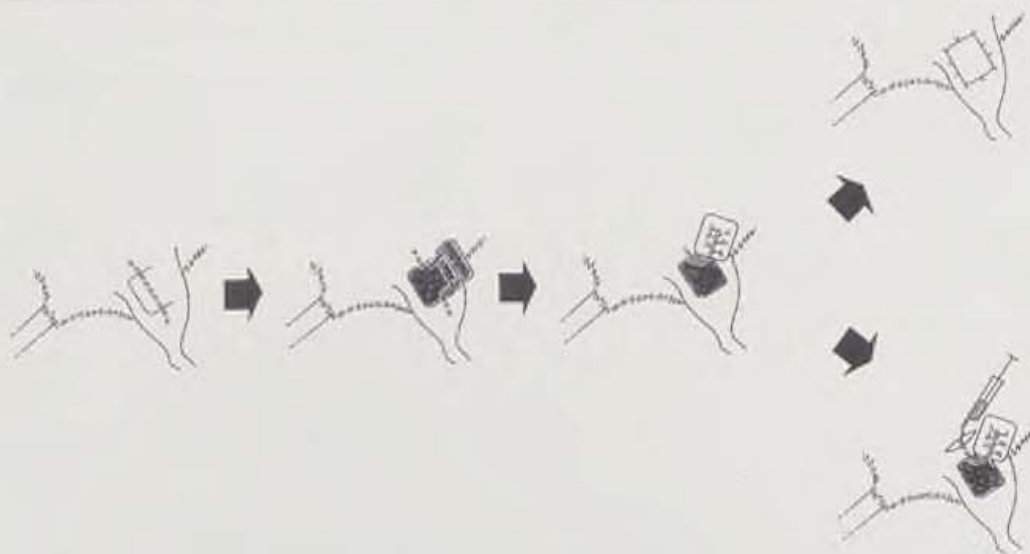


Fig. 1. Schematic representation of experimental design:

- A 12x20 mm flap situated on the inner aspect of the thigh;
- Implantation of vascular pedicle into the flap subcutaneous tissue.
- Lifting the flap after prefabrication. The flap is supplied by the implanted vascular pedicle; the distal segment of the implanted vascular pedicle has been transected during the lifting.
- The prefabricated flap is resutured into the bed to monitor its survival. Top - Group B;
- Bottom - Group A, contrast staining with Indian ink to visualize neovascularization.

Group A

After 7, 14 and 21 days, the flap was dissected while the rats were under general anaesthesia, and was raised from the bed along with an adjacent narrow band of skin. The implanted femoral wessels, whose course before entering the flap tissue was carefully mobilized, and ligated and transected at the distal end at the site of leaving the flap and was lifted along with the flap. The flap was now connected to the rat's blood circulation only via the implanted vascular pedicle (Fig. 1). The femoral artery in the ipsilateral groin was subsequently cannulated, and contrast staining of the limb with the flap was performed using a mixture of Indian ink and gelatine (380 ml distilled water, 180 ml of Indian ink, 30 g of powder gelatine). The aim of the staining was selective visualization of the implanted vessels and their newly formed branches and anastomoses to the original vascular bed. Provided the flap was connected to the rat's body only via the implanted vascular pedicle, then the contrast stained vessels in the flap were branches of implanted pedicle (Fig. 1).

Group B

After 7 and 14 days, the flap was dissected along the original lines including the cutaneous pedicle and the implanted vascular bundle, i.e., the same procedure was employed as in Group A with the only difference being that only the flap, minus adjacent skin, was lifted. As a result, the flap was again totally dependent on blood supply from the implanted vascular pedicle and its survival and engraftment were fully dependent on the pedicle's adequate function.

After dissection and lifting, the flap was returned to its bed and its engraftment and/or survival was monitored.

In two rats, the prefabricated flap was transplanted in experiment as a free flap. In one, the flap was raised from the bed, on day 14, as described above and immediately microsurgically transferred to the contralateral thigh. The implanted vascular pedicle was anastomosed to the femoral vessels of the recipient tissue. In the other rat, the procedure was identical except staged flap transfer was employed: it was raised on day 14 and returned to the bed to be transplanted only on day 19 after consolidation (Figs 2, 3).

After staining, each flap was histologically processed by fixation in Karnoy solution and cleared in glycerin. This technique allows examination of the tissue in a stereomicroscope without the need to obtain histological slices first.

RESULTS

Eighteen rats were excluded from final evaluation because of obvious technical error during surgery or staining.

Neovascularization, even though only in the area immediately surrounding the implanted vessels, was apparent after seven days.

The neovascularization was appreciably more extensive in flaps whose healing was associated with complications (dehiscence, infections, partial necrosis).

Flaps raised at that point and resutured into the bed (Group B) became necrotic. Survival of tissue in the immediate vicinity of implanted vessels was found in some cases.

After 14 days, a dense network of capillaries meandering, expanding into surrounding tissue and anastomosing to the original vascular bed, could be seen around the implanted vessels. Contrast medium reached, via the anastomoses, also areas outside the flap, and venous return via the implanted femoral vein could be seen (Figs 4, 5).

Flaps lifted after 14 days since pedicle implantation and returned to bed (Group B) will engraft. Of the 29 rats assigned to Group B, there were three cases of necrosis or biting off the flap, necrosis of the flap's margins (not exceeding 25 % of total flap surface) was seen in eight rats; engraftment of the other flaps was free complications.

At 21 days, there was no more proliferation of the newly formed vessels in Group A. As Group B flaps show a 89% survival after as short as 14-day prefabrication, we decided to discard the experiment with 21-day prefabrication. In flaps of Group B lifted on day 14 and returned to the bed, the network of newly formed vessels is richer, and the line separating it from the vascular network of the surrounding skin is more distinct.

Blood supply to the flap transplanted as a free flap to the contralateral thigh after 14-day prefabrication was impaired and the flap developed necrosis on day 3 following surgery. Engraftment of the second flap, transplanted using the delay technique (lifted on day 14 to be transplanted on day 19 as a free flap) was free of any complications whatsoever. As only two cases were studied, no authoritative conclusions can be drawn.

DISCUSSION AND CONCLUSION

It follows from our results that the time necessary for flap prefabrication in the rat is a minimum of 14 days since pedicle implantation. The finding that the degree of neovascularization in flaps healing with complications was superior to that in flaps with uneventful healing suggests that the factors involved in neovascularization include not only ischaemia but, also, re-

parative inflammation of tissue surrounding the implanted pedicle. This is consistent with current data regarding humoral regulation of the biological process of new blood vessel formation (5-8).

Neovascularization is provoked by a host of peptide-like growth factors naturally released by tissue cells of inflammatory infiltrate while the cell membranes are being destroyed. Today, the factors including their inhibitors are available in highly purified form (5, 8).

With these facts in mind and seen in this light, the process of neovascularization in flap prefabrication seems to be a natural response of the flap tissue, altered by surgery and relatively ischaemic. This leads to the release of "neovascularization promoting factors" (NPF) initiating formation of new vessels (5-8) and, consequently, establishing a new balance in blood supply characterized, according to some authors by initial overperfusion (22), which stabilizes within 28 days. The flap is neovascularized by branches of the implanted vascular pedicle and by capillaries growing from the flap bed. These systems largely anastomose one to the other, and their share in blood supply varies depending on the specific model situation.

SUMMARY

Flap prefabrication was studied on the rat thigh by implanting femoral vessels into the flap's subcutaneous tissue. The aim of the experiment was to determine optimal prefabrication time, and to monitor, using contrast staining, the dynamics and morphology of the neovascularization process. The minimal time for successful prefabrication was 14 days in our experimental model. The potential of physiological and pharmacological regulation of the process of capillary neoformation is discussed.

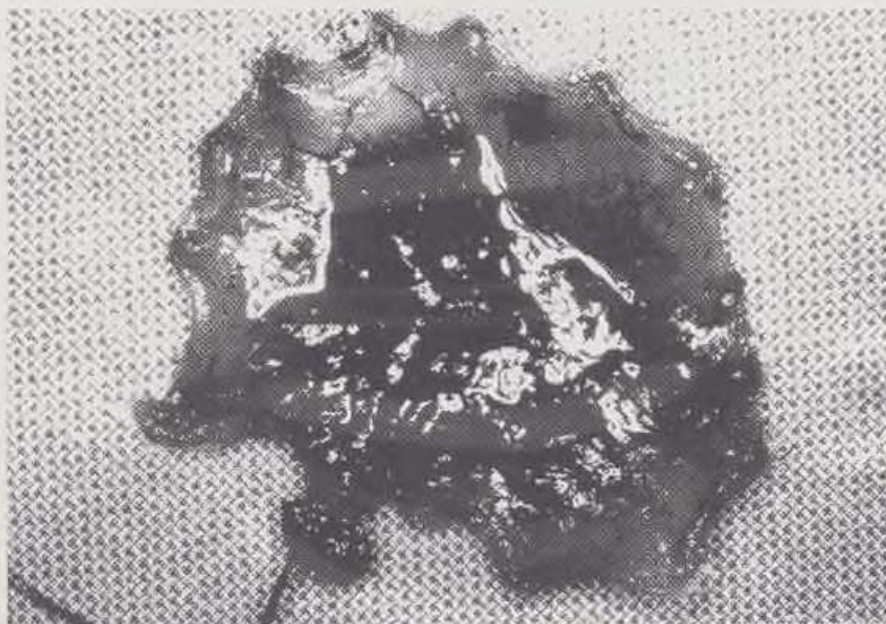
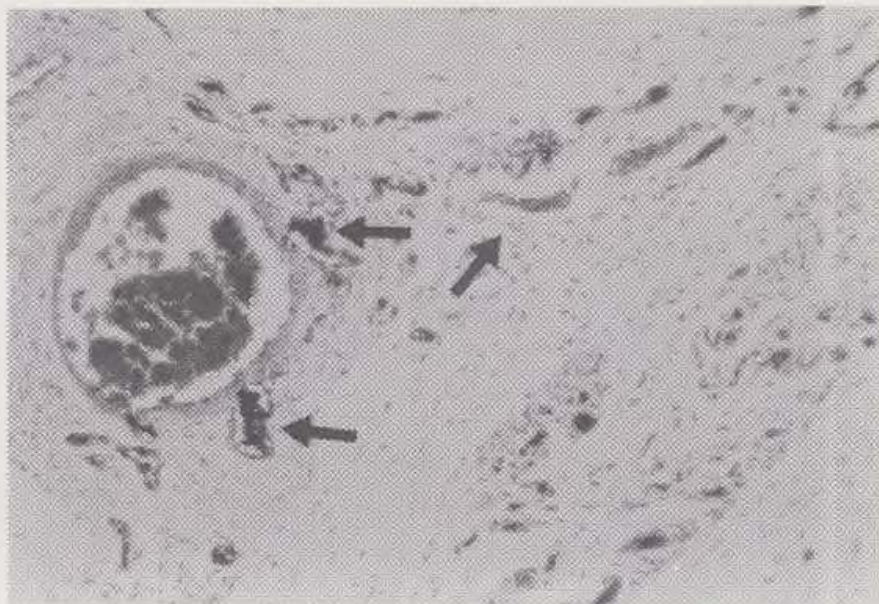


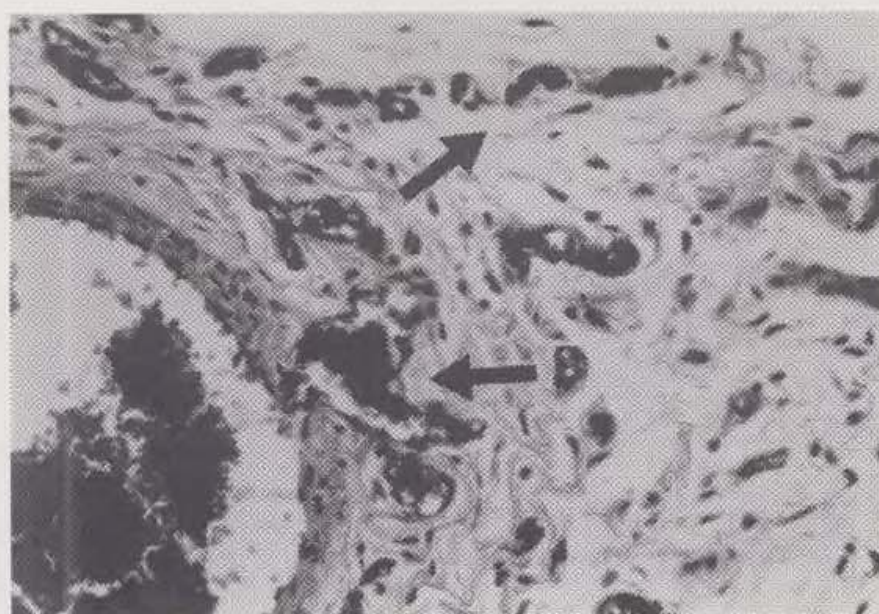
Fig. 2. Processed prefabrication flap preparation after contrast staining of the implanted vascular pedicle with Indian ink and after its clearing. The capillaries stained with Indian ink mark the bed of the implanted vessels and are the result of neovascularization.

Anastomoses to the original vascular bed can be seen in the periphery.

The pedicle serving as the route for staining is identified with ligature



a



b

Fig. 3. Detail of implanted artery at the site of origin of budding capillaries (arrows). Day 14 since prefabrication. Note the spiralling and meandering course (arrow) of proliferating capillaries characteristic for neovascularization. Particles of injected Indian ink are conspicuously visible among erythrocytes in the vessel. a) General view, b) detail

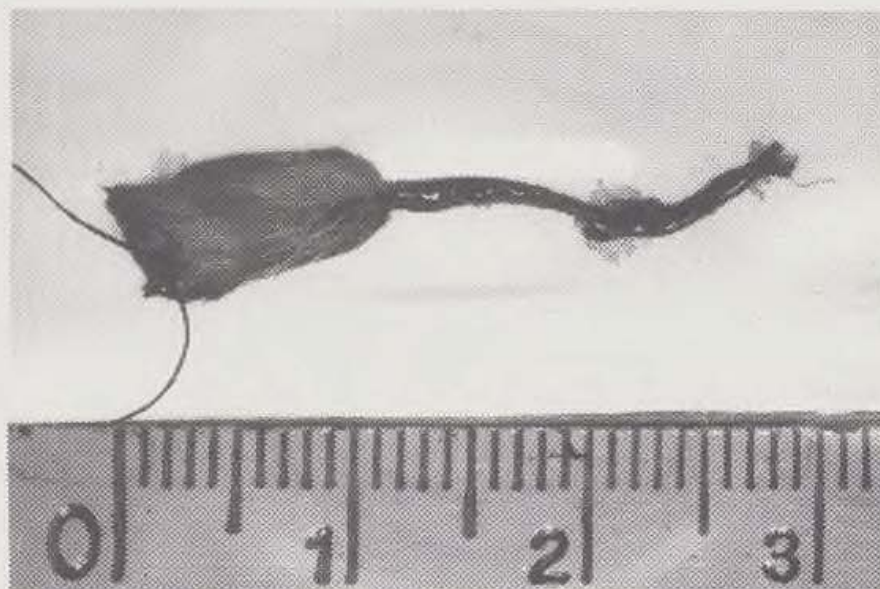


Fig. 4. Prepared prefabricated flap before transplantation. The distal part of the implanted pedicle has been ligated; note the long afferent segment of the femoral bundle



Fig. 5. Prefabricated flap on day 3 following successful transplantation

A successful attempt at free transfer of a prefabricated flap to the contralateral thigh and at femoral vessel anastomosis by microsurgery was also made as part of the experiment.

Key words: prefabricated flap, neovascularisation

RÉSUMÉ

Préfabrication du lambeau axial en expérimentation

Štěpán D., Válka J., Samohýl J., Meyer V. E., Šmahel J.

On a effectué une préfabrication d'un lambeau cutané sur la cuisse du rat à l'aide de l'implantation des artères fémorales dans l'hypoderme du lambeau. On vérifiait la longueur optimale de la préfabrication et, en injectant une substance de contraste, on observait la dynamique et la morphologie du procès de néovascularisation. Les possibilités physiologiques et pharmacologiques de régulation du procès de la néoformation des capillaires sanguins sont discutées.

On a effectué une expérimentation également réussie de transfert libre du lambeau ainsi préfabriqué sur la cuisse controlatérale, avec l'anastomose microchirurgicale d'artères fémorales.

ZUSAMMENFASSUNG

Präfabrikation eines axialen Hautlappens im Tierversuch

Štěpán D., Válka J., Samohýl J., Meyer V. E., Šmahel J.

Zwecks der Präfabrikation eines Hautlappens am Rattenschenkel erfolgte eine subkutane Implantation von femoralen Blutgefäßen. Es wurde eine optimale Länge der Präfabrikation ermittelt und nach der Einspritzung eines Kontrastmittels folgten Beobachtungen der Dynamik und Morphologie des Neovaskularisationsprozesses. Erörtert wurden die Möglichkeiten einer physiologischen und pharmakologischen Regulation des Prozesses der Neubildung von Blutkapillaren.

Ferner wird berichtet über die erfolgreiche freie Übertragung dieser Lappenpräfabrikation an den kontralateralen Rattenschenkel mittels einer mikrochirurgischen Anastomose der femoralen Blutgefäße.

REFERENCES

1. Hirase Y., Valauri F. A., Buncke H. J.: Prefabricated neovascularized free muscle flaps: pedicle variations. *J. Reconstr. Microsurg.*, 4: 203-7, 1988.
2. Hirase Y., Valauri F. A., Buncke H. J.: Prefabricated sensate myocutaneous free flaps: an experimental model. Preliminary report. *Plast. Reconstr. Surg.*, 82: 440-6, 1988.
3. Khouri R. K., Upton J., Shaw W. W.: Prefabrication of composite free flaps through staged microvascular transfer: an experimental and clinical study. *Plast. Reconstr. Surg.*, 87: 108-15, 1991.
4. Morrison W. A., Dvir E., Dou K., Hurley J. V., Hickey M. J., O'Brien B. M.: Prefabrication of thin transferable axial-pattern skin flaps: an experimental study in rabbits. *Br. J. Plast. Surg.* 43: 645-54, 1990.
5. Loughan M. S.: Neovascularization: has the angiogenic factor already been found. *Aus. N. Z. J. Ophthalmol.*, 19: 65-9, 1991.
6. King T. V., Vallee B. L.: Neovascularization of the meniscus with angiotensin. An experimental study in rabbits. *J. Bone Surg. Br.*, 73: 587-90, 1991.
7. Khouri R. K., Brown D. M., Leal-Khouri S. M., Tark K. C., Shaw W. W.: The effect of basic fibroblast growth factor on the neovascularization process: skin flap survival and staged flap transfers.

Br. J. Plast. Surg., 44: 585-8, 1991.

8. Schulz G. S., Grant M. B.: Neovascular growth factors. Eye, 5 (Pt 2): 170-80, 1991.

9. Takato T., Zuker R. M., Turkey C.: Prefabrication of skin flaps using vein grafts: an experimental study in rabbits. Br. J. Plast. Surg., 44: 593-8, 1991.

10. Hyakusoku H., Okubo M., Umeda T., Fumiiri M.: A prefabrication hair-bearing island flap for lip reconstruction. J. Plast. Surg., 40: 37-9, 1987.

11. Sanger J., Matloub H., Gosain A., Yousif N.: Scalp reconstruction with a prefabricated abdominal flap carried by the radial artery. Plast. Reconstr. Surg., 89: 315-9, 1992.

12. Tark K., Khouri R., Shin K., Shaw W.: The fasciovascular pedicle for revascularisation of other tissues. Ann. Plast. Surg., 26: 149-55, 1991

13. Erol O. Ö., Spina M.: Development and utilization of a composite island flap employing omentum: experimental investigation. Plast. Reconstr. Surg., 65: 405, 1980.

14. Washio H.: An intestinal conduct for free transplantation of other tissues. Plast. Reconstr. Surg., 58: 470, 1976.

15. Shintomi Y., Ohmori T.: The use of muscle vascularized pedicle flaps. Plast. Reconstr. Surg., 70: 725, 1982.

16. Vineberg A. M.: Development of an anastomosis between the coronary vessels and a transplanted internal mammary artery. Can. Med. Assoc. J., 55: 117-9, 1946.

17. Falco N. A., Pribas J. J., Eriksson E.: Vascularisation of skin following implantation of an arteriovenous pedicle: implications in flap prefabrication. Microsurgery, 13: 249-54, 1992.

18. Šmahel J., Meyer V. E., Válka J.: Implantation of a muscle flap in a free bone graft to promote revascularisation. Chir. Plastica, 8: 137-46, 1986.

19. Šmahel J., Meyer V. E., Válka J.: Knochen transplantate: Förderung der Heilung durch Implantation von Gefäßen oder von Muskellappen. Chirurgie, 8: 55-64, 1985.

20. Válka J., Šmahel J., Meyer V. E.: Implantation of blood vessels into a free bone graft to promote its revascularisation. Chir. Plastica, 8: 37, 1984.

21. Štěpán D., Samohýl J., Floriánová J.: Neovaskularizační aktivita mikrochirurgicky implantované cévy v experimentu. 29. sympozium o výzkumu pojiva. Špindlerův Mlýn, 1988.

22. Itoh Y.: An experimental study of prefabricated flaps using silicone sheets, with reference to the vascular patternization process. Ann. Plast. Surg., 28: 140-6, 1992.

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RECONSTRUCTION OF THE FRONTAL REGION WITH SKULL BONE GRAFTS

J. KOZÁK, P. VOSKA

Deformities within the frontal and nasal root region represent a major problem of reconstructive surgery. Besides the functional aspects of frontal reconstruction is of great importance also its cosmetic results since the forehead is an important part of the face which contributes to the formation of the identity of an individual.

The material which is convenient for reconstruction must meet certain criteria: it should be biologically inert, noncorrosive, nonresorbable, relatively of light-weight, with a low thermic and electric conductivity, yet at the same time firm and easy to mould. In children the frontal region should be able to grow and to enlarge together with the skull.

Historical reports mention numerous reconstructions within frontal and cranial region with the use of a variety of materials. Archeologists found skulls with defects which were reconstructed with soft metals. Towards the end of the 19th century were used gold and silver. Since 1940 have been used inorganic materials, as vitalium, stainless steel, tantalum, more recently were added some other materials as silicone and methyl methacrylate (13).

Besides these alloplastic materials these reconstructions were carried out with the use of bone grafts. The first report on osteoplasty was published by Meek'ren in 1682 (4) and more recently by Müller (5) in 1890, and by König (3) equally in 1890 who used a segment of the frontoparietal bone with a cutaneous pedicle for the reconstruction of a cranial defect. In 1901 Keen (2) used a bone graft from the calva and in 1945 Woolf and Walker (15) quoted the use autogenous grafts. Since 1916 followed the first reports on the use of a rib for cranioplasty. Pickerill described in 1931 long-term results after the use of the inner surface of the iliac bone (8).

After the tremendous progress of craniofacial surgery increasing attention was devoted to the possibility of an application of membraneous cranial bone. Craniofacial surgeons gained a large deal of experience with the use of these full thickness bone grafts during craniofacial surgical reconstructions (12). Anatomic and comparative studies of this type of bone grafting yielded highly positive results which led to their steadily increasing use.

MATERIAL AND METHODS

At our department underwent surgical repair 30 patients with defects in the frontal region. An alloplastic material was used in two patients, rib bone in seven and iliac bone in four. During the last six years have been used exclusively cranial bone grafts. This method was used in the surgical treatment of 17 patients.

Bone grafts were cut from the non-dominant parietal bone. In three patients were used full thickness grafts. The outer and inner layer was created by the introduction of an oscillation saw into the diploe. One part was used for the reconstruction of the defect and the second part served for the covering of the donor site. At these 3 operations was always present a neurosurgeon. In the remaining 14 cases was removed only the corticalis of the parietal bone, without the co-

operation of a neurosurgeon. It proved useful to obtain prior to surgery a wax moulage of the defect and to choose, according to its shape the most convenient curvature of the parietal bone in antero-posterior or lateral projection. It did not provide always an exact copy of the defect. In some cases were cut several lamellas of about 2 cm in width, which were subsequently inserted to fill-up the defect.

The actual removal of the bone graft begins by its delimitation with a round driller which penetrates into the diploe. Subsequently the use of Gigli's saw allows the detachment of the outer corticalis without any risk. Bleeding was checked with bone wax. The edges of osseous defect were corroded, sometimes with the creation of a small step to allow a more precise insertion of the given bone graft. After a slight modelling the bone grafts were placed into the recipient sites and fixed with a stainless thin steel wire. The reconstructed site was covered with a periosteal flap advanced from the neighbourhood to promote a rapid revascularization of the bone graft. The wound was ventilated with a suction drain and the skin wound was closed in layers.

Case reports

For illustration are presented two cases subjected to this type of reconstruction.

Patient No. 1, male aged 29 years, who suffered during a fall from a bicycle an injury of the left half of the forehead with a subsequent removal of a part of the shattered frontal bone. This resulted in a pulsating cosmetically conspicuous defect, 8x7 cm in size. One year after his injury a segment of outer corticalis was removed with Gigli's saw from the right parietal bone. The site of reconstruction was corroded and the dura mater was set free of adhesions. The bone graft was fixed with 3 wires and covered with 2 periosteal flaps. Subcutaneously were introduced two suction drains. For antibiotic cover of the operation was administered Lincomycine. The postoperative course was free of any complications. Three years after the operation the patient is without any subjective complaints, the frontal contour remains smooth (Figures 1a, 1b, 2a, 2b).

Patient No. 2, male aged 23 years, suffered since his childhood from frequent infections of the upper respiratory tract and was repeatedly treated for inflammations of the frontal sinus on the right side. Two years prior to reconstruction he underwent a radical operation of the frontal sinus according to Riedel. The patient had psychologic problems because of the marked deformity of the right half of the frontal region (Fig. 3a, 3b). The second look operation of the right half of the forehead was carried out from the bicorony incision with the formation of a frontal skin flap. It disclosed the presence of the posterior wall of the sinus alone. From the right parietal bone were detached, equally from the outer corticalis three bone grafts which were used for the reconstruction of the extensive defect. The bone grafts were fixed with wires and then covered with an advanced periosteal flap. Subcutaneously were introduced two suction drains. Antibiotic cover of the operation consisted of the administration of penicilin and the postoperative course was free of complications. The patient remains three years after the operation without complaints and he is satisfied with the attained cosmetic result.

The etiology of frontal defects reconstructed with bone grafts from the skull is presented in Table 1.

Trauma	12
Infection	1
Inborn malformation	1
ENT surgery	3
Total	17

Table 1. Etiology of frontal defects treated with cranial bone grafting



Fig. 1a



Fig. 1b



Fig. 2a

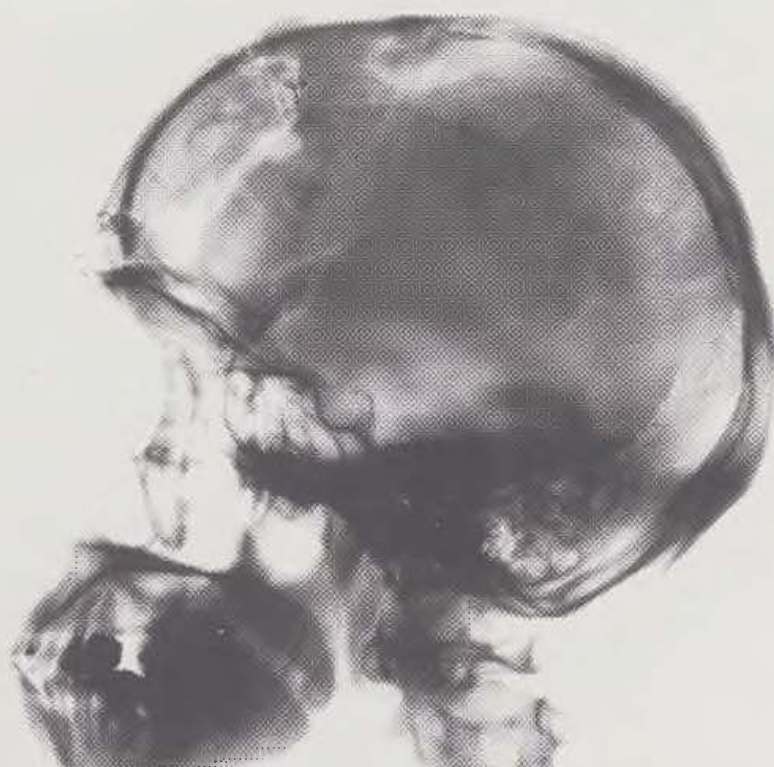


Fig. 2b



Fig. 3a



Fig. 3b

RESULTS

In all patients bone grafts healed without problems, but for the occurrence of a slight serous exudation in two cases. The patients are followed-up during a time period of 5 months to 5 years. The cosmetic results were very satisfactory in all patients with bone grafts from the skull, without any signs of resorption.

DISCUSSION

With regard to long-term results most materials mentioned in the introduction did not yield very satisfactory results.

The use of alloplastic material was often associated with a variety of complaints and complications. Very common were infections, fibrous and capsular contractures, as well as an atrophy of the skin covering the repaired defect and an elimination of the implanted graft (13). Our experience confirmed the occurrence of these sequelae. In two patients where the repair was carried out with methylmethacrylate it had to be removed because of the development of infections, fistulas and exposure of the implanted graft.

The use of enchondral bone grafts from the rib or iliac bone was associated with numerous difficulties. The cutting of costal bone grafts was associated with the risk of the development of a pneumothorax, hematoma or scars. The costal surface showed irregularities designated as a "washboard effect". An advantage consists in the easy bending of these bone grafts

which provides the possibility to create a natural frontal curvature. The cutting of bone grafts from the iliac bone is associated with a long-term marked postoperative morbidity, difficulties in walking and a prolonged treatment on an in-patient basis. These two types of enchondral grafts show a relatively high degree of resorption, which varies in individual patients and therefore can be hardly predicted. An excessive application of these grafts can lead in the case of a low degree of resorption to the need of repeated surgery.

These observations were fully confirmed by our clinical experience. In three, out of seven followed-up patients with costal grafts occurred such a high degree of resorption that the postoperative frontal pattern was almost identical with the preoperative defect. Bone grafts from the iliac bone were almost completely resorbed after nine years and the patient requested a new surgical repair. Therefore we turned our attention to bone grafts from the skull which are of membranous origin and their ossification proceeds in a more primitive and simpler way than it is the case in endochondral bones.

Peer demonstrated, as early as in 1950, that a bone graft which was cut from the vomer and subsequently implanted into soft tissues survived without any marked resorption (6). Smith and Abramson showed in 1974 on experimental animals that in rabbits membranous bone grafts showed a slighter resorption than endochondral bone grafts (10). Zins and Whitaker confirmed these results in 1983 in experiments on rabbits and monkeys. In rabbits bone grafts from the iliac bone and from the zygomatic arch were implanted on the bone of the muzzle and in monkeys bone grafts from the skull and from the iliac bone were implanted on the skull. At the end of the experiment the reduction of the volume of the graft from the ilium was more than three times larger in rabbits and more than four times larger in monkeys (17). The results of these experiments were confirmed by a large number of authors in clinical studies (1, 9).

The skull consists of an inner and outer layer separated by the diploe. The thickness of the bone varies according to individual sites and to the age of the patient and is related to the presence of malformations and diseases. Pensler and MacCarthy (7) in their study on 200 corpses showed that the thickness of the parietal bone measured in several points varied from 6.6 mm up to 7.7 mm. MacCarthy (7) advised that the bone graft should be obtained (cut) beyond the coronary suture.

The cutting of bone grafts could be associated with complications due to the damage to the dura mater, to intracranial bleeding, or to the development of cerebrospinal fluid fistula. Young (16) described a rightsided hemiplegia after the use of a chisel for the removal of a bone graft from the skull without an injury of the inner corticalis. He stated that the underlying mechanism is the transfer of energy to the brain tissue. We believe that our technique of cutting bone grafts with Gigli's saw is much less injurious. The cutting of bone grafts must be carried out about 2 cm in lateral direction from the sagittal sinus, in order to avoid an injury of the latter. Complications mentioned in other reports, as e.g. infection and extrusion, were not recorded in our patients.

The use of cranial bone grafts is associated with many advantages. In our opinion the most important consist in the hidden scar in the scalp, at the donor site do not develop secondary deformities, the patients suffer from little or no postoperative pain, the duration of in-patient treatment is reduced, the donor site is within the same operation field as the repaired defect. A major advantage is a substantially smaller resorption as compared to enchondral bone grafts. A drawback is the difficulty associated with the bending of cranial bone grafts, yet an adequate curvature can be attained by choosing a corresponding curvature of the parietal bone. The size of a bone graft is limited as well, however, as it was already stated these grafts can be put together in order to allow a reconstruction of larger defects.

Our clinical experience gained during six years of application of cranial bone grafts can be designated as very good. We failed to disclose, so far, any marked signs of resorption and at the present time the cranial membranous bone represents the sole material used in our reconstruction within the frontal region.

SUMMARY

Cranial bone grafts play a steadily increasing role as the dominant material used for reconstruction of defects within the frontal region. Both clinical experience and experiments on animals provided evidence that they showed a much smaller degree of resorption and that their cutting was associated with a markedly lower frequency of complications. Cranial bone grafts were used for the reconstruction of frontal defects in 17 patients. The results assessed six years after surgery disclosed a very slight degree of resorption in the presence of very good functional and cosmetic effects.

Key words: cranial bone grafts, frontal defects, frontal reconstruction

RÉSUMÉ

Reconstruction dans la région du front par greffons osseux de voûte crânienne

Kozák J., Voska P.

Les greffons osseux de voûte crânienne deviennent un matériau de plus en plus dominant dans les reconstructions de la région du front. Il était prouvé en expérimentation aussi que cliniquement que ce matériau succombe moins à la résorption et son prélèvement est lié à un nombre de complications considérablement moins élevé. Dans la reconstruction d'un défaut du front chez 17 patients, on a utilisé les greffons de voûte crânienne. Les résultats datant de six ans témoignent un moindre degré de résorption et de bons résultats cosmétiques et fonctionnels.

ZUSAMMENFASSUNG

Rekonstruktionen im Stirngebiet durch Transplantation von Knochenspanen aus der Calva

Kozák J., Voska P.

Knochenspane aus der Calva sind in ansteigender Häufigkeit das dominierende Material bei den Rekonstruktionen im Stirngebiet. Klinisch und experimentell wurde der Nachweis erbracht, dass sie eine wesentlich geringere Resorption aufweisen und dass ihre Entnahme mit einer bedeutend kleineren Anzahl von Komplikationen begleitet wird. Zur Stirnrekonstruktion wurden bei 17 Patienten Knochenspane aus der Calva angewandt. Die sechsjährigen Ergebnisse zeigten einen sehr niedrigen Resorptionsgrad und gute kosmetische und funktionelle Ergebnisse.

REFERENCES

1. Jackson I.T., Helden G., Marx R.: Skull bone grafts in maxillofacial and craniofacial surgery. *J. Oral. Maxilofac. Surg.*, 44 : 949, 1986.
2. Keen W.W.: *Surgery; Its Principles and Practice*. Philadelphia W.B. Saunders, 1901.
3. König F.: Der knöcherne Ersatz Grosser Schädeldefekte. *Zentralbl. Chir.*, 17 : 467, 1890.
4. Meek'ren T.A.: *Observations medico. Chirurgicae Amsterodami, Theodori Boom 1682*.
5. Müller W.: Zur Frage der Temporären Schädel an Stelle der Trepanation. *Zentralbl. Chir.*, 17 : 65, 1890.
6. Peer L.A.: The fate of autogenous human bone grafts. *Br. J. Plast. Surg.*, 3 : 233, 1950.
7. Pensler J., McCarthy J.C.: Anatomical study of calvarial thickness. *Plast. Reconstr. Surg.*, 75 : 648, 1984.
8. Pickerill H.P.: New method of osteoplastic restoration on the skull. *Med. J. Aust.*, 2 : 28, 1931.
9. Powell N.B., Riley R.W.: Facial contouring with outer-table calvarial bone. *Arch. Otolaryngol. Head Neck Surg.*, 115 : 1454, 1989.
10. Smith I.D., Abramson M.: Membranous versus endochondral bone autografts. *Arch. Otolaryngol.*, 99 : 203, 1974.
11. Stark R.B.: *Plastic Surgery of the Head and Neck*. Churchill Livingston, N.Y., Edinburgh, London, Melbourne, 1987, vol. 1, p. 60.
12. Tessier P.: Autogenous bone grafts taken from the calvarium for facial and cranial application. *Clin. Plast. Surg.*, 9 : 531, 1982.
13. Walker A.E., Erculei, F.: The late results of cranioplasty. *Arch. Neurol.*, 9 : 105, 1963.
14. Weber H.: Schädelplastik. *Berl. Klin. Wochenschr.*, 53 : 1115, 1916.
15. Woolf J. I., Walker A.E.: Cranioplasty. Colective review. *Int. Abstr. Surg.*, 81 : 1, 1945.
16. Young V.L., Schuster R.H., Harris L.W.: Intracerebral hematoma complicating split calvarial bone graft harvesting. *Plast. Reconstr. Surg.*, 86 : 763, 1990.
17. Zins J.E., Whitaker L.A.: Membranous versus endochondral bone autografts: Implication for craniofacial surgery reconstructive. *Plast. Reconstr. Surg.*, 72 : 72, 1983.

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LATE RESULTS OF THE SURGICAL TREATMENT OF COMPLETE UNILATERAL CLEFT LIP AND PALATE: SOFT TISSUE CHARACTERISTICS

M. KRAUSS, T. POLACZEK

A complex treatment of the complete unilateral cleft lip and palate (UCLP) requires many years. Final evaluation of its effectiveness can be made first after the period of an intense growth of a patient and the late results differ usually significantly from those obtained immediately after the cleft closure. Thus, only an analysis of the late results allows to assess the value of the surgical method used and to determine its effect on the growth and development of soft tissues in the perioral area and of the craniofacial skeleton (Farkas, 1990; Heiner et al., 1982; Paulin and Thilander, 1991; Roberts-Harry et al., 1991; Seyfer and Simon, 1989; Schweckendiek, 1987; Šmahel and Müllerová, 1988; Van Demark et al., 1989; Walter and Hale, 1987).

Aim of this study was to evaluate the soft tissues in the nose, lip and perioral area as well as the hard and soft palate characteristics.

MATERIAL AND METHODS

Sixty-one UCLP patients treated by the same surgeon (Krauss) in years 1960-1972 at the Plastic Surgery Hospital at Polanica Zdrój were examined at 17-20 years of age. There were more UCLP patients invited to participate in the follow-up study but only a part of them (55 %) has accepted the invitation. No additional preselection has been made.

The sex ratio and cleft side in the studied population are shown in Table 1. Before the treatment, all individuals had a particularly serious deformity comprising of an asymmetrical lack of continuity of the skin, mucosa, muscles and bone in the area of upper lip, alveolar process, hard and soft palate. The cheiloplasty was done at 6-9 months of age using the modified Le Mesurier procedure (Fig. 1.). The palatoplasty was performed at 3-4 years using the modified Veau procedure (Fig. 2).

Among the UCLP patients studied, 2 had additional corrective operation of the lip, 2 that of the nose, and 2 that of both the lip and nose at the age of 15-17 years. Most UCLP patients underwent subsequent orthodontic treatment of various intensity and duration. Approximately, 64 % of subjects were treated orthodontically for at least 3 years. Some patients had a speech therapy. Approximately, 43 % of subjects were treated by speech pathologist for at least 1 year.

The control examination was intentionally performed by a physician not involved in the operation. Facial attractiveness of the patients was assessed as "normal face" or "cleft face". The presence of typical cleft abnormalities, such as irregular nose, deformed nasal ala and crest,

Table 1. Division of Cleft Patients According to Their Sex and Cleft Side

Sex	Cleft side		Total
	left	right	
MALE	23	17	40 (66 %)
FEMALE	13	8	21 (34 %)
Total	36 (59 %)	25 (41 %)	61 (100 %)

face asymmetry, and deformation at the cleft lip suture, which were obviously visible facing the patient directly, determined the "cleft face". The shape and symmetry of the nose and of the upper lip were additionally assessed in a detailed clinical investigation by comparing the operated side with the contralateral side. An oblique bent nose pyramid, asymmetrical and/or flattened nasal ala, bent columella, narrowed or widened naris on the cleft side, flattened and/or lowered nose tip, unreconstructed nose floor, and an impaired or absent nasal airflow were recognized as irregularities of the nose shape. Hypertrophic scars or spots, flattened or a narrowed lip shape, shortened or lengthened lip height, uneven vermilion border line, unreconstructed Cupid's bow, non-reconstructed orbicularis oris muscle and an excess or deficiency of vermilion were recognized as irregularities of the upper lip. The presence of these irregularities was determined during a detailed examination of the patient's face directly and in profile.

The continuity of alveolar process, the depth of the oral vestibule, and the state of the soft palate were evaluated during a detailed clinical investigation. A cleft crevice present in the alveolar process, shallow or atresic vestibule of the mouth (as well as the presence of fistulae therein), scarred and/or short soft palate (also with residual foramens) and finally, a poor or absent mobility of the soft palate were assessed as irregularities.

Condition of hard palate was assessed by clinical examination. Flat or Gothic-type hard palate and the presence of residual foramens were considered as irregularities.

The speech was evaluated by listening to the patient's articulation. It was considered incorrect, when different from the generally accepted. Poor or blurred pronunciation of everyday talk, defective articulation, and nasalization were evaluated as irregularities. A poor pronunciation of the speech was assessed in cases when its understanding was impossible without focusing attention on the patient's face. The pronunciation was assessed as blurred when understanding was difficult due to articulation disturbances and nasalization. Articulation of the speech was considered as disturbed, when the patient produced wrongly the dental, palatal and velar consonants. If the patient's speech sounded nasal, the case was considered as nasalization.

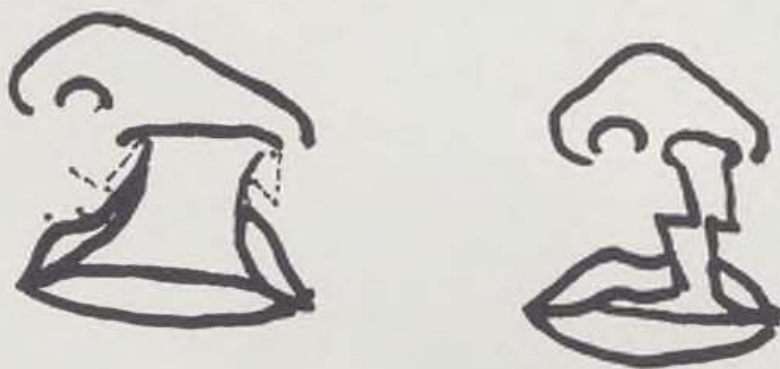
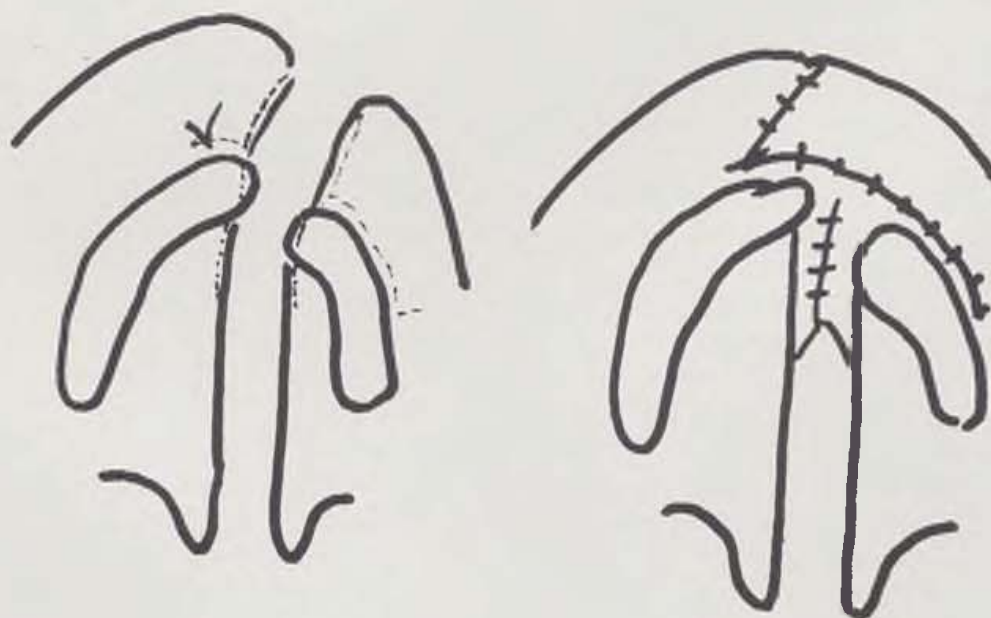


Fig. 1. Modified Le Mesurier technique of the lip closure.
a) Marked lines on the lip skin; b) incision on the lip;



c) incision in the oral vestibule; d) closure of the oral mucosa

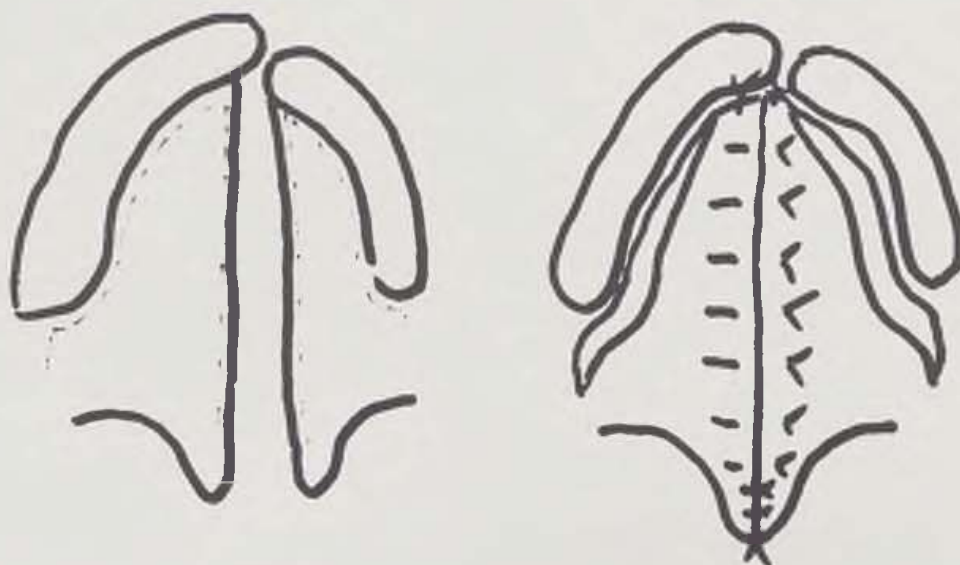
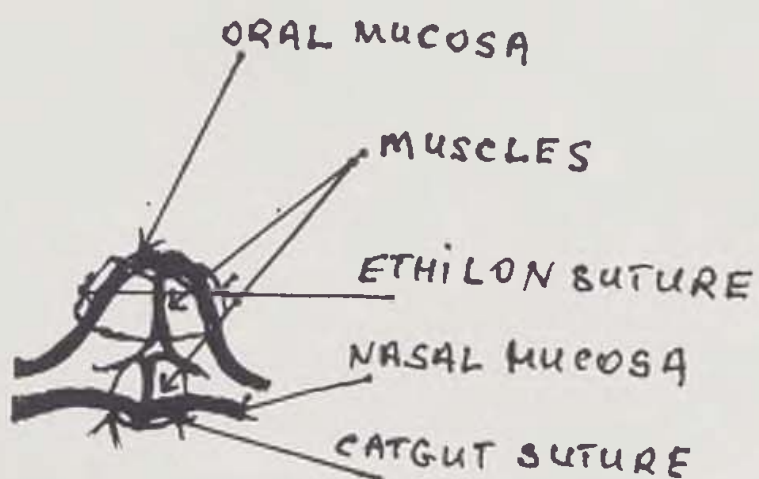


Fig. 2. Modified Veau technique of the palate closure.
a) Incision on the mucoperiosteal flap; b) closure of hard and soft palate;



c) cross-section of the palate after closure

RESULTS AND DISCUSSION

The results shown in Tables 2-6 allow to make a complex evaluation of the efficiency of the surgical UCLP treatment.

The results of the initial visual evaluation of the appearance of the UCLP patients' face indicate that a "correct" or "normal" appearance was found in 69 % of the patients. Only 31 % had a "cleft face". The appearance of the middle and lower portion of the face depends to a considerable extent on the shape (symmetry) of the nose and lip, and also on the development of the jaw and dental occlusion (Fig. 3). The data on the seven evaluated features of the nose shape and function reported in Table 2 allow to evaluate the effect of the surgery on nose development. The attempt to correct nose deformity at the first operation was successful in more than one third of the patients. The remainings showed various malformations of either the whole nose or of the nasal part adjacent to the cleft. The most frequent irregularity was an impaired or totally closed nasal airway on the operated side (62 % cases) and an asymmetry of nares (82 % cases). Partial obstruction of the nasal airway is annoying to patients and requires often a surgical intervention. On the contrary, a small asymmetry of nostrils does not essentially affect the appearance of the face and does not contribute to the "cleft face" appearance. It should be emphasized that the floor of the nasal vestibule was restored at the first operation in 92 % of cases.

The data in Table 3 allow to evaluate the effect of surgery on the development of the lip. In most cases, the primary operation was successful in restoring the correct lip shape, the continuity of the orbicularis muscle, and the correct outline of the Cupid's bow. Minimal scars were also essential from the aesthetic point of view. The most commonly observed irregularity was the uneven edge of the vermillion and of the skin (62 % cases).

The data in Table 4 show that a correctly deep oral vestibule was obtained in most cases. Essential for this was the transfer of the mucous flap from the cleft to the noncleft side. Small fistulae in the vestibule were found in only 8 % cases. No single case of vestibular atresia was observed. Reconstruction of the continuity of the alveolar process by closing the anterior poles of the cleft maxilla occurred spontaneously after the reconstruction of soft tissues in the majority of cases. A fissure, 1-8 mm wide was observed in only 11 %.

The occurrence of dental malocclusion was also observed. A detailed analysis of this occurrence is discussed separately (Polaczek, 1992).

Results of the hard and soft palate evaluation are shown in Table 5. The correct shape of the hard palate was observed in 62 % cases. Minor fistulas, of no functional importance, occurred in only 3 % case. Morphological reconstruction of the soft palate may be considered good: correct formation was found in 92 % cases, and correct mobility in 93 % cases.

Results of the speech evaluation are collected in Table 6. In the most cases (95 %) the speech was correct although the cleft palate was closed relatively late. Speech disturbancy was found in 21 % cases, whereas nasalization occurred in 20 % cases.

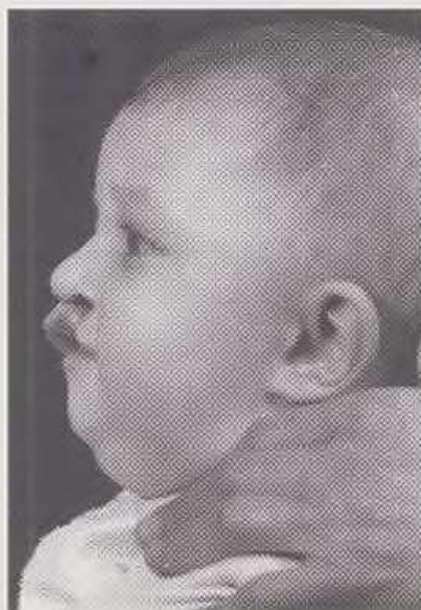


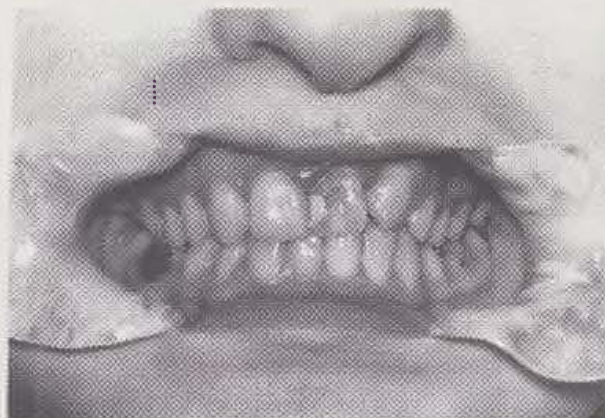
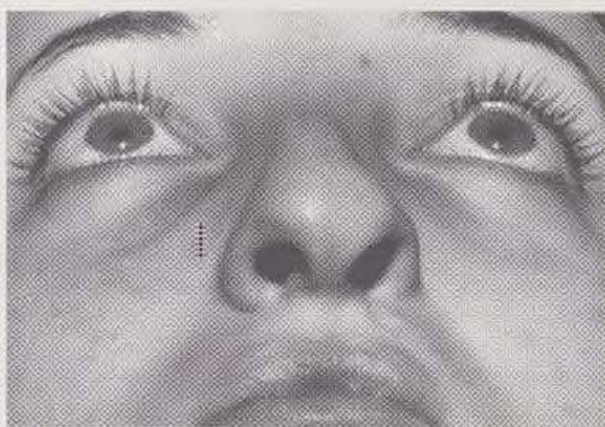
Fig. 3. Patient Maria P., complete UCLP, cheiloplasty undertaken at 6 months of age, palatoplasty at 3 1/2 years of age, correction of nose deformities at 12 years of age, efficient orthodontic treatment with intraoral appliances for 16 years, no further surgery is required;
a) full and side face before closure of cleft lip, 6 months of age;



b) full and side face after closure of cleft palate, 7 years of age;



Fig. 3 c) full and side face in adulthood, 18 years of age;



d) nostris, upper lip and dental occlusion, at 18 years of age

Table 2. Evaluation of the Nose Shape and Function

Characteristics	Number of Cases**)
NASAL PYRAMID	
normal	26 (43)
oblique	35 (57)
ALA*)	
symmetrical	32 (52)
uplifted	21 (34)
lowered	8 (13)
flattened	27 (44)
COLUMELLA	
symmetrical	41 (67)
oblique	20 (33)
NARIS*)	
symmetrical	11 (18)
narrowed	2 (3)
widened	48 (79)
NOSE TIP	
correct	24 (39)
flattened	26 (43)
lowered	21 (34)
NASAL FLOOR	
restored	56 (92)
unrestored	5 (8)
NASAL AIRWAY*)	
normal	22 (36)
impaired	30 (49)
obstructed	9 (15)

*) on the cleft side

**) in brackets, frequency of incidence, %

Table 3. Evaluation of the Upper Lip Shape

Characteristics	Number of Cases*)
SCARS	
linear	59 (97)
hypertrophic	1 (2)
suture spots	1 (2)
SHAPE	
regular	56 (92)
flattened	4 (7)
narrowed	1 (2)
HEIGHT	
normal	46 (75)
shortened	10 (16)
lengthened	5 (8)
VERMILION BORDER EDGE	
regular	38 (62)
irregular	23 (38)
CUPIDO'S BOW	
restored	44 (72)
impaired	17 (28)
ORBICULARIS MUSCLE	
restored	58 (95)
unrestored	3 (5)
VERMILION	
symmetrical	44 (72)
excessive	5 (8)
deficient	12 (20)

*) in brackets, frequency of incidence, %

Table 4. Evaluation of the Alveolar Process Continuity and of the Buccal Vestibule Depth

Characteristics	Number of Cases*)
ALVEOLAR ARCH	
continuous	54 (89)
split	7 (11)
VESTIBULE	
correct	50 (82)
shallowed	9 (15)
with fistula	5 (8)

*) in brackets, frequency of incidence, %

Table 5. Evaluation of the Palate

Characteristics	Number of Cases*)
HARD PALATE	
regular	38 (62)
flat	11 (18)
Gothic	8 (13)
with residual foramens	2 (3)
cicatricial	9 (15)
SOFT PALATE	
regular	56 (92)
cicatricial	2 (3)
short	5 (8)
with residual foramens	1 (2)
VELUM MOBILITY	
good	57 (93)
poor	4 (7)
none	- (0)

*) in brackets, frequency of incidence, %

Table 6. Speech Evaluation

Characteristics	Number of Cases*)
SPEECH INTELLIGIBILITY	
very good	51 (84)
good	7 (11)
indistinct	3 (5)
poor	- (0)
ARTICULATION	
correct	48 (79)
slightly disturbed	2 (3)
disturbed	11 (18)
NASALIZATION	
none	49 (80)
slight	10 (16)
considerable	2 (3)

*) in brackets, frequency of incidence, %

CONCLUSION

The late results of the treatment can be considered satisfactory. One can presume that the studied group was not fully representative for the whole population of the treated UCLP patients. The patients who have refused to come for check-up examination should have had no essential objections in respect to their face shape or appearance and did not feel any need for additional surgical treatment. This factor, however, could only contribute to an underestimation of the results obtained. In every case, the presented data can be used as comparable material by others in evaluation of their UCLP subject groups treated with different methods and/or in different time.

SUMMARY

Sixty-one UCLP patients at 17-20 years of age treated in childhood by the same surgeon (Krauss) were invited for check-up examination to evaluate the late results of the surgical treatment. In the patients, the cleft lip was closed by a modified Le Mesurier procedure at 6-9 months of age and the cleft palate by a modified Veau procedure at 3-4 years of age. The "normal face" appearance showed 69 % of the patients. More than one third of the population had successfully corrected nose deformities after the primary operation. In the most cases, the lip was also restored satisfactorily during the first treatment. Regular border between the lip and vermillion was observed in 62 % of cases. The correct shape of hard palate was also found in 62 % of the

patients. The soft palate was well reconstructed in 92 % of cases. In the most cases (95 %), the speech was correct although the cleft palate was closed relatively late. The late results of the treatment can be considered satisfactory.

RÉSUMÉ

Résultats tardifs du traitement chirurgical chez la fente labio-palatine unilatérale totale; caractéristiques des tissus mous

Krauss M., Polaczek T.

Dans le but d'évaluation des résultats tardifs du traitement chirurgical, on a invité aux examens de contrôle 61 patients avec la fente labio-palatine unilatérale totale, âgés de 17 à 20 ans et opérés à l'âge enfantin par le même chirurgien (Krauss). La fente labiale a été fermée à l'âge de 6 à 9 mois par la méthode modifiée d'après Le Mesurier, la fente palatine à l'âge de 3 à 4 ans par la méthode modifiée de Veau. Le "visage normal" se manifestait auprès de 69 % de patients. Plus d'un tiers de sujets présentaient, après l'intervention primaire, une bonne correction de difformités nasales. Dans la majorité des cas, la lèvre aussi était bien reconstruite dans la première séance opératoire. Les limites régulières entre la lèvre et le vermillon étaient constatées dans 62 %. Egalement, la forme correcte du palais osseux était trouvée dans 62 %. Le voile était bien reconstruit chez 92 % de sujets. Dans la plupart des cas (95 %), le langage était correcte, bien que la fermeture du palais avait été effectuée relativement tard. Les résultats tardifs peuvent être considérés comme satisfaisants.

ZUSAMMENFASSUNG

Spätergebnisse der chirurgischen Behandlung der totalen, einseitigen Lippen- und Gaumenspalten: Eigenschaften der Weichteile

Krauss M., Polaczek T.

Bei 61 Patienten im Alter von 17-20 Jahren, die im Kindesalter derselbe Chirurg behandelte (Krauss), erfolgten Kontrolluntersuchungen der Spätergebnisse der chirurgischen Behandlung. Die Lippenspalte wurde mit einem modifizierten Verfahren nach Le Mesurier im Alter von 6-9 Monaten, und die Gaumenspalte mit einer Modifikation des Verfahrens von Veau, im Alter von 3-4 Jahren operiert. Ein sog. "normales Gesicht" war bei 69 % der Kranken vorhanden. Mehr als ein Drittel des Untersuchungsgutes hatte bereits nach der ersten Operation eine gut aussehende Nase. In den meisten Fällen war auch die Korrektur der Lippe nach der ersten Operation erfolgreich. Eine regelmässige Grenze zwischen der Lippe und dem Vermilion bestand bei 62 % der Fälle. Die Gestaltung des harten Gaumens war ebenfalls befriedigend in 62 % der Kranken. Eine erfolgreiche Rekonstruktion des weichen Gaumens war in 92 % der Fälle vorhanden. Bei den meisten war die Sprache fehlerfrei trotz der relativ späten Operation des harten Gaumens. Die Spätergebnisse der Behandlung konnten als befriedigend bezeichnet werden.

REFERENCES

1. Farkas L. G.: Anthropology of the face in cleft patients. In: Bardach J., Morris H. L. (eds.): Multidisciplinary Management of Cleft Lip and Palate. Saunders, Philadelphia, 1990, p. 474.
2. Heiner H., Schumann D., Erler U., Karl P.: Kontrolle der Lippenplastik 18 Jahre nach modifizierter Le Mesurier Technik. In: Pfeifer G. (ed.): Lippen-Kiefer-Gaumenspalten, Thieme Verlag, Stuttgart, 1982, p. 30.
3. Paulin G., Thilander B.: Dentofacial rela-

tions in young adults with unilateral complete cleft lip and palate. *Scand. J. Plast. Reconstr. Surg.*, 25: 63, 1991.

4. **Polaczek T.:** Late results of the surgical treatment in unilateral complete cleft lip and palate. Occlusal and craniofacial characteristics. *Acta Chir. Plast. (Prague)*, 34: 215, 1992.

5. **Roberts-Harry D. P., Evans R., Hathorn I. S.:** Effects of different surgical regimes on nasal asymmetry and facial attractiveness in patients with clefts of the lip and palate. *Cleft Palate-Craniofacial J.*, 28: 274, 1991.

6. **Seyfer A. E., Simon C. D.:** Long-term results following the repair of palatal clefts. A comparison of three different techniques. *Plast. Reconstr. Surg.*, 83: 785, 1989.

7. **Schweckendiek W.:** Primary veloplasty: long-term results without maxillary deformity: a twenty-five year report. *Cleft Palate J.*, 15: 268, 1987.

8. **Šmahel Z., Müllerová Ž.:** Effects of primary periosteoplasty on facial growth in unilateral cleft lip and palate. 10 year follow-up. *Cleft Palate J.*, 25: 356, 1988.

9. **Van Demark D. R., Gnoinski W., Hotz M., Perko M., Nussbaumer H.:** Speech results of the Zürich approach in the treatment of unilateral cleft lip and palate. *Plast. Reconstr. Surg.*, 84: 605, 1989.

10. **Walter J. D., Hale V.:** A study of the long-term results achieved by the Gilles Fry procedure. *Brit. J. Plast. Surg.* 40: 384, 1987.

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EFFECTS OF PREMAXILLARY SETBACK AND OF PROLONGATION OF THE COLUMELLA ON THE CONFIGURATION OF THE FACIAL PROFILE IN COMPLETE BILATERAL CLEFT LIP AND PALATE

B. ŠKVAŘILOVÁ, I. HORÁK, H. POLÍVKOVÁ, Z. ŠMAHEL

Our previous study (Šmahel et al., 1992) included a comprehensive analysis of the configuration of the soft and skeletal facial profile in adults with individual types of orofacial clefts. In complete bilateral cleft lip and palate the results obtained were definitely affected by two surgical techniques, which were not applied in other types of clefts. They consisted of premaxillary setback and of the prolongation of the columella. In order to define the effects of these procedures and to increase the comparability of the previous data are presented in this report the results obtained after the use of the two above mentioned surgical techniques.

MATERIAL AND METHOD

Our series included 26 males ranging in age from 20 to 40 years. They had complete bilateral cleft lip and palate without any associated malformation and were not subjected to maxillofacial surgery (but for the premaxillary setback). At the time of examination their mean age was 27.7 years. The suture of the lip was carried out according to Tennison (in six cases according to Veau) in two stages at a mean age of 7.3 months on the left and 8.2 months on the right. Palate repair of a pushback and pharyngeal flap surgery was performed at the mean age of 5.8 years. During the interval between the suture of the lip and of the palate premaxillary setback was carried out in 9 patients at the age of 2.3 to 5.5 years. The position of the premaxilla was adjusted with the application of mucoperiosteal flaps. But for three persons, all individuals examined were subjected, on the average, to two nose and/or lip corrective surgical procedures, inclusive of the prolongation of the columella in 17 patients. The latter procedure was carried out with the fork flap technique during adolescence (at the mean age of 14.2 years). All patients were born between 1945 and 1960 and all were operated on at the Department for Plastic Surgery in Prague. Thus the results obtained were characteristic for this period of time during which the orthodontic treatment yet did not include the use of fixed appliances.

The patients were subdivided two times always in two subgroups: with ($n = 9$) and without ($n = 17$) premaxillary setback, as well as with ($n = 17$) and without ($n = 9$) prolongation of the columella. Out of the patients with premaxillary setback ($n = 9$) four (44 %) had no prolongation of the columella, while of the patients without this procedure ($n = 17$) five (29 %) remained without a prolonged columella. Though the proportions of patients according to the prolongation of the columella was not quite symmetrical, the difference exerted no definite effects

on the results obtained. This was true equally for the second subdivision where of the patients with a prolonged columella ($n = 17$) five had a premaxillary setback (29 %), while in the other subgroup ($n = 9$) a setback was performed in four cases (44 %). A symmetrical proportion required actually the transfer of a single patient into another group. Globally five patients were not subjected to these two procedures, while five patients were subjected to both methods of surgical repair. These numbers are too small, however, for any statistical assessment.

The series of controls consisted of 50 volunteers matched in age (mean age 27.2 years). They were selected at random from university students and in-patients treated for minor injuries. The series was described in more detail in our previous study (Šmahel et al., 1992).

X-ray films were obtained under standard conditions during centric occlusion. The determined craniometric points and reference lines are presented on Figure 1-2. The perpendicular distance of a point from the reference line was marked e. g. Pmp-VL, the angle as N-S-Ar, or as a fraction of reference lines forming a given angle, e.g. Coll/LsL (the nasolabial angle). Wits appraisal (the distance between points Ss and Sm after their perpendicular projection on the occlusal plane OL) was designated Ss+Sm. Dental characteristics were not included, since in the predominant majority of the nine patients with premaxillary setback the upper incisors were missing and during the second classification according to the prolongation of the columella these parameters were not influenced by the above mentioned procedure. In contrast to the previous analysis (Šmahel et al., 1992) were omitted equally some other characteristics which proved insignificant for the purpose of our study. The prominence of the upper lip over the lower was determined as the difference of the distances of Ls and Li points from N'Pg'L (marked Ls+Li) and the height of the vermillion of the upper (Ls+Sto) and lower (Li-Sto) lip as the projected distance measured parallel to N'Pg'L. The thickness of soft tissues of the facial profile was measured on the upper lip from points Ss' and Pr parallel to the palate plane, on the lower lip from Id and Sm points as the smallest thickness, and on the chin from point Pg' perpendicular to N'Pg'L (marked Ss', Pr, etc.). The depth of the concavities of the upper (Ss's depth) and lower (Sm' depth) lip was determined as the distance of points Ss' and Sm' from the line connecting points Sn and Ls resp. Li and Pg. The flattening of the tip of the nose was determined as the perpendicular distance of point Prn from the line crossing points Prns and Prni expressed in terms of percent of the direct distance between Prns and Prni (marked as index). The investigated characteristics are summed up in table 1.

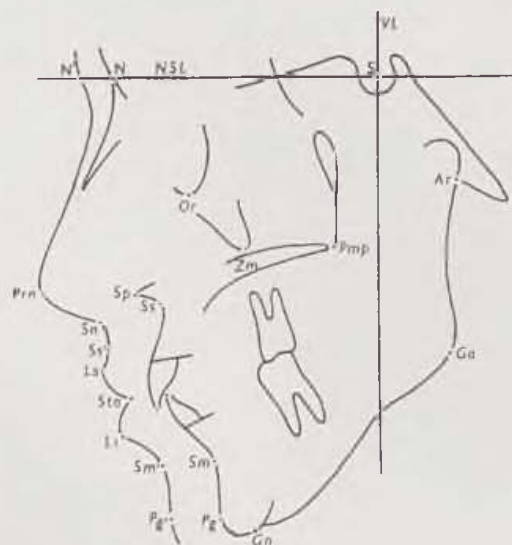


Fig. 1. Cephalometric points used for the assessment of lateral X-ray films

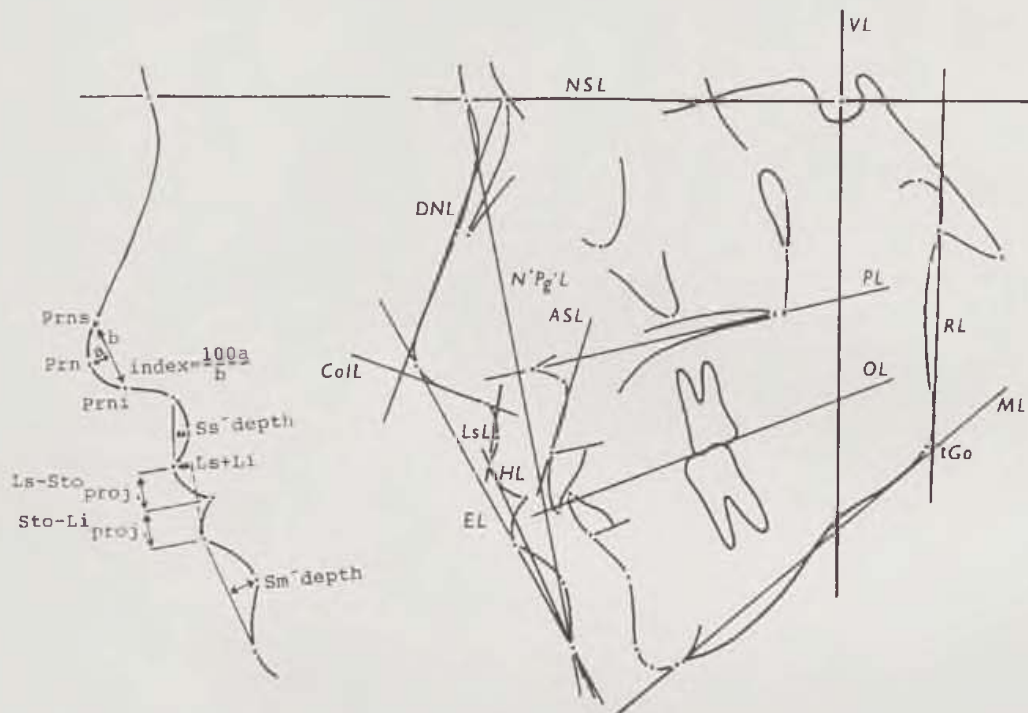


Fig. 2. Reference lines and special characteristics of the soft profile used in the study: NSL = line through N and S, VL = perpendicular to NSL through S, PL = line through Sp and most posterior point of the palatal processes, OL = line through midpoint between tips of upper and lower central incisors and between cusps of the first upper and lower molars, ML = tangent to the mandibular body through Gn, RL = tangent to the mandibular ramus through Ar, ASL = tangent to the upper alveolar process through Pr, N'Pg'L = line through N' and Pg', DNL = tangent to the dorsum nasi, Coll = tangent to the columella through Sn, LsL = line through Ls and midpoint between Sn and Ss', EL = tangent to the soft chin and to the tip of the nose, HL = tangent to the soft chin through Ls, tGo = intersection of ML and RL, Prns and Prni = points of inflexion of the apex nasi contour, PrnsPrniL = line through Prns and Prni

The measured data were analysed with routine statistical methods and the differences from controls and between individual subgroups were tested with the non-paired t-test. For the construction of profile craniograms were used larger numbers of characteristics than are mentioned in the table. The profilograms are superimposed on NSL and registered at the nasion point (N).

RESULTS

The results are summed up in table 1 and documented on Figure 3. For illustration of the size of deviations the patients without premaxillary setback were compared with controls (Fig. 3). Neither of the investigated subgroups of patients differed from controls in the curvature of the cranial base (N-S-Ar). This documented that the latter did not participate in the development of deviations of the facial profile.

Effects of premaxillary setback: The position of the lower (N-S-Go) and upper (Pmp-VL) jaw showed no significant differences between patients with and without premaxillary setback,

Tab. 1. X-ray cephalometric characteristics: Mean values in controls and differences from controls in individual subgroups of patients with complete bilateral cleft lip and palate (in mm or degrees)

	Control	premax. setback	without setback	columellar lengthening	without lengthening
Jaws position					
N-S-Ar	126.92	3.58	1.24	2.20	1.97
N-S-Go	102.31	1.19	2.92 *	2.01	2.91
Pmp-VL	13.84	-4.40 ***	-5.31 ***	-4.84 ***	-5.28 ***
S-N-Ss	80.68	-7.90 ***	-5.44 ***	-7.15 ***	-4.68 ***
S-N-Pg	79.84	-4.17 **	-4.60 ***	-5.25 ***	-2.95
PL/NSL	8.02	0.20	2.57 *	1.39	2.42
OL/NSL	13.02	1.54	6.10 **	4.74 *	4.09
ML/NSL	30.06	8.38 ***	10.53 ***	9.65 ***	10.05 ***
Ar-tGo-N	48.85	0.70	-0.11	-0.27	0.98
N-tGo-Gn	70.27	8.34 **	11.11 +**	9.97 ***	11.61 ***
Bony profile					
Ss-N-Or	26.32	-2.32	-0.61	-1.61	-0.43
Ss-N-Zm	27.63	-1.80	-0.31	-1.48	-0.46
Ss + Sm	3.00	-3.55 *	-4.35 *	-4.03 *	-4.16 *
Ss-N-Sm	2.48	-2.92	-0.54	-1.36	-1.37
N-Ss-Pg	178.12	6.99	1.70	3.23	4.10
ASL/PL	107.60	-11.22 +**	-20.35 ***	-16.25 ***	-18.85 ***
Soft profile					
DNL/NSL	117.76	-5.65 ***	-5.70 **	-5.00 *	-6.98 ***
DNL/N'Pg'L	36.56	-2.23	-2.38	-1.09	-4.67 **
S-N'-Ss'	87.08	-9.08 ***	-9.26 ***	-9.84 (+)***	-7.97 ***
S-N'-Pg'	82.34	-4.56 **	-4.99 ***	-5.40 ***	-3.78 *
Ss'-N'-Pg'	4.74	-4.52 ***	-4.27 ***	-4.44 ***	-4.19 ***
N'-Sn-Pg'	164.64	13.47 ***	12.48 ***	14.01 ***	10.58 ***
EL/DNL	124.11	6.22 **	4.77	3.71	8.22 *
N'-Prn-Pg'	134.00	9.78 ***	8.65 ***	7.35 ***	12.22 ***
Nose depth					
Prn-Sn	20.00	1.33	2.59 **	4.00 +++**	-1.44
Prn-Sp	32.30	-1.41	-5.65 ***	-2.12 ++	-8.08 ***
index	22.21	-3.45 **	-1.51	-1.81	-2.90 *

	Control	premax. setback	without setback	columellar lengthening	without lengthening
Lip height					
Sn-Sto	24.34	-1.56	-2.63 *	-1.46	-3.78 *
Sn-Ls	17.66	-1.66	-2.02 *	-1.48	-2.66
Ls + Sto	6.15	1.18	0.79	1.32	0.18
Sto + Li	8.85	1.87 *	2.27 ***	2.79 ***	0.87
Lip protrusion					
Li - HL	0.65	-5.98 ***	-5.00 ***	-5.06 ***	-5.87 ***
Ls + Li	5.08	-9.69 ***	-9.08 ***	-8.93 ***	-9.97 ***
Lip thickness					
Ss' _t	14.80	-1.14	-2.27 **	-2.13 *	-1.36
Pr' _t	15.26	-0.26	-1.26	-1.06	-0.51
Id' _t	11.60	0.40	-0.37	0.16	-0.60
Sm' _t	12.26	-0.59	-1.14 *	-0.85	-1.15 *
Pg' _t	14.68	-1.68 **	-0.74	-0.74	-1.68
Nasolabial region					
ColL/N'Pg'L	108.10	-7.77 +*	1.25	-1.86	-1.88
LsL/N'Pg'L	9.14	4.42	0.10	3.62	-2.47
LsL/PL	100.21	-0.43	-2.27	0.05	-4.82
ColL/LsL	98.96	-11.96 (+)*	1.16	-5.49	0.60
Ss' depth	2.63	0.31	-1.10 **	-0.98 ***	0.82
Sm' depth	6.75	1.58 *	0.43	1.01	0.47

* significant differences between clefts and controls at $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

+ significant differences between patients with and without premaxillary setback, or between patients with and without columellar lengthening at $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, (+) $p < 0.1$

similarly as it was the case in the predominant majority of skeletal parameters. Yet in some characteristics it was due to the small number of individuals with premaxillary setback. These patients (Fig. 3) developed a larger retrusion of the maxilla (S-N-Ss) which was reflected by an impairment of sagittal jaw relations (a negative Ss-N-Sm) and by a flattening of the skeletal profile (N-Ss-Pg). This was associated with a significantly lesser oral slope of the premaxilla (ASL/PL) which resulted in a smaller height of the upper face, which thus did not differ from controls. Thus, patients with premaxillary setback had a smaller total height of the face, as well as no changes in the slope of palatal (PL/NSL) and occlusal (OL/NSL) plane. The extent of mandibular retrusion did not differ in patients with and without premaxillary setback, which confirmed the validity of the above described differences. Wits appraisal yielded in both groups (Ss+Sm) an identical deviation which was due to the differences in the slope of the occlusal plane (OL/NSL).

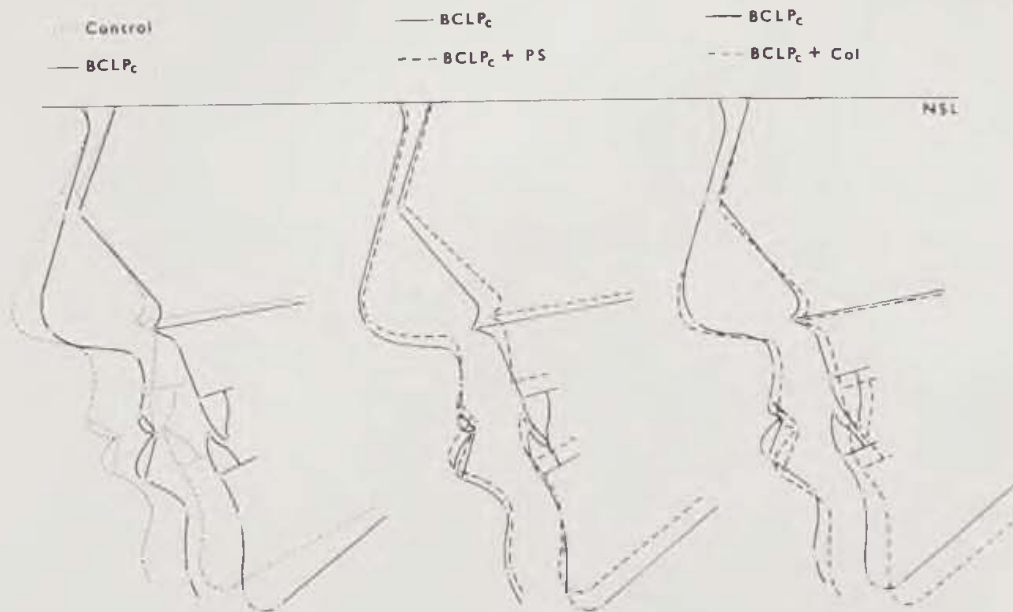


Fig. 3. Profilograms in adult males with complete bilateral cleft lip and palate without premaxillary setback or without columella lengthening (full line) as compared to patients treated with these procedures (dashed line) and to controls (dotted line). PS = premaxillary setback, Col = columella lengthening

The main features of the facial soft profile were identical in patients with and without premaxillary setback, the prominence of the upper lip was similar as well. Because of the larger retrusion of the maxilla, premaxillary setback was not followed by a reduction of the distance between the tip of the nose and the anterior spina (Prn-Sp), or by a reduced thickness of the upper lip (Ss'). A flattening of the tip of the nose was recorded only in patients with premaxillary setback (index) and it could be due to an increased tension of tissues within this region during a larger retrusion of the maxilla.

In individuals with premaxillary setback the smaller height of the upper face and of the nose was associated with a slighter slope of the columella (ColL/N'Pg'L) and thus also with a more acute nasolabial angle (ColL/LsL). This region is rather sunken, with a more oblique profile of the upper lip (LsL/N'Pg'L), which corresponds to the slighter retroinclination of the alveolar process (ASL/PL). Therefore these patients had not a reduction of the concavity of the upper lip (Ss' depth) which was present in individuals without premaxillary setback.

Effects of a prolongation of the columella: Patients with and without a prolonged columella showed no differences in the position of the upper (Pmp-VL) or lower (N-S-Go) jaw, or between most other skeletal characteristics. In individuals with a prolonged columella both jaws recede more markedly backwards (S-N-Ss, S-N-Pg, S-N'-Ss', S-N'-Pg', Fig. 3).

A prolongation of the columella resulted conspicuously in an increase of nasal depth (Prn-Sn) which was excessive equally as compared to that recorded in controls. Simultaneously occurred a normalization of the distance between the tip of the nose and the anterior spina (Prn-Sp), which was markedly reduced in individuals without a prolonged columella. These patients had also a flattened nasal tip (index). An improvement of nasal protrusion after the prolonga-

tion of the columella reflected the slighter flattening of the total facial profile (inclusive of the nose; EL/DNL, N'-Prn-Pg'). However, in contrast with this feature the flattening of the facial profile alone (without the inclusion of the nose, N'-Sn-Pg') was more marked than in individuals without a prolonged columella. This could be suggestive of a larger retrusion of the nasolabial transition due to tissue deficiency after the prolongation of the columella. This was confirmed by a more oblique profile of the upper lip (LsL/PL), since there were only minimum differences in the relation of both lips at the level of the vermillion border, between the two subgroups (Ls+Li, Li-HL).

The increase of the depth of the nasolabial transition after a prolongation of the columella somewhat reduced the shortening of the upper lip (Sn-Sto) and decreased the nasolabial angle (Coll/LsL) and the concavity of the lip (Ss' depth). This could be related to the higher (more uncovered) vermillion of the lower lip (Sto+Li). However, the reported differences were only small and because of the small numbers of patients without a prolonged columella they were not significant. Yet they were in good agreement with the global pattern of the anticipated changes.

DISCUSSION

The main feature recorded after premaxillary setback in childhood represented a more marked retrusion of the maxilla in adulthood. Without doubt this procedure was performed mainly in children with a marked protrusion of the premaxilla and thus a retrusion in adults was by no means related to the initial condition, but represented solely the sequelae of the applied surgical procedure. This procedure resulted in an additional impairment of the already deficient anterior growth in the vomeropremaxillary suture which amounts only to half of the growth rate in normal individuals (Vargervik, 1983). The extent of the simultaneous effect on vertical growth is not clear, but the slighter oral slope of the premaxilla suggests that this deviation and the smaller height of the upper face are due rather to the manipulation of the premaxilla during the surgical procedure. Thus they could be absent in other series. Skeletal deviations exert an action on the configuration of the soft profile, and as mentioned above especially on the nasolabial transition. An absence of a smaller thickness of the upper lip after premaxillary setback is due to the retrusion of the maxilla (due to the extension of the lip into the vestibular sulcus increased by maxillary retrusion).

A retrusion of the maxilla and a flattening of facial skeletal profile in adults who were subjected during childhood to premaxillary setback was demonstrated also by Friede and Pruzansky (1985) and mentioned by Bishara and Olin (1972) and by Vargervik (1983). In our patients without premaxillary setback both facial convexity and sagittal jaw relations were identical with those in controls. This was caused by the receding mandible and the persisting protrusion of the premaxilla (Šmahel, 1984). This protrusion is to a certain degree favourable. It was shown that the pressure exerted by the reconstructed lip alone, proved sufficient for a substantial reduction of the initially protruding premaxilla in adult individuals. Therefore premaxillary setback should be used only in exceptional situations. It could be indicated in the presence of a small mandible, or in a posterior rotation of the face when the sequelae of a setback are less marked. Therefore the decision to use this surgical procedure should be always preceded by an assessment of the above mentioned characteristics.

A prolongation of the columella was equally carried out mostly in patients with an initially short columella. The increase of nasal depth and the other associated changes therefore, represent solely the sequelae of this surgical procedure. These observations were confirmed by

the fact that individuals without a prolonged columella had an adequate depth of the nose and therefore were not subjected to this procedure. However, they had a flattened tip of the nose and thus the adequate depth of the nose resulted from the sunken lip. A prolongation of the columella with an appropriate elevation of the nasal tip resulted in an excessive nasal depth, but the tip of the nose was no more flattened. An excessive nasal depth was enhanced by the observed deeper nasolabial transition since the tissue from this region served for the prolongation of the columella. An excessive nasal depth underlines further the presence of retrocheilia and has an unfavourable esthetic effect on facial configuration. However, in our series it was not related to an excessive elevation of the tip of the nose, but rather to the sunken upper lip. The choice of the extent of a prolongation of the columella, therefore, should be based on the actual situation in a given patient and on the knowledge of the effects associated with the use of any individual procedure. A slighter prolongation of the columella does not lead to an excessive depth of the nose, but it does not allow a sufficient elevation of the nasal tip. A compromise is provided by esthetic considerations, the clue for satisfactory results represents the extent of retrocheilia. However, since this surgical procedure is applied in children of pre-school age, it is difficult to assess the final extent of retrocheilia.

The results showed that the columella was prolonged most likely in individuals with backwards receding jaws. It is possible that the retrusion of upper jaw due to the excessive tension exerted by neighbouring tissues contributes to the flattening of the nose. The posterior obliquity of the profile (backward position of the mandible) has an esthetically unfavourable action and predisposes these individuals for an indication of surgery.

SUMMARY

Roentgencephalometric studies were carried out in 26 adult males with complete bilateral cleft lip and palate. They were subdivided two times in two subgroups, with and without premaxillary setback, and with and without prolongation of the columella. The subgroups were compared mutually, as well as with a group of controls including 50 males matched in age.

Premaxillary setback during childhood resulted in a more marked retrusion of the maxilla in adulthood. A simultaneous slighter oral slope of the premaxilla led to a normalization of the upper face height. Skeletal deviations acted on the configuration of the soft profile, in particular of the nasolabial transition: the slope of the columella towards the profile was reduced and so was the nasolabial angle. Thus the region appeared more markedly sunken. This surgical procedure should be used only in an exceptional situation in a small or posteriorly rotated mandible.

Prolongation of the columella resulted in an excessive nasal depth. This was not caused by an adequate elevation of the tip of the nose which corrected a flattening of the tip, but rather by the sunken upper lip. An unfavourable effect exerted also a larger deepening of the nasolabial transition after a prolongation of the columella. However a slighter prolongation of the columella did not allow a sufficient elevation of the nasal tip. It is therefore necessary to seek a compromise.

Key words: bilateral cleft lip and palate, premaxillary setback, columella lengthening, profile configuration, maxillary retrusion, X-ray cephalometry

RÉSUMÉ

Influence de vomérotomie avec rétro-position du premaxillaire et prolongement de la columelle sur formation du profil chez la fente labio-palatine bilatérale totale

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Par les examens radiocéphalométriques on a examiné 26 hommes adultes atteints de la fente labio-palatine bilatérale totale. Les patients étaient classés deux fois dans deux sous-groupes: avec et sans premaxillaire rétrograde et avec et sans columelle prolongée. Les sous-groupes étaient comparés mutuellement et aussi avec un contrôle de 50 hommes sains à l'âge adéquat.

La rétroflexion du premaxillaire en enfance a causé l'accentuation du retroussement du maxillaire à l'âge adulte. Simultanément, le premaxillaire était moins basculé oralement ce qui a normalisé la hauteur de l'étage supérieur du visage. Les déviations squelettiques ont influencé la formation du profil mou, notamment la transition naso-labiale: l'inclinaison columellaire par rapport au profil était réduite et, par conséquent l'angle naso-labial aussi, toute la région avait l'air reculé. L'intervention doit être réservée aux situations exceptionnelles d'une mandibule petite ou en rotation postérieure.

L'allongement columellaire a causé une profondeur excessive du nez. Mais elle n'était pas liée à la pointe du nez retroussée, qui était adéquate et qui représentait le facteur corrigeant l'applatissage de la pointe, mais à la lèvre supérieure reculée. L'effet défavorable exerce un plus grand approfondissement de la transition naso-labiale après l'allongement de la columelle. Comme un allongement columellaire moins grand ne permet pas monter suffisamment la pointe du nez, il ne reste que se résigner au compromis.

ZUSAMMENFASSUNG

Einwirkungen der Vomerotomie mit der Rückverlegung der Prämaxilla und der Verlängerung der Columella auf die Profilgestaltung bei totalen bilateralen Lippen- und Gaumenspalten

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Röntgenzephalmetrische Untersuchungen erfolgten bei 26 erwachsenen Männern mit totalen bilateralen Lippen-, Kiefer- und Gaumenspalten. Das Untersuchungsgut wurde zweimal in je zwei Gruppen unterteilt, mit und ohne Rückverlegung der Prämaxilla, und mit bzw. ohne Verlängerung der Columella. Die Untergruppen wurden sowohl gegenseitig, wie auch mit einer Kontrollgruppe von 50 gesunden Männern verglichen.

Die Rückverlegung der Prämaxilla im Kindesalter führte zu einer stärkeren Retrusion der Maxilla bei Erwachsenen. Dabei war die Neigung der Prämaxilla in oraler Richtung geringer, mit der Normalisierung der Obergesichtshöhe. Skeletale Abweichungen beeinflussten die Gestaltung des weichen Profils, insbesondere des nasolabialen Überganges. Die geringere Neigung der Columella gegenüber dem Profil und dadurch auch ein engerer nasolabialer Winkel erweckten den Eindruck eines stärkeren Einsinkens dieser Gegend. Der Eingriff war nur in Ausnahmefällen indiziert, d.h. bei einer kleinen oder rückwärts rotierten Mandibula.

Die Verlängerung der Columella vergrößerte übermäßig die Tiefe der Nase. Sie war jedoch in keinem Zusammenhang mit dem Heben der Nasenspitze, die völlig adequat war und die Verflachung der Nase korrigierte, und war durch die Einsenkung der Oberlippe bedingt. Ungünstig wirkte auch der tiefere nasolabiale Übergang nach der Verlängerung der Columella. Eine kleinere Verlängerung der Columella ermöglichte jedoch nicht eine genügende Hebung der Nasenspitze. Ein Kompromis ist daher unerlässlich.

REFERENCES

1. **Bishara S. E., Olin W. H.:** Surgical repositioning of the premaxilla in complete bilateral cleft lip and palate. *Angle Orthodont.*, 42: 139-147, 1972.
2. **Friede H., Pruzansky S.:** Long-term effects of premaxillary setback on facial skeletal profile in complete bilateral cleft lip and palate. *Cleft Palate J.*, 22: 97-105, 1985.
3. **Šmahel Z.:** Craniofacial morphology in adults with bilateral complete cleft lip and palate. *Cleft Palate J.*, 21: 159-169, 1984.
4. **Šmahel Z., Polívková H., Škvařilová B., Horák I.:** Configuration of facial profile in adults with cleft lip with or without cleft palate. *Acta Chir. Plast.*, 34: 190-203, 1992.
5. **Vargervik K.:** Growth characteristics of the premaxilla and orthodontic treatment principles in bilateral cleft lip and palate. *Cleft Palate J.*, 20: 289-301, 1983.

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THE EFFECT OF TWO-STAGE PALATOPLASTY ON FACIAL DEVELOPMENT IN UNILATERAL CLEFT LIP AND PALATE

Z. ŠMAHEL, I. HORÁK

The tension of scars after palatoplasty and the uninterrupted ossification of the reconstructed palate without the growth suture limit the anteroposterior and transversal growth of the maxilla. It is justified to anticipate that the earlier is performed the closure of the palate, the earlier occurs an impairment of maxillary growth and this will necessarily result in more marked final sequelae. They will consist mainly in a retrusion of the maxilla and in severe orthodontic anomalies. However the delay of palate repair shows a correlation with a less favourable development of speech and thus the phoniaticians request that the operation should be carried out as early as possible. Schweckendiek (1951) made an attempt to settle this discrepancy by the introduction of the closure of the palate in two stages. He proposed to perform during the first year of life only a suture of the soft palate and to delay the repair of the hard palate up to the age of twelve years. He anticipated a satisfactory development of speech after the early onset of function of the velum and simultaneously an undisturbed growth of the upper jaw.

The closure of the palate in two stages, with some modifications, was used at the Department for Plastic Surgery in Prague in 1960-1961 in all patients with complete cleft lip and palate (Fára, 1969). In view of the fact that most of these children attend regularly youth centres and have their meals at school and in view of the psychic effects of the long duration of a life in a collective of children, it proved necessary to perform the second stage of surgical repair before the school age, i. e. about the age of 6 years. Because of the incomplete velopharyngeal closure it proved also necessary to supplement the repair of the hard palate regularly with a pushback of the palate associated mostly with pharyngeal flap surgery. Veloplasty was carried out simultaneously with lip suture.

Recently have been newly discussed the advantages of palate surgery in two stages and since it was reintroduced into the practice at numerous departments, it was decided to assess to what extent this technique in a modification convenient for the situation in our country, exerts an effect on facial growth and development on patients with clefts. The study is based on an evaluation of measurements on X-ray films of the skull.

MATERIAL AND METHOD

The series included 17 boys and 7 girls with complete unilateral cleft lip and palate operated upon with the modified two-stage palatoplasty according to Schweckendiek. The investi-

gated parameters in the group of girls did not differ from those in boys and therefore both groups were pooled. The patients were examined at the age of 10 to 11 years (at a mean age of 10 years and 5 months) and they had no associated malformations. The soft palate was closed simultaneously with primary lip suture at a mean age of 6.9 months, the hard palate was repaired at the age of 6 years and 1 month.

The group of patients with palate closure in one stage consisted of 27 boys with the same type of cleft who were examined equally at the age of 10-11 years (at a mean age of 10 years and 4 months). They were operated upon at a time following immediately after the two year period of palate closure in two stages. The lip was repaired at the mean age of 7 months, the palate at 4 years with the method of pushback associated with pharyngeal flap surgery. Cheiloplasty was carried out in both series with the same technique, according to Tennison (exceptionally according to Millard) without surgical repair of alveolar cleft. All patients in the first series and a predominant majority in the second series were operated upon by the same surgeon and all were subjected to orthodontic therapy at the same department with the use of removable appliances only. They were not treated with any other procedure up to the above mentioned age of examination.

X-ray films were made under standard conditions during centric occlusion with the head of the patient fixed in a cephalostat. Craniometric points and reference lines used for the evaluation of X-ray films are presented on Figure 1, a list of measured characteristics is presented in Table 1. The angles are marked as e.g. N-S-Ba (the angle of the cranial base), or as a fraction of reference lines forming the given angle (mandibular angle ML/RL), and proportional characteristics as N-Sp%N-Gn (the distance of N-Sp in percent of the N-Gn distance). An overjet (Is-Ii) was measured as the distance between the edges of upper and lower incisors parallel to the occlusal plane (negative values designated a crossbite). Ls+Li shows the extent of the prominence of the upper lip over the lower lip (measured in the above mentioned points perpendicular to the connecting line N'-Pg'; Fig. 1).

The data obtained by measurements were analyzed with routine statistical methods and the differences between both series were evaluated with the t-test.

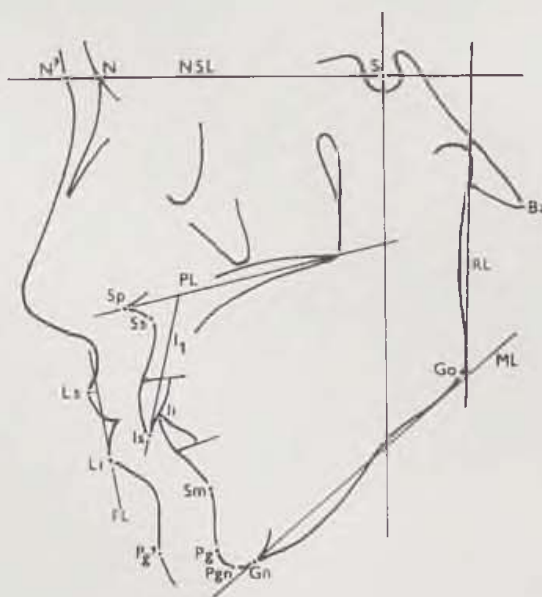


Fig. 1. Cephalometric points and reference lines used for the assessment of X-ray films
(FL = line through Li parallel with line connecting N' and Pg' points,
Ls+Li = perpendicular distance of Ls from FL)

Table 1. Mean values of basic cephalometric characteristics in patients with two-stage and one-stage palatoplasty

variable	2-stage	1-stage
N-S-Ba	132.6	131.9
N-S-Pgn	70.5	70.6
ML/NSL	38.5	38.0
RL/NSL	86.4	87.4
ML/RL	132.1	130.9
S-N-Ss	76.0	75.1
S-N-Sm	74.2	73.7
S-N-Pg	75.1	74.9
Ss-N-Sm	1.8	1.4
N-Ss-Pg	178.1	179.3
Is-Ii	0.3 *	-0.8 *
I ₁ /PL	99.3	96.9
Ls + Li	0.9	0.6
N-Sp%N-Gn	42.5	42.9
S-Go%N-Gn	60.4	60.5
n	24	27

* difference between patients with two-stage and one-stage palatal repair at $p < 0.1$

RESULTS

The results of measurements are summed-up in Table 1. The curvature of the cranial base (N-S-Ba) and the direction of growth of the mandible (N-S-Pgn) were identical in both series and confirmed their comparability with regard to the facial growth pattern. The impairment of vertical facial proportions (N-Sp%N-Gn), the deficient anterior growth rotation during facial development (S-Go%N-Gn) and the excessive steepness of the mandibular body (ML/NSL) which are typical of clefts were equally identical in both series. Patients with palate closure in two stages had a somewhat (insign.) slighter retrusion of the upper jaw than individuals operated upon in one stage (S-N-Ss) but there was only little difference in sagittal jaw relations (Ss-N-Sm) and in facial convexity (N-Ss-Pg). There were equally no differences between both series in the protrusion of the lower jaw (S-N-Sm, S-N-Pg), in the inclination of the mandibular ramus (RL/NSL) and in the mandibular angle (ML/RL). There was only one more marked difference consisting in the attained slight positive overjet (0.3 mm) in patients operated upon according to Schweckendiek (Is-Ii) as compared to an anterior crossbite (-0.8 mm) in patients with an one-stage closure of the palate. However, because of the high variability of the characteristic the difference did not attain the significance level ($p < 0.1$). An analysis of the causes of this difference revealed that the improvement after the two-stage closure of the palate was due mainly to the larger proclination of upper incisors (I₁/PL) which was attained by orthodontic therapy. The prominence of the upper lip showed no differences between both series (Ls+Li).

DISCUSSION

The improved overjet in patients with two-stage palatoplasty as compared to one-stage operation was most probably due to the intense orthodontic therapy, since the skeletal parameters, inclusive of the sagittal jaw relations and the convexity of facial profile, did not show any changes between both series. The intense and systematic orthodontic care for these patients was mentioned by Fára (1969). Its aim was to prevent the participation of the compression of maxillary segments in the narrowing of the residual cleft in the hard palate (Fára and Brousilová, 1988) which is due to the growth by apposition on the edges of the palatal plates (Berkowitz, 1985). For the evaluation of the effects of the surgical method on the growth and development of the jaws are therefore of major importance skeletal parameters which disclosed that the two-stage closure of the palate according to Schweckendiek, modified for the use in our practice, did not provide any improvement. Similar conclusions reached Brousilová and Fára (1989) during a long-term follow-up of the development of the dentoalveolar arch of the upper jaw on dental casts. The narrowing of the cleft defect was equally not large enough to avoid during the suture of the hard palate an extensive mobilisation of mucoperiosteal flaps from the palatal plates (Fára and Brousilová, 1988). The assessment of speech equally did not show any substantial improvement (Fára and Brousilová, 1969).

During the assessment of our results it should be realized, however, that the delay of surgical repair of the hard palate according to Schweckendiek amounted only to two years as compared to the time of an one-stage operation. It is not possible to exclude favourable changes in the growth of the upper jaw in a postponement of the closure of the hard palate into a more mature age, inclusive of a greater narrowing of the cleft defect. New procedures used for reconstruction of the soft palate and its suturing to the vomer with the disconnection of faulty insertions of muscles provide hope that it will be possible to improve the early function of the velum and the quality of speech (Hotz et al., 1986). However, it can be stated that the delay of hard palate surgery amounting to two years, i.e. from 4 to 6 years of age, failed to provide an improvement. Since the delay was rather short it is not possible to state whether a longer time interval would actually yield the requested substantial improvement.

The assessment of the results obtained was carried out in the prepubertal period with the same methods as after other surgical procedures. The main reason was that a collection of comparable series is associated with difficulties at a more mature age because of the differences in the applied orthodontic therapy and the increasing frequency of the use of fixed appliances. Both of them can modify the effects of a given surgical method on the subsequent growth. However, it was demonstrated that an impairment of facial development occurred regularly during puberty (Šmahel and Müllerová, in press). When a deficient development of the jaws was recorded prior to the onset of puberty it is not possible to anticipate a more favourable situation in the postpubertal period. It was shown that in adequate series of patients a comparison can as early as in the prepubertal period indicate whether newly introduced surgical methods could lead to an improvement or to a deterioration. In the case of a deterioration of jaw development it is not justified to postpone for many years a change of the applied therapeutic procedure until the termination of growth. All these observations and facts induced us to assess the effect of surgical methods on facial growth prior to the onset of puberty when a sufficient postoperative period elapsed for the manifestation of the effects of surgery. However, the follow-up of the patients should continue and it will be the subject of our future studies.

SUMMARY

Measurements on X-ray films were used for the assessment of facial development in 24 individuals with complete unilateral cleft lip and palate, ranging in age from 10 to 11 years and operated upon in two stages. The suture of the velum was performed simultaneously with cheiloplasty at the age of 7 months, the suture of the hard palate followed at the age of 6 years. They were compared with a series of 27 individuals with the same type of cleft who were subjected to one-stage closure of the palate at the age of 4 years. But for the more favourable occlusion of incisors after two-stage palatoplasty, which was due to the more intense orthodontic therapy, these two series showed no differences in facial growth and development. The delay of surgical repair of the hard palate by two years did not improve the growth and development of jaws. However, it is not possible to exclude favourable effects of a delay of the suture of hard palate into a substantially more mature age.

Key words: unilateral cleft lip and palate, two-stage vs. one-stage palatoplasty, roentgencephalometry

RÉSUMÉ

Influence d'intervention à deux temps sur évolution faciale chez la fente labio-palatine unilatérale

Šmahel Z., Horák I.

L'étude radiocéphalométrique a évalué 24 patients âgés de 10 à 11 ans, sujets de la fente labio-maxillo-palatine unilatérale totale, chez lesquels une intervention de fermeture palatine à deux étapes a été effectuée: suture du voile étant effectuée simultanément avec la cheiloplastie à l'âge de 7 mois, suture du palais osseux à 6 ans. Les sujets ont été comparés avec un groupe de 27 personnes au même type de la fente, avec la fermeture palatine à une étape, effectuée à l'âge de 4 ans. Sauf une meilleure occlusion des incisives chez le groupe opéré à deux étapes, due à une thérapie orthodontique plus intensive, on n'a pas trouvé aucunes différences dans la croissance et dans l'évolution du visage. Le sursis d'intervention du palais osseux à 2 ans n'a pas apporté, du point de vue de la croissance et du développement des maxillaires, aucune amélioration. Néanmoins, il n'est pas exclu que l'exécution de la suture du palais osseux à l'âge essentiellement plus élevé puisse apporter des changements plus favorables.

ZUSAMMENFASSUNG

Die Einwirkung der Gaumenoperation in zwei Etappen auf die Gesichtsentwicklung bei einseitigen totalen Lippen- und Gaumenspaltnmissbildungen

Šmahel Z., Horák I.

Röntgenzephalmetrische Auswertungen erfolgten bei 24 Patienten mit totalen einseitigen Lippe-, Kiefer, und Gaumenspalten im Alter von 10 bis 11 Jahren, nach vorheriger Gaumenoperation in zwei Etappen. Die Suture des Velum erfolgte gleichzeitig mit der Cheiloplastik im Alter von 7 Monaten, die Suture des harten Gaumens folgte dann im Alter von 6 Jahren. Zu Vergleichszwecken diente eine Gruppe von 27 Kranken mit demselben Typo der Spaltmissbildung, die im Alter von 4 Jahren in einer Etappe

operiert wurden. Mit der Ausnahme einer günstigeren Okklusion der Schneidezähne nach der Gaumenoperation in zwei Etappen, die das Ergebniss einer intensiven orthodontischen Behandlung darstellte, bestanden zwischen den beiden Gruppen keine Unterschiede im Gesichtswachstum und Entwicklung. Die Aufschiebung der Operation des harten Gaumens um zwei Jahre brachte daher keine Verbesserung des Wachstums und der Entwicklung der Kiefer. Es kann jedoch, nicht ausgeschlossen werden, dass in einem bedeutend tieferen Alter die Suture des harten Gaumens unter günstigeren Bedingungen stattfinden könnte.

REFERENCES

1. **Berkowitz S.:** Timing cleft palate closure - age should not be the sole determinant. *J. Craniofac. Genet. Dev. Biol., Suppl.* 1: 69-83, 1985.
2. **Brousilová M., Fára M.:** Development of the maxillary arch in cleft patients treated by Schweckendiek technique. In *Multidisciplinary Management of Cleft Lip and Palate*. J. Bardach and H. L. Morris (eds), W. B. Saunders, Philadelphia, 1990, pp. 662-671.
3. **Fára M.:** Zkušenosti s dvoudobým operováním rozštěpu patra podle Schweckendieka. *Rozhl. Chir.*, 48: 264-270, 1969.
4. **Fára M., Brousilová M.:** Experiences with early closure of velum and later closure of hard palate. *Plast. Reconstr. Surg.* 44: 134-141, 1969.
5. **Fára M., Brousilová M.:** Dlouhodobé zkušenosti s dvoudobým operováním rozštěpu patra u celkových jednostranných a oboustranných rozštěpů z hlediska vývoje horní čelisti. *Rozhl. Chir.*, 67: 729-741, 1988.
6. **Hotz M., Gnoinski W., Perko M., Nussbaumer H., Hof E., Haubensak R.:** The Zürich approach, 1964 to 1984. In M. Hotz, W. Gnoinski, M. Perko, H. Nussbaumer, E. Hof and R. Haubensak (eds), *Early treatment of cleft lip and palate*. Hans Huber, Bern 1986, pp. 42-48.
7. **Schweckendiek H.:** Zur Frage der Früh- und Spaltoperationen der angeborenen Lippen-Kiefer-Gaumenspalten. *Z. Laryngol. Rhinol.* 30: 51, 1951.
8. **Šmahel Z., Müllerová Ž.:** Growth and development of the face in unilateral cleft lip and palate during the period of puberty: Longitudinal study. *J. Craniofac. Genet. Dev. Biol.*, in press.

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CLASSIFICATION OF DEEP BURN INJURIES - ANALYSES OF 117 CASES

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Treatment of deep burn injuries has been a challenge to the burn surgeon because of the immense variety of the burn extent, which varies dramatically from the full skin thickness necrosis to the bone carbonized. A single diagnosis of III degree (full thickness) or IV degree burn is too sweeping to make a difference between the tissues of burn injuries. Some classifications for such injuries have been found in the literature (1-4) but these classifications have failed to meet the needs of the treatment because they were equivocal or used only for a special site of burn injuries, or hard to be mastered. In the studies about the deep burn injuries, an ideal numerical system, index of deep burn injuries (IDBI), has been proposed in Jiamusi Medical College (5). After using this system for a 3-year period, it was reported as follows.

MATERIALS AND METHODS

IDBI design

Our extensive investigations, involving not only the severity and every extent of burn injuries in the wound but also the local anatomic structures and the functions of every tissue, suggested that a correct diagnosis of a deep burn injury could be made with a numerical indicate system, IDBI, which is summarized in Table 1. Using this system, we analysed 304 burn sites in 117 cases for the diagnosis, classification, indications of repair, prognosis, function and figure etc.

Clinical data

The one hundred seventeen patients who were admitted to our hospital between July 1988 and August 1991 accounted for 22.7 % of the total admissions in this department at the same time period. Of them 88 cases were male, 29 cases were female, mean age was 23.8 years ranging from 7 months to 63 years, and average total body surface of burn (TBSB) was 14.9 % varying from 1 % to 50 %. Of them the burn causes as well as the distribution of the total 304 burn sites are described in Table 2. The size of the IDBI for every site of burn injuries was calculated after admission, and finalized during the first operation. These burn injuries were repaired using a general comprehensive method (GCM) which includes: 1. conservating some important degenerative structures, such as nerve, tendon, bone etc during the debridement; 2. flap coverage; 3. immediate grafting vessels, nerves or tendons if necessary; 4. continuous irrigation beneath the flap with CLS (2000 mg of chloromycetin, 40 ml of 2 % lidocain and 1000

Table 1. Distribution of index of burn injuries

Tissue type	Burn extent			
	Exposure (index)	Damage (index)	Necrosis (embolism) (index)	Loss (index)
Full skin & subcutaneous tissues (F.S)	0.0	0.0	1.0	1.0
Vessels (artery & accompanying vein) (V)	1.0	1.5	2.5	2.5
Nerve (N) (one)	1.0	1.5	2.0	2.5
Bone (B) (one)	0.5	1.5	2.0	2.5
Tendon (T) (one)	0.5	1.0	1.5	1.5
Joint capsule (JC) (one)	0.5	1.0	1.5	1.5
Muscle (M) (one)	0.0	0.5	1.0	1.0
Ligament (L) (one)	0.0	0.5	1.0	1.0

Note: A single artery, such as a finger artery, is calculated with only 1/2 index, conversely, no index was designed for a single vein, also, no index is used for the sensitive nerves except the digital and radial nerves, which is numbered with only 1/2 N. index.

ml of normal saline solution). The repair was carried out as early as possible (4-6). After admission, average 4 days ranging from 1 hour to 15 days the repairs of 304 burn sites were carried out except the 18 sites lost spontaneously after burns. A total of 214 flaps, including 16 free flaps, 34 island flaps and 164 random flaps was used in this group. Of them 211 survived completely, the rest included one free flap lost and two random flaps lost their distant ends. The results in this group were very satisfactory.

RESULTS

Obviously, the IDBI category of the 304 burn sites is in directly proportional to the severity and extent of burn injuries and inversely proportional to the quality of the results (Table 3). The sites with the IDBI of less than 6 got an excellent or good result with the repair of GCM (Figure 1). The IDBI from 6 to 10.9 indicated that some deep structures had been burned or lost. After aggressive repair with the GCM, almost all of them obtained good figures and excellent functions (Figures 2 and 6). The IDBI from 11 to 15.9 suggested that the injuries were very severe. If they were treated with routine conservative method, most of them would have been lost because of infection, dryness, dehydration and continuous necrosis of the tissues in the burn sites. Fortunately, most of them in this group obtained a satisfactory result with the repair of the GCM (Figures 3-5). The IDBI from 16 to 20.9 indicated that most important structures, such as vessel, nerve, and tendon were deteriorated or lost. Although we also tried to rehabilitate all the 20 sites in this section of IDBI with the GCM, only two of them preserved the figures and partial functions, and the rest failed in the repair (Figures 2 and 5). The IDBI that was equal to or more than 21 indicated that the extremities of burn injuries lost spontaneously post injury, and no repair was needed (Figure 6). According to the analyses above, the IDBI was further grading in Table 4. The type from I to III indicated that these injuries could be repaired with the GCM and the prognoses were favourable although there were many differences between the three types. Type IV was very difficult to treat and the prognosis was bad. Last, for the type V, no repair was needed according to this group.

Table 2. Comparison between the burn sites and burn causes

Sites	Burn causes							TOTAL n
	Flame n	Scald n	Electric n	Heat-Crush n	Explosive n	Chemical n	Other n	
Finger	12	3	120	18	2	5	15	175
Dorsum	1	6	2	4	0	0	0	13
Palm	3	2	1	4	0	0	0	10
Wrist	1	0	14	4	0	0	0	19
Forearm	0	0	1	1	0	0	0	2
Elbow	0	1	1	2	0	0	0	4
Upperarm	2	3	2	2	0	0	0	9
Digit	7	5	5	0	0	0	0	17
Dorsum	1	3	3	3	0	0	2	12
Plantar	2	0	0	0	0	0	0	2
Ankle	1	0	2	2	1	0	2	8
Shank	1	0	0	2	0	0	1	4
Knee	1	0	0	0	0	0	3	4
Thigh	0	0	2	0	0	0	0	2
Buttock	1	0	1	6	0	0	3	11
Scalp	3	0	6	0	0	0	3	12
TOTAL	36	23	160	48	3	5	29	304

DISCUSSION

During the last decade, much effort for the treatment of deep burn injuries has been found in the literature (2-4, 7, 8, 10), but even so the amputation rate of such injuries still remains at unacceptable level, which varies between 25.1 % and 71.4 % (2-4, 8, 9). Progressive necrosis of tissues in the burn wounds was greatly responsible for such unsatisfactory results. Thereupon, the early repair with aggressive measures was considered a hopeful treatment for to rescue the extremities or digits of burn injuries, which varied greatly from full skin thickness necrosis to the bone carbonized. For that matter, the questions how to make a correct diagnosis, how to make a difference between the tissues of burn injuries and how to decide the repair indications were very difficult. Obviously, a decisive classification, which involved every burn tissue and every burn extent, was absolutely necessary, and the IDBI, a numerical system of classification, just emerged as the times required. Although the IDBI makes the diagnosis a little complex, it will be a great help for the treatment. First of all, it indicates clearly that the standard of IV degree burn is equal to or more than 2 of the IDBI, which is generally considered to require the repair with the flap coverage. Other significances of the IDBI include: 1, making a correct diagnosis for every site of deep burn injuries, avoiding thus a mistake of unnecessary stress on some kind of tissue; 2, providing decided repair indications; 3, indicating the prognoses of every burn site; 4, providing a reliable method for further investigations and studies in the burn field.

Table 3. Comparison between IDBI and results

IDBI category	Results					
	Excellent n	Good n	Fair n	Poor n	Loss n	TOTAL n
2-	5	0	0	0	0	5
3-	10	0	0	0	0	10
4-	12	4	0	0	0	16
5-	24	7	0	0	0	31
6-	11	15	0	0	0	26
7-	22	12	0	0	0	34
8-	19	31	1	0	0	51
9-	12	17	2	0	0	31
10-	7	4	0	0	0	11
11-	8	3	0	0	0	11
12-	6	10	0	0	0	16
13-	4	1	1	0	0	6
14-	2	3	2	0	0	7
15-	2	3	4	0	1	10
16-	0	0	0	1	1	2
17-	0	0	0	2	5	7
18-	0	0	0	3	0	3
19-	0	0	2	1	0	3
20-	0	2	0	3	0	5
21	0	0	0	1	18	19
TOTAL	144	112	12	11	25	304

Note: Excellent result indicates the functions and the figure of the site repaired was normal; Good means excellent functions with not good figure; Fair means partial functions loss with not good figure; Poor indicates full functions loss with rigid figure; Loss including amputation and extremities lost spontaneously post injury.

Table 4. Comparison between the gradation of IDBI and the results

Results	Type I Index 2- n	Type II Index 6- n	Type III Index 11- n	Type IV Index 16- n	Type V Index 21- n	TOTAL	
						n	%
Excellent & good	62	150	42	2	0	256	84.2
Fair	0	3	7	2	0	12	4.0
Poor & loss	0	0	1	16	19	36	11.8
TOTAL	62	153	50	20	19	304	100.0

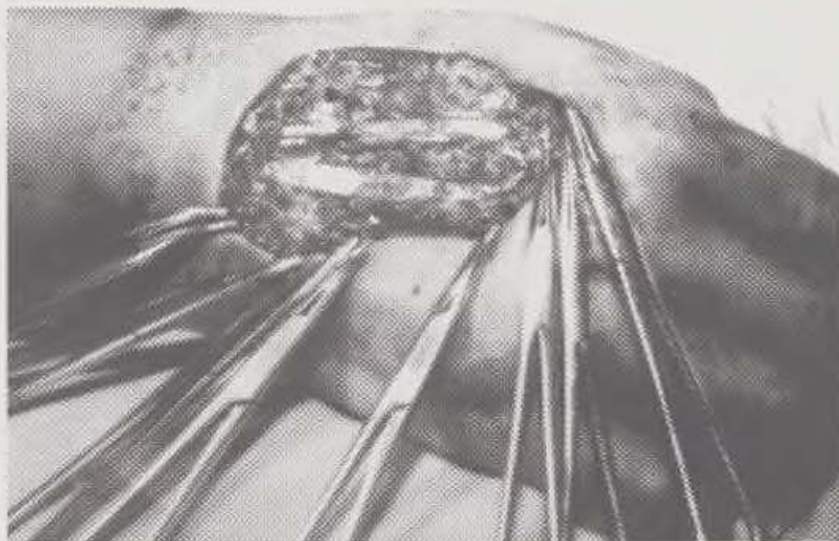


Fig. 1a) Female, age 35, day 5 after a contact burn, according to the design in Table 1. the IDBI of dorsum was 2 (type I) which included T. 0.5x2, and FS. 1



b) In three weeks after repair, the function of the hand is excellent

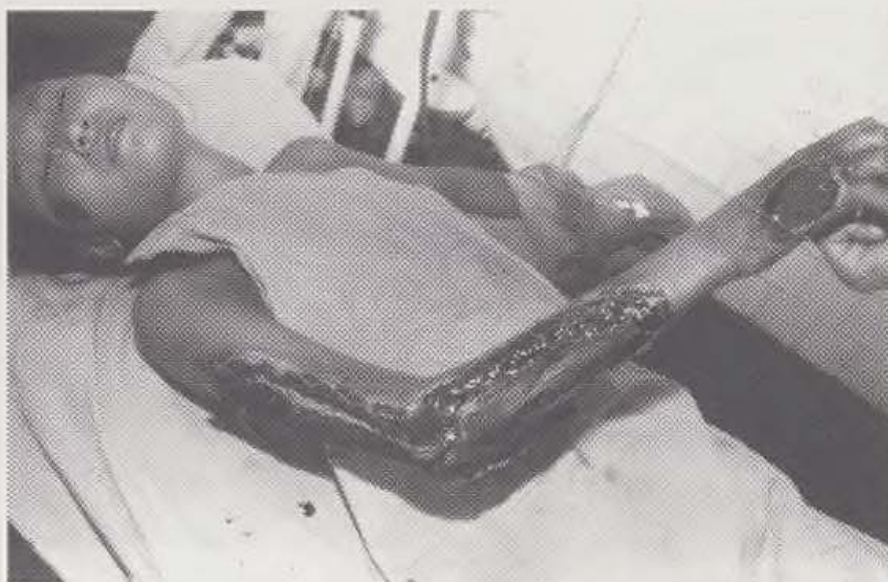


Fig. 2a) Female, age 18, day 15 after a heat-crush injury, the wounds were sloughing



b) After debridement, the IDBI of the elbow was 17.25 (type IV), including FS. 1, V. 2.5, N. 1.25, B. 1.5x3, M. 1x4, JC. 1, and L. 1x3; IDBI of forearm was 16.5 (type IV): FS 1, V 2.5, N 2.0, B 1.5x2, and M 1x8; IDBI of hand dorsum was 7.0: FS 1, T 1.5x3, and M 0.5x3. (type II)



Fig. 2c) In one year after injury, a partially functional arm is obtained

SUMMARY

A new system of classification, index of deep burn injuries (IDBI), was proposed in this paper. Using this system, we investigated 304 burn sites in 117 cases, of which 94.1 % were repaired with the GCM with a satisfactory result. The IDBI of the 304 burn sites is in direct proportion to the severity and extent of burn injury and inverse ratio to the results. Analyses performed in this group suggested that the IDBI has many significances, which include: 1, making a correct diagnosis; 2, providing decided repair indications; 3, indicating the prognosis; 4, providing a reliable method for further investigation in the burn field. The standard of IV degree burn is equal to or more than 2 of IDBI.

Key words: deep burn injury, classification, IDBI, flap, repair

RÉSUMÉ

Classification de profondeur du traumatisme de brûlure - analyse de 117 cas

Liou X. Y., Wang Y., Wang T. J., Yu D. C., Wang S. B.

Dans ce travail, on a proposé un nouveau système d'évaluation de l'importance de la brûlure consistant dans l'indice de la profondeur d'endommagement par brûlure (IDBI). A l'aide du système, 304 de brûlures chez 117 patients étaient examinées, dont 94,1 % étaient guéries par les méthodes



Fig. 3a) Male, age 13, day 7 after 3300 voltage electrical injury, the wrist was sloughing, and the IDBI was 15 (type III) FS 1, V 2.5, N 1.5, T 1.5x6, and N 1.0



b) One year after a free inferior epigastric flap coverage, a functional hand is obtained

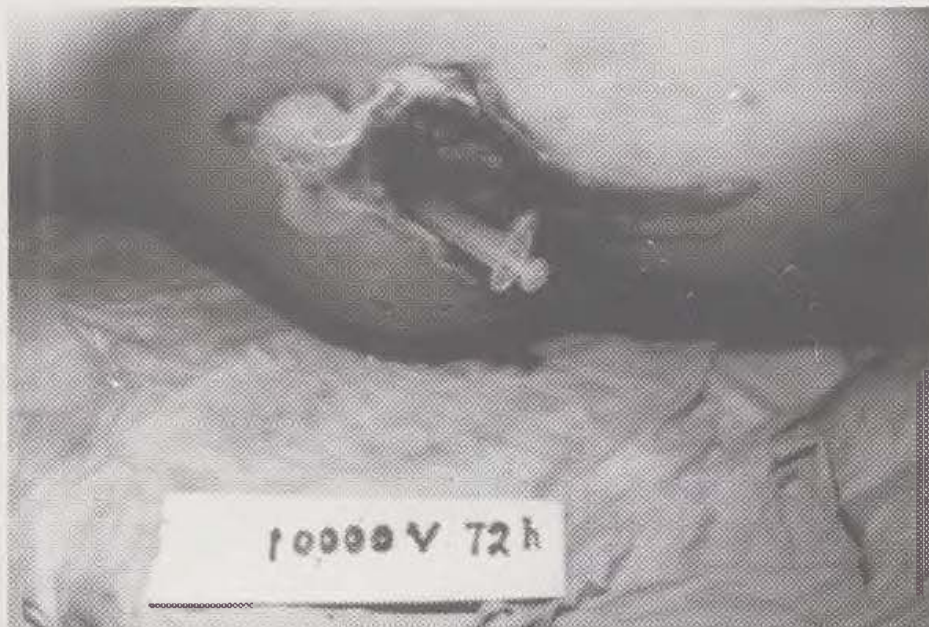
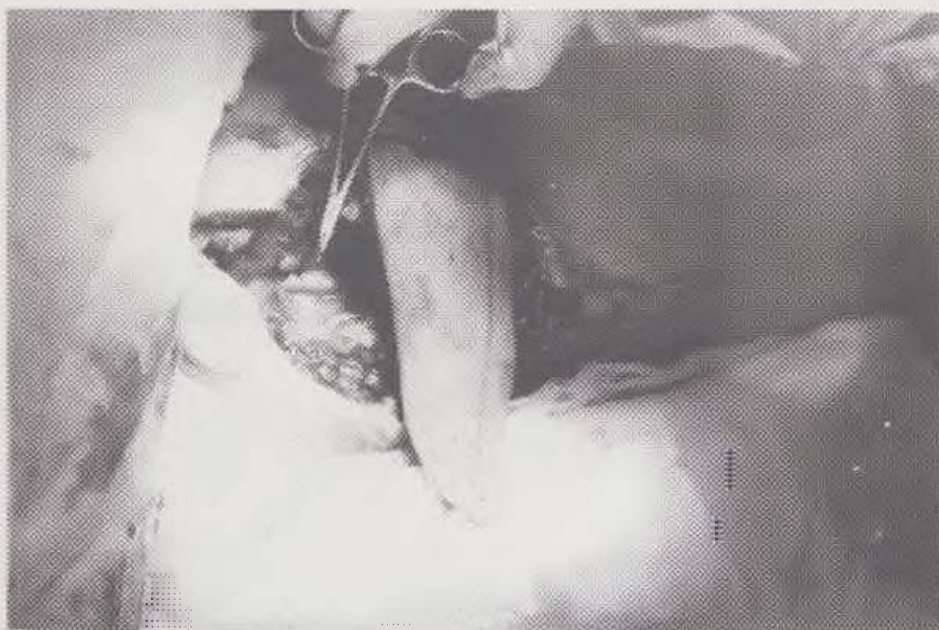


Fig. 4a) Male, age 35, hour 12 after 10 000 voltage electrical injury, the injector was inserted into the charred hole of the inferior gluteal muscles



b) The hemostatic forceps indicates sciatic nerve damaged.
The IDBI was 12.5 (type III): FS 1, N 1.5, M 1x9, L 1.0



Fig. 4c) Three months after repair, a functional leg is obtained with not good figure

employées généralement (GCM) et les résultats obtenus étaient satisfaisants. IDBI dans 304 localisations de brûlure est en fonction directe de l'importance et de l'étendue du traumatisme de brûlure et en proportion inverse aux résultats du traitement. L'analyse employée chez notre groupe a découvert que IDBI possède plusieurs sens, ce qui implique: 1. déterminer un diagnostic correcte, 2. choisir une méthode correcte du traitement, 3. établir le pronostic, 4. offrir une méthode fiable pour la recherche ultérieure sur le plan des brûlures, 5. déterminer le standard du IV. degré de brûlure correspondant à la valeur 2 et plus de IDBI.

ZUSAMMENFASSUNG

Klassifikation der Verletzungen durch tiefe Verbrennungen - Analyse von 117 Fällen

Liou X. Y., Wang Y., Wang T. J., Yu D. C., Wang S. B.

Die Arbeit befasst sich mit dem Vorschlag eines neuen Systems der Klassifikation - dem Index der Verletzungen durch tiefe Verbrennungen (DBI). Mit diesem System erfolgten Untersuchungen von 304 Verbrennungen bei 117 Personen, davon wurden 94,1 % mit den üblichen Methoden geheilt (GCM) und zwar mit guten Ergebnissen IDBI war bei 304 Verbrennungen direkt abhängig von der schwere und Ausdehnung der Verbrennungen und war im entgegengesetztem Verhältnis zu den Ergebnissen. Die angewandte Analyse zeigte die folgenden Vorteile des IDBI: 1. die richtige Diagnosestellung, 2. Bestimmung der korrekten Wahl der Behandlungsmethode, 3. Aussage über die Prognose, 4. der Vorschlag einer verlässlichen Methode der weiteren Untersuchungen in der Gegend der Verbrennung, 5. Bestimmung des IV. Standards des Verbrennungsgrades der dem Wert von 2 bzw. mehr IDBI entsprechen würde.

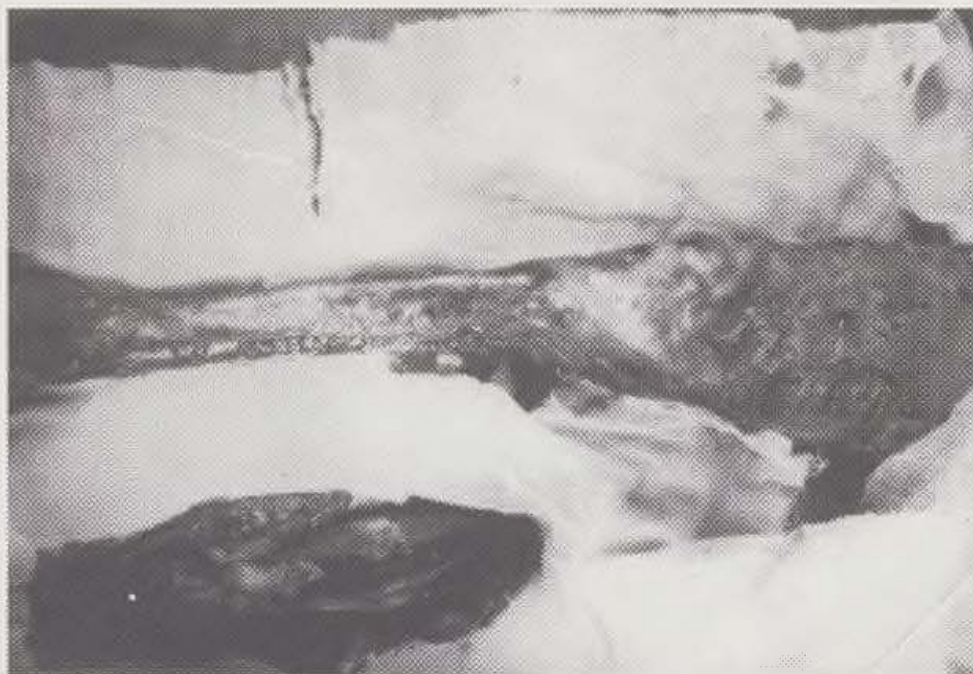
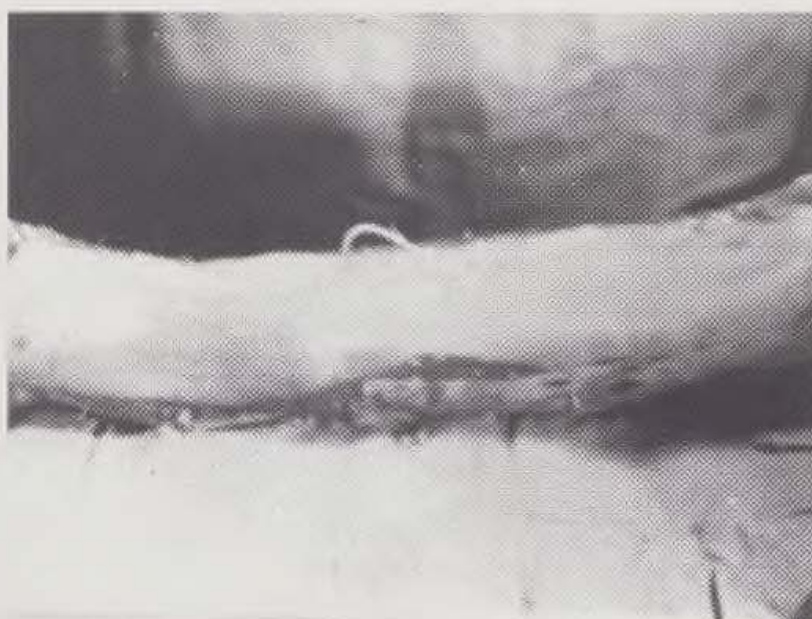


Fig. 5a) Male, age 50, day 7 after scald, the shank and knee were sloughing. Arrow indicates the necrotic muscles debrided. IDBI of the knee was 10.5 (type II): FS 1, B 1.5x3, T 1, JC 1 and L 1x3



b) The shank was covered with a free thoraco-abdominal flap



Fig. 5c) The dysfunctional leg can stand only

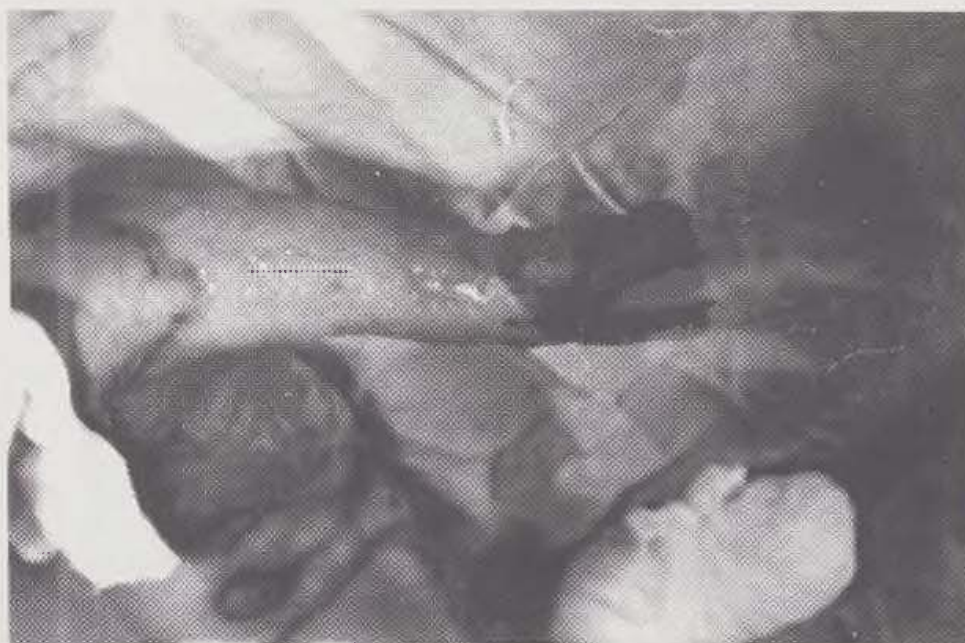


Fig. 6a) Male, 5 months old, day 7 after injury. His TBSB was 20 %. All of five digits charred. IDBI of every digit was 21 (type V): FS 1, V 1.25x4, N 1.25x4, T 1x3, B 2.0x3 and JC 1.0.
The IDBI of dorsum was 7.0 (type II): FS 1, T 1x5, M 0.5x2, and plantar IDBI was 6.5 (type II): FS 1, B 1.5, L 1.0 and M 1.0x3



Fig. 6b) Three months after injury, the foot had been repaired with the GCM, and the digits lost

REFERENCES

1. Hanumadass M., Kagan R., Matsuda T.: Classification and Surgical correction of postburn axillary contractures. *J. Trauma*, 26: 3, 1986.
2. Shen Z. Y., Chang Z. D., Wang N. Z.: Electrical injury of wrist: classification and treatment - clinic analysis of 90 cases. *Burns*, 16: 449, 1990.
3. Wang X. Z.: The management of heat-crush oneself. *Chinese J. Surg.*, 25: 534, 1987.
4. Zhu Z. X.: Urgent repair of electrical injuries: Analysis of 40 cases. *Acta Chir. Plast.*, 32: 142, 1990.
5. Zhu Z. X.: Classifying index for deep burn injuries. *J. Jiamusi Medical College*, 15: 33, 1992.
6. Zhu Z.X., Zhang Y. J., Wang, T. J. et al.: Increasing flap survival: a new method. *Ann. Plast. Surg.*, 24: 414, 1990.
7. Andrew M.: The early management of thermal burns. *Surgery*, 87: 29, 1980.
8. Parslley P. F.: Aggressive approach to the extremity damaged by electrical current. *Ann. Plast. Surg.*, 150: 38, 1985.
9. Haberel M.: Electrical burns: a five year experience. *J. Trauma*, 26: 103, 1986.
10. Zhu Z. X., Wang Y., Liu X. Y.: The early repair of deep burns of foot. *Chinese J. Plast. Surg. and Burns*, 6: 265, 1990.

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MICROCIRCULATION FLOW ALTERATIONS IN BURN WOUNDS

P. BASSE, D. J. B. HOVGAARD, M. LOHMANN, B. F. ALSBJØRN

The severity of a burn wound is related to two different dimensions, - the body surface extension and the burn depth, the former being rather easy to calculate and the latter, on the contrary, being difficult to diagnose. It is not a problem to define the extremes, e. g. the epidermal burn (I°) with erythema due to maximal dilated microcirculation and intact epidermis, or the subdermal burn (III°) with destruction of all aspects of the whole skin. Between these two extremes lies the claim to proper differentiation between autohealing or grafting procedure. A superficial dermal burn will heal within 2 weeks and is characterized by an intact microcirculation whereas the deep dermal burn is seldom healed within 3-6 weeks and is associated with a compromised microcirculation. It is the authors' opinion that deep dermal burns must be excised and skin grafted.

Numerous devices have been developed for burndepth diagnosing (Aselmo & Zwacki, 1977; Black et al., 1986, Koruda et al., 1986, Wachtel et al., 1986, Afromowitz et al., 1987 and Bauer & Sauer, 1989). In almost every case, burn depth was sought diagnosed on the first day of the trauma.

Yet a burn wound is a dynamic process of which the burndepth is not a definitive within the first days after the trauma.

Laser Doppler flowmetry has proved to be a reliable tool for burn depth diagnosing (Alsbjörn, 1991; o'Reilly et al, 1989 and Waxman et al, 1988). Furthermore, it has been demonstrated that the microcirculation flow in non-burned skin of burned patients is rather unhomogeneous during the first 72 hours after the trauma (Micheels et al., 1984).

In the present study, microflow of burned skin has been recorded by a laser Doppler flowmeter during the first four days post burn.

MATERIAL AND METHODS

Patients

Three patients with burns ranging within 9 % and 38 % burned surface area entered the study (Table 1).

Table 1. Overall description of patients who entered the study

	age	sex	% burned area	% subdermal	day of surg.
Patient I	31	m	9	2	15
Patient II	34	m	17	8	15
Patient III	19	f	34	4	15

Patient II and III required resuscitation therapy due to the extent of the burn wounds

Measurements were performed at admittance to the hospital (= hour 6) and on hour 24, 48, 72 and 96 post burn. All measurements were performed as described in (Micheels et al., 1984). Each patient had 4 points measured in the burned areas. A measurement consisted of a basic flow value and a heat stimulated flow value (2 min., 44 °C).

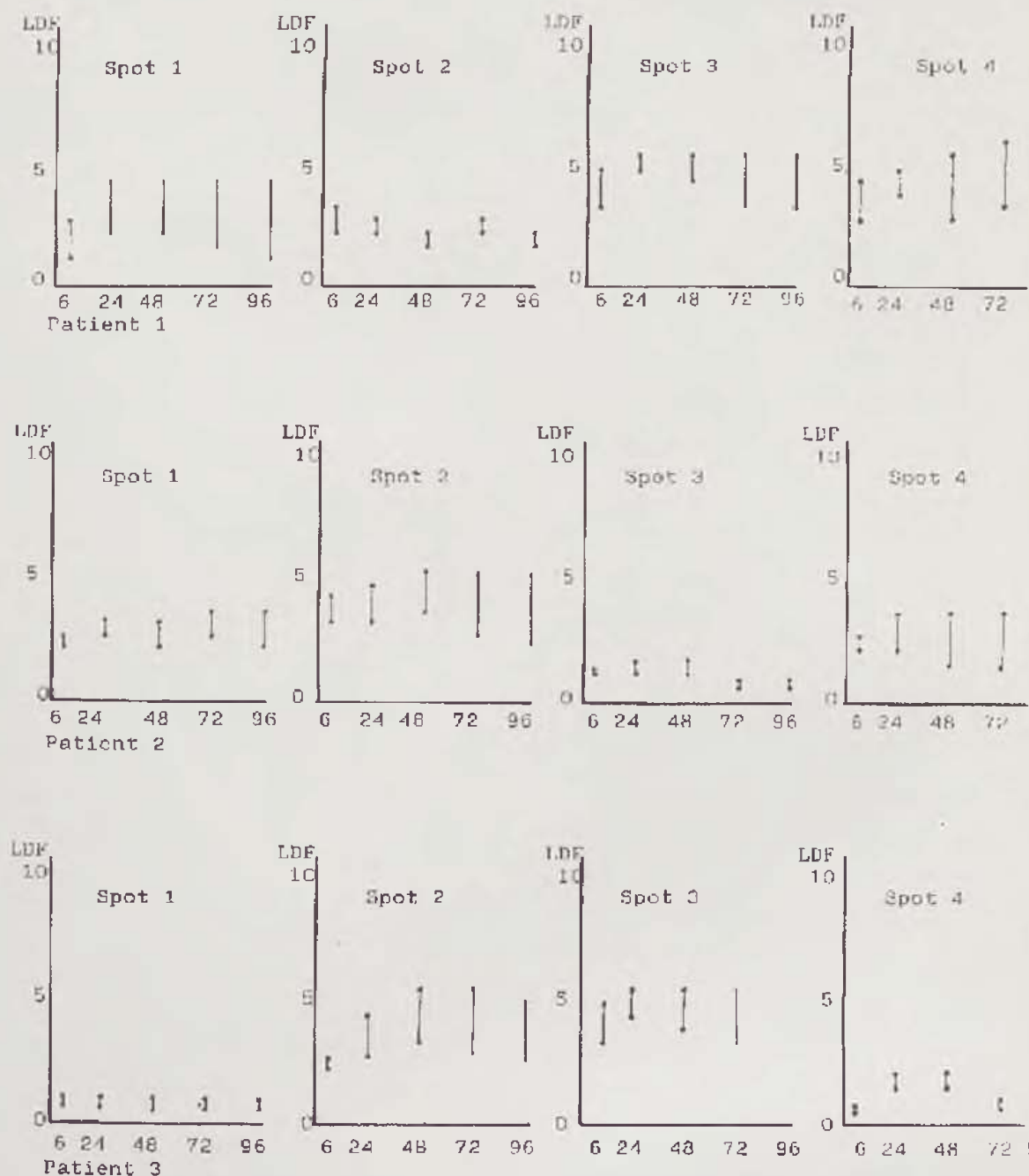


Fig. 1. Four spots of 3 patients with laser Doppler flow values recorded on hour 6-96 post burn. Lower dots represent basic flow values and upper dots represent local heat stimulated values.

In this manner each recorded spot gives an expression of the actual flow and what is possible after stimulation

Laser Doppler flowmeter

A Perflux PF 1d Laser Doppler flowmeter was used. A thermostat probe holder (26 to 44 °C) was used to induce vasodilation and to have an undisturbed vascular bed. The measured microflow was set on an arbitrary scale of 1-10, with 10 representing max. flow.

Burn depth schedule

As a schedule for interpretation of recorded flow, the following values (Alsbjörn et al., 1984) were used:

Superficial dermal burn ≥ 2.5 or a vasodilation value of ≥ 0.5

Deep dermal burn < 2.5 or a vasodilation value of < 0.5

Subdermal burn < 1.5 and no vasodilation ability

RESULTS AND DISCUSSION

The results of the measured microflow are illustrated in Fig. 1.

Initial low flow situations, due to vasoconstriction, were invariably seen in all three patients. This vasoconstriction phase is a result of the hypercatecholaminaemia state the patients suffer from due to the stress situation.

After this vasoconstriction phase, a dilation of the microcirculation followed.

In patient I, the alterations described above were demonstrable. The burn wound was a minor wound and the patient did not require resuscitation therapy. Measured values on admittance corresponded to a certain degree with values of e. g. hour 72 post burn. Therefore, initially obtained values were as such predictable for the burndepth.

In patient II, on the contrary, an inhomogeneity of measured values was definite. The initial vasoconstriction was followed by a dilation which started between hour 6 and hour 24. If the schedule for burndepth diagnosis is used for this patient, it can be seen that spots 1 & 4 initially were deep dermal burns which later changed into superficial dermal burns in the resuscitation phase. Both these spots did heal before day 14 post burn.

Initial diagnoses of spots 2 & 3 remained constant although alterations of the flow did occur.

In patient III, the inhomogeneity described above was even more pronounced. The constriction/dilation pattern was identical to patient 1 and 2. Stable values were not reached before hour 72 post burn. Spot 2 was, on admittance, judged to be a deep dermal burn, for later clearly turning into a superficial burn. The spot was healed on day 14 post burn. Spot 4 started as a subdermal burn and in the dilation phase showed values as a deep dermal burn very close to superficial dermal values. This spot did not heal before day 14 post burn and therefore must have been deep dermal/subdermal according to healing capacity.

From these findings of these 3 patients it is seen that the larger burn wound, the more dispersion of flow values during the first 3 days post burn. Values obtained on admittance or day 1 post burn seemed only reliable for burn depth diagnosis with absolute minor burns or definitive subdermal burns. If resuscitation therapy was necessary, an even more inhomogeneity of values was seen.

From the present findings it can be concluded that

- Laser Doppler flowmetry reflect the microflow situation in a burn wound.
- An initial vasoconstriction phase was followed by a vasodilation phase which seemed proportional to the severity of the trauma.
- Reliable (i. e. stable) values for burn depth diagnosis was only obtainable from hour 72 post burn.

Key words: laser Doppler flowmetry, microcirculation flow, burn wound depth

RÉSUMÉ

Troubles de microcirculation dans les traumatismes de brûlure

Basse P., Hovgaard, D. J. B., Lohman M., Alsbjörn B. F.

Se référant aux examens de 3 patients on met en évidence qu'au cours de 3 premiers jours suivants une brûlure, la dispersion de valeurs du débit sanguinaire augmente dans la mesure de l'étendue du traumatisme de brûlure. Les valeurs obtenues lors de l'admission du malade ou le premier jour après la brûlure paraissent fiables pour le diagnostic de la profondeur de brûlure seulement aux cas des brûlures absolument petites ou évidemment subdermales. Des valeurs encore moins homogènes étaient observées dans les situations où la réanimation du malade était nécessaire.

Se basant aux examens présentés, nous pouvons conclure que le mesurage Doppler du débit sanguinaire par laser reflète la situation microcirculatoire du traumatisme de brûlure. La phase initiale de la vaso-constriction était suivie de la phase vaso-dilatatrice qui se manifestait en fonction proportionnelle de l'importance du traumatisme. On ne pouvait obtenir des valeurs fiables (c'est-à-dire constantes) pour le diagnostic de la profondeur de brûlure que 72 heures après la brûlure.

ZUSAMMENFASSUNG

Störungen des Mikrozirkulationsstromes in Wunden durch Verbrennungen

Basse P., Hovgaard D. J. B., Lohman M., Alsbjörn B. F.

Die Befunde in 3 Patienten zeigten dass in grösseren Wunden nach Verbrennungen die Strömungswerte eine grössere Streuung während der ersten 3 Tage nach der Verbrennung aufweisen. Die bei der Aufnahme oder am Tage nach der Verbrennung ermittelten Werte waren massgebend für die Bestimmung der Tiefe der Verbrennung nur bei absolut kleinen Verbrennungen oder bei eindeutig subdermalen Verbrennungen. In denjenigen Fällen wo eine Wiederbelebung nötig erscheint besteht eine noch niedrigere Homogenität der Werte.

Anhand der erhobenen Befunde kann geschlossen werden dass

- die Laser Doppler Strömungsmessung die Situation der Mikrozirkulation in der Brandwunde illustriert;
- die initiale Phase der Vasokonstriktion wurde von einer Phase der Dilatation der Gefässe gefolgt deren Ausmass dem Schweregrad der Verletzung entsprach;
- verlässliche (i. e. stabile) Werte zur Bestimmung der Tiefe der Brandwunde konnten erst ab 72 Stunden nach der Verbrennung ermittelt werden.

REFERENCES

1. Afromowitz M. A., von Liew G. S., Heimbach D. M.: Clinical evaluation of burn injuries using an optical reflection technique. IEEE Trans. Biomed. Eng., BME-34, 114. 1987.
2. Alsbjörn B. F.: Towards early excision and extended grafting of excessive burns. (Public defended thesis). Available from author. 1991.
3. Alsbjörn B. F., Micheels J., Sørensen B.: Laser Doppler flowmetry measurements of superficial dermal, deep dermal and subdermal burns. Scand. J. Plast. Reconstr. Surg., 18: 75, 1984.
4. Aselmo V. J., Zavacki B. E.: Multi-spectral photographic analysis: A new tool to assist in the early diagnosis of thermal burn depth. Ann. Biomed. Eng., 5: 179, 1977.

5. **Bauer J. A., Sauer T. H.:** Cutaneous 10 MHz ultrasound B scan allows the quantitative assessment of burn depth. *Burns*, 15: 49, 1989.
6. **Black K. S., Hewitt C. W., Miller D. M., et al.:** Burn depth evaluation with flowmetry: Is it really definitive? *J. Burn Care Rehab.*, 7: 313, 1986.
7. **Koruda M. J., Zimble A., Settle R. G., et al.:** Assessing burn wound depth using in vitro nuclear magnetic resonance (NMR). *J. Surg. Res.*, 40: 475, 1986.
8. **Micheels J., Alsbjörn B. F., Sørensen B.:** Clinical use of laser Doppler flowmetry in a burns unit. *Scand. J. Plast. Reconstr. Surg.*, 18: 65, 1984.
9. **O'Reilly T. J., Spence R. J., Taylor R. M., Scheulen P. A.:** Laser Doppler flowmetry evaluation of burn wound depth. *J. Burn Care Rehab.*, 8: 1989.
10. **Wachtel T. L., Leopold G. R., Frank H. A., et al.:** B-mode ultrasonic echo determination of depth of thermal injury. *Burns*, 12: 432, 1986.
11. **Waxman K., Lefcourt N., Achauer B.:** Laser Doppler flow measurements to determine depth of burn injury. American Burn Association, 20th ann. meeting, Seattle, 1988.

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OUR EXPERIENCE WITH THE TECHNIQUE OF AREOLAR ROTATION IN REDUCTION MAMMAPLASTY

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In procedures aimed at reduction and moulding of breast hypertrophy, departments of plastic surgery prefer techniques differing in the mode of reduction of excess tissue and in the method of areolar transposition (2-4, 7, 8). Preference for a specific surgical technique is based both on the need for creating a favourable shape of the breast, and on the effort to minimize postoperative complications. These complications include, for instance, peroperative interference of blood supply to the transposed areola which may appreciably extend the time of postoperative healing, or lead to loss of areolar sensitivity.

A modality minimizing the incidence of the above mentioned postoperative complications is the method of areola rotation on a decorticated superior-lateral dermal areola flap. The method is derived from original Skoog's operation (6), complemented with the technique of resec-

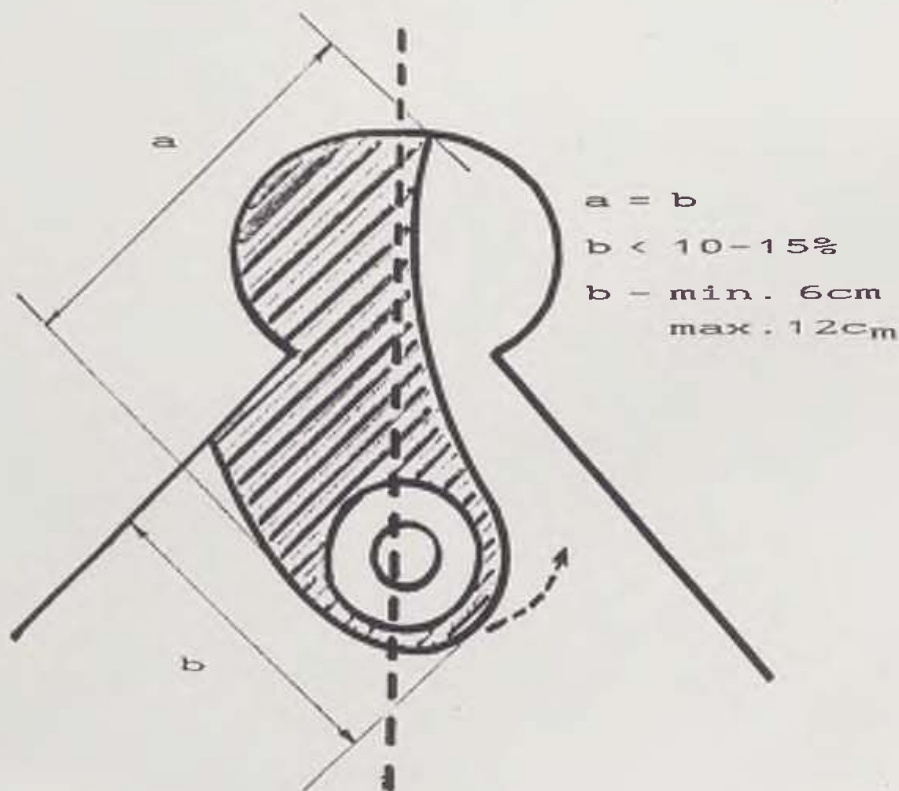


Fig. 1. Flap decortication and rotation

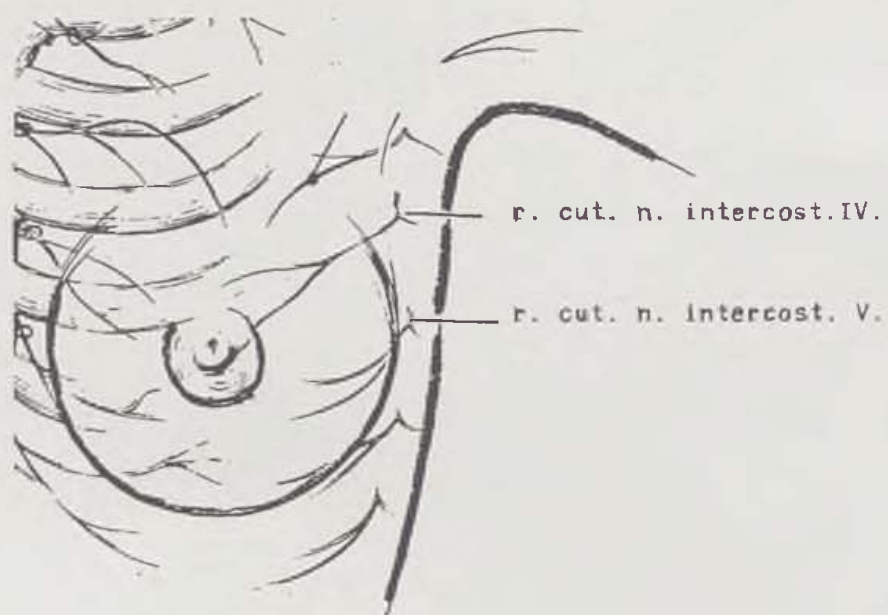


Fig. 2. Innervation of the areolo-mamillary complex

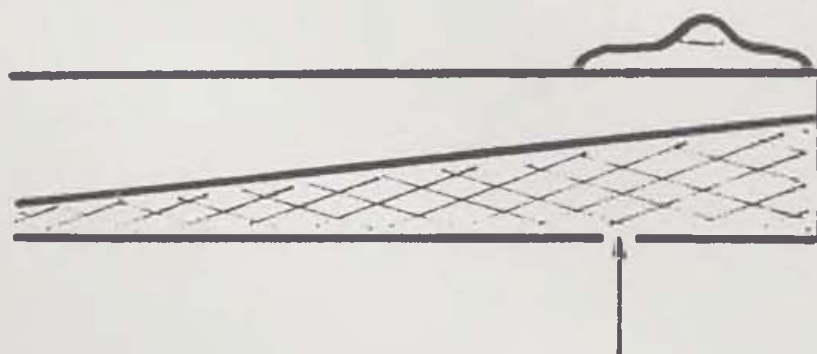
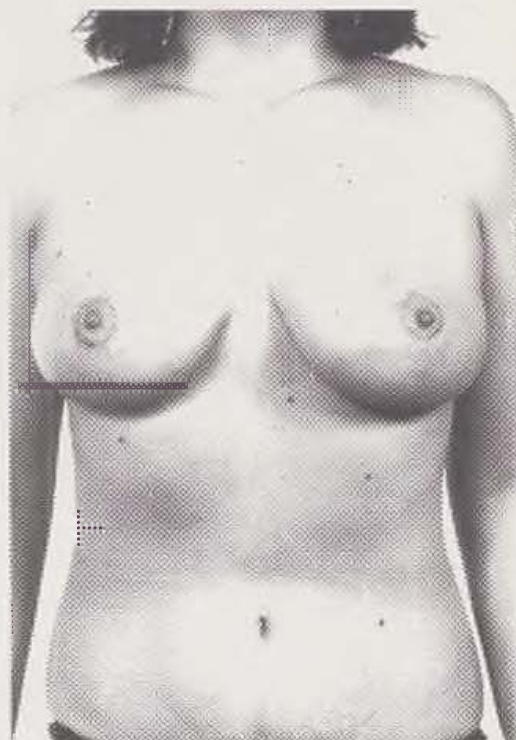


Fig. 3. A wedge-shaped flap



Figs 4, 5. Patient K. before and after surgery



Figs 6, 7. Patient K. before and after surgery

tion and rotation of the mammary gland according to Biesenberger (1, 5).

The operative procedure involves decortication of the flap with its base transposed from the axis of the breast up to the arm of the lateral breast flap (Fig. 1). The rationale for a wide lateral flap is as follows. In addition to maintaining blood supply to the areola, an important factor is avoiding loss of areolar sensitivity, provided for by means of r. cutaneus nn. intercostales III-V with the main role played by r. cutaneus n. intercostalis IV (Fig. 2). To facilitate rotation, the flap must taper in a wedge-like manner up to the decortication line (Fig. 3). By contrast, in exceptional cases, where the areola is located extremely outward (which would render areola rotation difficult because of a very short arm b), the decorticated flap can be rotated laterally with its base situated medially even at the expense of a loss of superficial sensitivity of the areola.

There are several rules that must be observed during the plotting of the flap. The length of the arm b should correspond to that of the arm a. However, in cases where the resulting length of the arm b would be shorter than that of arm a by more than 10-15 %, the former must be extended by an incision of the corium along the line of decortication of the lateral mammary flap. The arm b should not be shorter than 6 cm and longer than 12 cm.

In our department, we have performed a breast reduction and moulding in gigantomastia using the above described procedure in 31 women since 1991 (Figs 4-7). The extent of the reduction varied from 350 to 1700 g. Superficial sensitivity of the areola has been maintained in all patients. One patient developed partial areolar necrosis which may have been caused by compensatory reduction of subcutaneous tissue under the flap pedicle without optical control (Tab. 1).

Table 1. Number of female patients operated on at the Department of Plastic Surgery in Prague between 1991-1993

Number of female patients	Complications (areola) %
31	1.6

Just as with other methods, areolar repositioning may occasionally pose a problem in this operative technique. The pitfalls in areolar rotation and repositioning include: inadequate separation of the gland from the underlying tissue, a firmer gland at the site of the decorticated flap, an inadequate thinning of the decorticated flap, an areola positioning to an excessively high position, or an inadequately short arm b of the decorticated flap.

SUMMARY

In the article, the authors present a relatively uncommon method employed for breast reduction and moulding in gigantomastia. They examine the benefits of the surgical technique based on areolar rotation with a wide superior-lateral dermal areolar flap. The authors point out the fact that postoperative blood supply to the areolas is very good while their sensitivity is preserved.

Key words: breast hypertrophy, reduction, areolar rotation

RÉSUMÉ

Nos expériences avec la technique de rotation d'aréole dans le traitement de gigantomastie

Měšťák J., Ambrožová J., Tomášek D., Krýslová I.

Dans leur article, les auteurs présentent une méthode moins fréquente, employée pour la réduction et pour le modelage de la gigantomastie. Ils mettent en évidence les avantages de ce procédé opératoire, basé sur la rotation de l'aréole sur un large pédicule supérieur et latéral. Ils soulignent notamment une très bonne alimentation postopératoire de l'aréole avec conservation de sa sensibilité.

ZUSAMMENFASSUNG

Unsere Erfahrungen mit der Technik der Rotatio der Aureola bei der chirurgischen Behandlung der Gigantomastia

Měšťák J., Ambrožová J., Tomášek D., Krýslová I.

Die Mitteilung befasst sich mit einer weniger üblichen Methode zur Reduktion und Modellierung bei der Gigantomastia. Die Vorteile dieser chirurgischen Technik werden unterstrichen. Die Methode beruht auf der Rotation der Aureola mit einem breiten oberen und lateralen Stiel. Besonders wird die gute postoperative Versorgung der Aureolen hervorgehoben, mit der Erhaltung ihrer Sensitivität.

REFERENCES

1. Biesenberger H.: Deformatitäten und Kosmetische Operationen bei Weiblichen Brust. Verlag von Wilhelm Maudrich, 1931.
2. Georgiade N. G., Serafin D., Morris R., Georgiade G.: Reduction mammoplasty utilizing an inferior pedicle nippleareolar flap. *Ann. Plast. Surg.*, 3: 211, 1979.
3. McKissock P. K.: Reduction mammoplasty by the vertical bipedicle flap technique. *Plast. Reconstr. Surg.*, 49: 245, 1972.
4. Pitanguy I.: *Aesthetic Plastic Surgery of Head and Body*. New York, Springer Verlag, 1981.
5. Reichert H.: Wiederherstellung der weiblichen Brustform nach subkutaner Mastektomie. Wiederherstellung von Form und Funktion organischer Einheiten der verschiedenen Körperregionen. Herausgegeben von E. Schmid, W. Widmaier und H. Reichert. Georg Thieme Verlag, Stuttgart, 1977.
6. Skoog T.: A technique of breast reduction: transposition of the nipple on a cutaneous vascular pedicle. *Acta Chir. Scand.*, 126: 453, 1963.
7. Strömbeck J. O.: Mammoplasty; report of a new technique based on a two-pedicle procedure. *Br. J. Plast. Surg.*, 13: 79, 1960.
8. Weiner D. L., Aiache A. E., Silve L., Tittiranonda T.: A single dermal pedicle for nipple transposition in subcutaneous mastectomy, reduction mammoplasty or mastopexy. *Plast. Reconstr. Surg.*, 51: 115, 1973.

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1994 AWARD THE TANNER-VANDEPUT-BOSWICK BURN PRIZE

The 1994 Tanner-Vandeput-Boswick Burn Prize will be awarded during the 9th Quadrennial Congress of the International Society for Burn Injuries to be held July 1994 in Paris, France. The Prize consists of a cash payment in the range of US \$ 80,000 & and a gold and diamond pin.

The Prize will go to a person (or persons) who in the opinion of the Prize Committee has made an outstanding contribution to any aspect of the burn field. The recipient does not have to be a physician or a member of the ISBI, but be responsible for a major advancement in the burn field.

Nominations for the 1994 Prize may be made by colleagues of those who have made such major contributions, or a candidate may make application on his own behalf. Anyone interested in making a nomination for the 1994 prize should send information to the International Burn Foundation at the address below.

A. INFORMATION REQUIRED TO APPLY FOR THE 1994 PRIZE:

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3. Current CV
4. Letters of support from colleagues

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C. SEND INFORMATION TO:

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International Burn Foundation
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ABOUT THE PRIZE

The "Tanner-Vandeput Burn Prize" (now the Tanner-Vandeput-Boswick Burn Prize) was started in 1984 by Dr. J. C. Tanner of Atlanta, Georgia, co-inventor with Dr. Jacques Vandeput of the Tanner-Vandeput mesh dermatome. The Prize was conceived and established to promote the aims of the International Society for Burn Injuries and to motivate individual investigators to do research, study, undertake patient care and treatment and other aspects of the burn problem. In 1984 the ISBI Executive Committee voted to accept Dr. Tanner's offer to work with the ISBI in coordinating the Prize, which consists of a cash payment and a gold & diamond pin and is awarded at each Quadrennial Congress of the ISBI.

The International Burn Foundation was created to promote and administer the Prize. In 1991 Dr. Tanner requested that the name be changed to the "Tanner-Vandeput-Boswick Burn Prize" to reflect the contributions of Dr. John Boswick, who has been Chairman of the Foundation Board of Directors since inception.

Dr. Tanner and others have contributed funds which have been invested to produce income used for the Prize. The Foundation Board of Directors oversees a trust fund and the Foundation investments. These funds are completely separate from those of the ISBI. Due to investment of funds it is anticipated that some time in the future prizes will be equal to the Nobel Prize. The Foundation has a Prize Committee which reviews applications and makes recommendations for the award of each Prize.

The first award was presented to Dr. Ian Alan Holder of Cincinnati at the 7th ISBI Congress in Melbourne in 1986. The second award was presented to Dr. Fortunato Benaim of Buenos Aires at the 8th ISBI Congress in New Delhi in 1990. The next award will be presented at the 9th Quadrennial Congress of the ISBI to be held July 1994 in Paris.

Nominations are now being requested for the 1994 Prize and should be sent to:

**Dr. John Boswick, Chairman, Board of Directors
International Burn Foundation
2005 Franklin St. #355
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USA**

Title:	XIII Annual Congress European Society of Regional Anaesthesiologists
Date:	19-21 May 1994
Venue:	Hotel Princesa Sofia, Plaza Pio XII, 4-08028 Barcelona, Spain
Local Scientific Committee:	Dr. L. Aliaga, Dr. J. M. Villar Landeira
Deadline (call for papers):	1 November 1993
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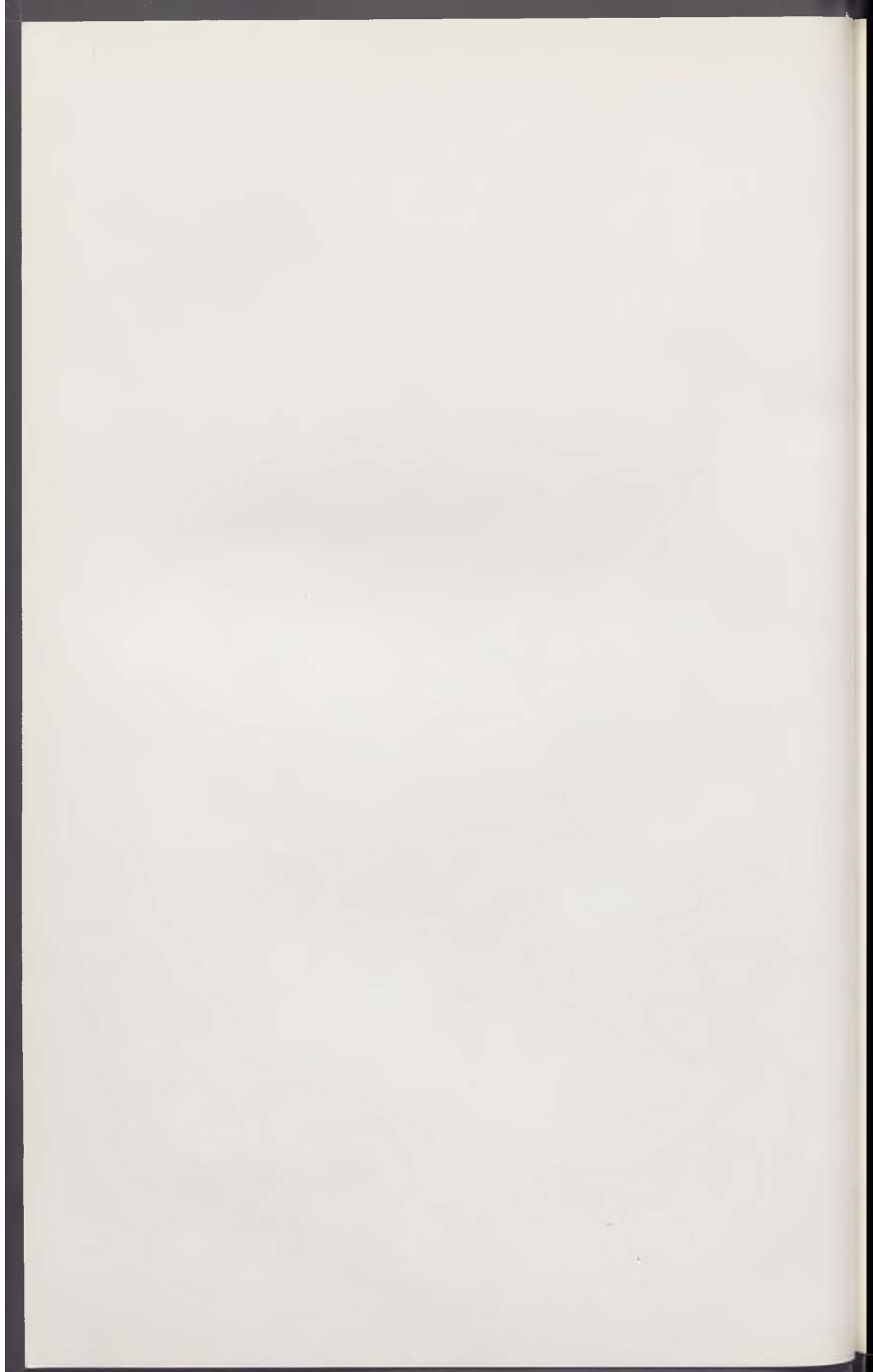
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CONTENTS

Prof. Miroslav Fára M.D., D.Sc. - to his jubilee	1
A. Govila: The radial forearm flap: Experiences with the extraordinary Procedure	3
A. Govila: „Symbiotic tissue transfer” - A new concept in reconstructive plastic surgery	21
D. Štěpán, J. Válka, J. Samohýl, V. E. Meyer, J. Šmahel: Prefabrication of a skin axial flap in experiment	28
J. Kozák, P. Voska: Reconstruction of the frontal region with skull bone grafts	36
M. Krauss, T. Polaczek: Late results of the surgical treatment of complete unilateral cleft lip and palate: Soft tissue characteristics	44
B. Škvařilová, I. Horák, H. Polívková, Z. Šmahel: Effects of premaxillary setback and of prolongation of the columella on the configuration of the facial profile in complete bilateral cleft lip and palate	57
Z. Šmahel, I. Horák: The effects of two-stage palatoplasty on facial development in unilateral cleft lip and palate	67
X. Y. Liou, Y. Wang, T. J. Wang, D. C. Yu, S. B. Wang: Classification of deep burn injuries - analyzes of 117 cases	73
P. Basse, D. J. B. Hovgaard, M. Lohmann, B. F. Alsbjörn: Microcirculation flow alterations in burn wounds	86
J. Měšťák, J. Ambrožová, D. Tomášek, I. Krýslová: Our experience with the technique of areolar rotation in reduction mammoplasty	91
1994 award; the Tanner - Vandeput - Boswick Burn Prize	96
XIII Annual Congress European Society of Regional Anaesthesiologists	98
Instructions to authors	98

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