ACTA CHIRURGIAE PLASTICAE

INTERNATIONAL JOURNAL
OF PLASTIC SURGERY

27 · 2

1985

CS ISSN—0001—5423

AVICENUM - CZECHOSLOVAK MEDICAL PRESS
PRAGUE

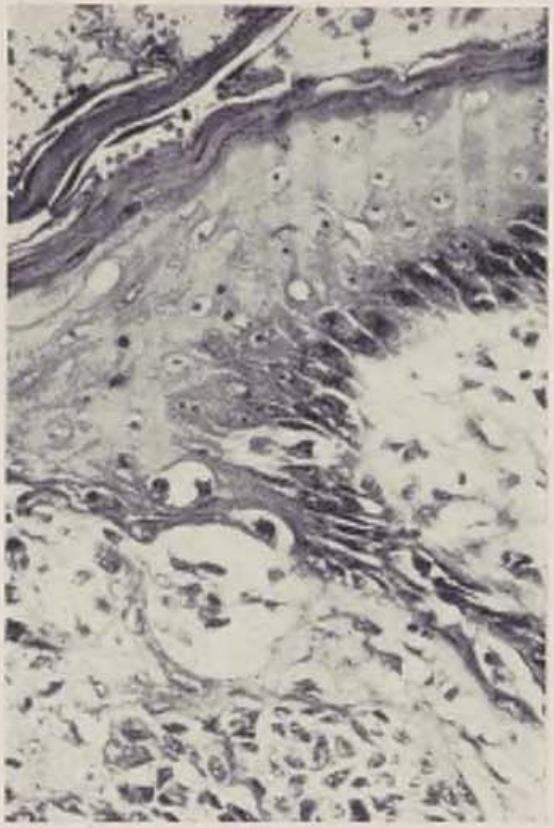
Exclusive Distributors for all Western Countries
KARGER-LIBRI AG, Petersgraben 31, CH-4000 Basel 11 (Switzerland)

Distributed by PNS. Information on subscription can be obtained from and orders are accepted by every administration of PNS, post-office, postman and PNS Central Expedition Prague. Orders for abroad are accepted by PNS Central Expedition and Press Import, administration of press export Kafkova 19, 160 00 Praha 6.

Published four times (in 1959: two times) a year by Avicenum - Czechoslovak Medical Press, Malostranské nám. 28, Praha 1. Editor in Chief Prof. H. Pešková, M. D. — Address of the Editorial Office: Acta Chirurgiae Plasticae, 120 00 Praha 2, Lidových milicí 63, Czechoslovakia. — Press: Tiskařské závody, n. p., Praha, závod 1 — provoz 11, Praha 2, Hálkova 2.

Subscription rate: Sfr 130 — plus postage, Exclusive distributors for all countries with the exception of Albania, Bulgaria, China, Cuba, Czechoslovakia, German Democratic Republic, Hungary, North Korea, Vietnam, Mongolia, Poland, Romania, the Union of Soviet Socialist Republics and Yugoslavia:

KARGER LIBRI AG, Petersgraben 31, CH-4000 BASEL 11 (Switzerland)



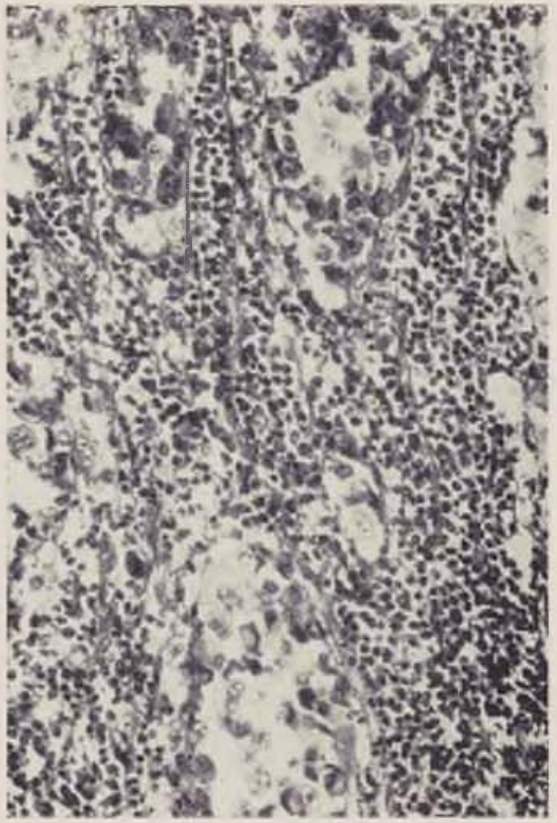


Fig. 6. Malignant melanoma developed on the basis of a large pigmented nevus. Neoplastic cells with features of atypia are lying in groups, infiltrating lower levels of the epidermis. H+E. × 400. — Fig. 7. A malignant melanoma metastasis in the mediastinal lymph node. In the lymph node tissue — atypical melanotic cells loaded with dark pigment (melanin). H+E, ×400.

A. Zielinski, M. Pruszczynski

Fig. 3. Microscopic picture of the tumour at the first operation: nevocytes [N.C.] in fibrous connective tissue visible in the dermis. No changes in the epidermis. H+E, × 200. — Fig. 4. Microscopic picture of the tumour from the period of the first operation: deep parts of the lesion — melanocytes scattered among thick collagen bands [neuroid appearance of the lesion]. H+E, × 400.

Europe, a continent which in this century alone became twice the main theatre of the biggest conflagrations in the history of mankind, and with it the whole progressive world will this year be commemorating the 40th anniversary of the termination of the horrors of the 2nd World War. Towards the end of that war, in May 1945, Czechoslovakia, a country in the very heart of the continent, came to be liberated and restored after six years of Hitlerite occupation. None of that would have been possible without the defeat of fascism where a decisive share was without any doubt taken by the Soviet Union.

That war claimed the lives of, among others, many physicians and health workers who died on the fronts, in concentration and POW camps, in the Gestapo torture rooms. Cone were valuable people who had devoted all their lives to combatting diseases and death. The immeasurable sacrifices brought by the peoples of all countries showed beyond any shadow of doubt that peace, national independence and sovereignty could not be guaranteed except by the joint efforts of all democratic and peace-loving forces.

Physicians of all countries now occupy prominent places in the steadily growing peace movements all over the world. They meet ever more often to express their credo: no to war, yes to peace. This was expressed by the Czech Minister of Health Prof. Dr. J. Prokopec at last October's meeting in Prague of health workers: "The task of us as physicians is to make the world's conscience alert to constructive work for the benefit of mankind which is the subject and object of all evolution. In their Hippocratic oath physicians pledge themselves to protect people's health and lives, and it is only appropriate to supplement the oath with the pledge of protection against the ultimate epidemic — nuclear war."

Through the elimination of wars, through mutual understanding and co-operation between countries with different social systems mankind can far sooner achieve the harmonious development of the personality of each individual and of the human community as a whole.

Editorial Board

Academic Hospital Rotterdam-Dijkzigt (The Netherlands)
Department of Plastic Surgery

THE HISTORY OF FREE SKIN TRANSPLANT OPERATIONS

D. J. HAUBEN

Surgery is handicraft,
science and art

Lexer

Free skin graft operations have undergone a number of developmental changes. In 1869, Jacques Louis Reverdin (1842—1929) introduced his "greffe épidermique". Later on Louis Ollier (1830—1900) described a dermo-epidermic transplant operation. Voluminous works by Carl Thiersch (1822—1896) as well as studies by J. R. Wolfe (1824—1904) were denials of Tegliacozzi's rule. Indeed, Wolfe was able to say: ". . . we are hence forward free to choose our bit of skin from any part of the body we may find suitable". George Lawson (1831—1903) insisted that skin be transplanted free from the subcutaneous fatty tissue to allow transplantation to take place. This method was familiar to surgeons even before Wolfe's and Krause's publications of 1875 and 1893 respectively. The use of free skin grafts brought forth the idea of homograft transplantation. In 1909, Davis reported on 40 cases of successful allograft transplantations. Others seemed to favour heterografts (xenografts) taken from pigs, pigeons, chickens, dogs, rabbits, cats, guinea-pigs, frongs, etc.

As a result of transplantations with an 85—100% success rate performed by Venable, enthusiasm began to develop for the Ollier-Thiersch heterograft taken from pigs. It follows then that Reverdin cannot claim the title of father of skin transplant operations since such operations had been performed well before him.

The first even skin transplantation should be traced back to ancient India [ancient Indian surgery still requires a great deal of charting. In particular, the work Sushruta Samhita is still difficult to locate chronologically. Present-day historians place the year of its origin anywhere between 100 B.C and 700 A.D (Leibowitz 1972). Also, it is quite difficult to translate the disputed part of the text Sanskrit into a modern language. A detailed section on India in Sigerist, vol. 2 (1961), pp. 121—180, makes no reference to surgery at all!]. Davis (1941) wrote: "Before pedicled flaps were employed in reconstructing noses, the Tilemaker Caste in India is said to have successfully utilized free grafts of skin, including the subcutaneous fat, taken from the gluteal region."

Davis mentioned Freeman's notes on the Indian pioneers from the Sushruta era: "One of the most remarkable achievements of these pioneers in surgery was the replacement of the nose by a graft from the thick skin of the gluteal region." It appears that Freeman's source was a work by Leroux published in Paris in 1817.

Avraham ibn Ezra, a 12th century Jewish author, mentioned plastic operations for large skin abrasion replacement, taking skin grafts from sheep.

Referring to a report by Leroux, Gnudi and Webster in "The Life and Times of Gaspare Tagliacozzi" described how Indian surgeons used to take skin grafts from the gluteal region in order to reconstruct noses. However, even before Leroux's report, Sancassani, writing in 1731, related the following story: "A Florentine woman of the name of Gambacurta wishing to sell balm tried to show, using skin taken from her thigh which she then transplanted onto the wound, that nothing but that particular balm would result in a successful transplantation." Sancassani told Baronio of that event, and Gnudi translated that method as "free skin transplantation".

In 1804, Baronio made three successful experiments with free skin graft operation in the sheep stressing that fat was an impediment to successful tissue transplantation. During his lifetime, his experiments met with little attention, and it was not until fifty years later that free skin grafts came to be generally used.

At the beginning of the 19th century, six years after Leroux's report was published, Christian Bünger, in 1823, described a reconstruction of the nose according to an "ancient Indian method", i. e. using a strip of skin from the buttocks and transplanting it onto the nasal defect. Unlike the Indian method, though, Bünger used skin from the thigh. His bit of skin was oval in shape measuring 7.5 by 10 cm, and was transplanted after 1 to 1.5 hours. The procedure proved to be a success as the skin was free from fat. Bünger published his experiment 47 years before Reverdin's report. Bünger's contemporaries such as Dieffenbach, von Graefe, Walther and Wutzer were not so successful, which led them to an underestimation of the method.

Two more publications appeared on free skin graft transplantations before Reverdin's time, namely two reports from America — one by Jonathan Mason Warren of Boston, the other by Joseph Fancoast of Philadelphia.

In April 1840, Warren took a full thickness graft from the arm to transplant it to the nose "... filling small breaches of surface with integument entirely detached from the arm or thigh, at once applied on the surface of the defect". In 1844, Pancoast reported on the reconstruction of the pinna using a free skin graft referring to an "ancient Indian tradition described by Leroux in 1817". Nevertheless, Gnudi and Webster stressed that it had really been Guiseppe Baronio of Milan in 1804 "who first demonstrated on sheep that full thickness skin grafts could be successfully transplanted after detachment from the body".

Then came a report in 1869 on the now famous technique of "greffe épidermique", or epidermic graft devised by J. L. Reverdin of Switzerland, who work in the Hôpital Necker in Paris. He succeeded in transplanting two small islands

of skin onto an injured thumb to prove that there were ways of enhancing granulation tissue epithelialization. His report on the technique of epidermic graft was published by the Société Impériale de Chirurgie in December 1869. His description of the rapid healing of granulation tissue with the aid of small skin transplants met with wide response. In 1872, Ollier of Lyon reported on the successful transplantation of much larger pieces of skin (4—6 or 6 cm^2) consisting of the epidermis and a thin layer of the dermis called "thin split-thickness graft".

Lawson and Le Fort used full thickness skin grafts in 1870 and 1872 for the reconstruction of the ectropion. But the credit for that goes to Wolfe of Glasgow dating back to 1875. Indeed, the transplant bears his name — Wolfe's graft. This graft consists of the whole epidermis and the whole of the dermis without the underlying subcutaneous tissue.

In 1886, addressing the 15th Congress of the German Surgical Society, Carl Thiersch spoke of skin transplants consisting of nothing but the epiderms and a very fine layer of the dermis. The parts closest to the granulation tissue were noted for the best healing. Thiersch failed to mention Ollier's procedure although he did not use the method until 14 years after Ollier. In spite of that, the technique bear both discoverers' names — namely the Ollier-Thiersch graft.

In 1893, Fedor Krause (1856—1937) referred to full-thickness skin graft proposing the use of thick skin in case the Ollier-Thiersch graft was found unsatisfactory. Today, the full-thickness skin graft goes under the names of Wolfe and Krause. Wolfe's contribution was in that he insisted on the subcutaneous tissue being free of all fat. On the other hand, Krause is credited for extending the graft to cover large areas.

In 1914, John Staige Davis wrote of skin transplant operations wherein he mostly used more dermis than Reverdin. His technique was given the name of thick split thickness graft transplantation. Later on in 1929, Blair used even more dermis (three quarters of the whole dermis). The name again was thick split thickness graft or three-quarter-thick graft. The composite graft of skin and other structures, among other things, even cartilage was first described by König, who used it in 1902.

Skin allo- or homografts

In 1872, Reverdin reported good results after using homografts for skin transplant operation. He lifted an island of skin from an amputated extremity and even from his own body to act as a homograft donor. He was sure the homograft would be a success. However, centuries before that, in 1503, the poet Elision Calenzio wrote in his letter to Orpianas that slaves were used as skin donors. "... Branca of Silicy, a man of wonderful talent, has found out how to give a person a new nose, which he either builds from arm or borrows from a slave." Étienne Gourmelen quoted from this letter in 1580 to stress that skin should be used solely for the reconstruction of the nose. In 1570, Fioravanta was the first to describe tissue or skin autografts. He washed an amputated piece of the nose with urine, and subsequently transplanted it to a Spanish soldier of the name of Andreas Gutier. Having used some balm, he left the dressing in place for eight days, whereafter he found good union.

In Samual Butler's "Hudibras" we can find verses describing homograft rejection:

"So learned Tagliacotus from the brauny part of Potter's bum.
Cut supplemental noses which would last as long as Parent-breech:
But when the last date of Nock was out
off dropt the sympathetic Snout".

Samual Butler "Hudibras", London 1710,
p. 10, Canto I, Part I, Verse 281—286.

Nose homograft transplant operations were also described by Tagliacozzi and Carpue.

Skin hetero- or xenografts

In 1871, Reverdin, the father of skin transplant operations, took animal skin to transport it to man, calling this method "zoografting" and maintaining that "skin can be taken not only from the same being but also from individuals of the same species or, indeed, from other species as well". Treating foot ulcerations in 1872, Coze used rabbit skin. His report on that achievement greatly impressed the Academy and made it recommend the author to the Medical Prizes Committee. This marked the beginning of the era of free skin xenografts (zoografts, heterografts).

However, reports on the use of skin xenografts had been published quite some time before. Thus, in 1682, Meek'ren wrote of dog bone transplant given to a Russian nobleman who had suffered skull injury from a Tartar. Sédillot in 1868 was really the first to transplant pedicles skin flaps to man, using skin from the dog belly (Great Dane) to cover a skin defect on the human hand. The experiment resulted in a failure as, reportedly, "the animal was too fidgety".

In 1880, Lee of Boston used a pedicled flap from sheep skin to cover a burn defect on the back of a girl. The attempt failed, though, and the girl died. Nevertheless, autopsy showed that the pedicle flap had, indeed, been supplied from the girl's vascular system. Death resulted from exhaustion and amyloidosis.

Writting about "zoografting", Gibbson gave several examples:

— In 1886, Peyrot took a tendon from the hind leg of a dog to transplant it to a boy's finger.
— In 1889, Mc Gill covered a human arm defect (in the radius) with the aid of a rat thigh.
— In 1889, Power reported on frog skin transplantation in one case of large human burns.
— In 1889, Alexander Miles described a successful grayhound skin transplant operation to treat human burns.
— Wolfer, a German, reported in the British Journal, among other things, having made successful transplantations using skin taken from frogs, pigeons and rabbits.
— In 1890, Fillet de Grandmot used frog skin to reconstruct ectropion in a child.
— In 1906, writing to the Editor of Lancet, Ranking reported having achieved good results with frog skin transplantations in about 300 to 400 patients.

— In 1888, Masterman and Redard regarded frog skin as too revolting, and used rabbit and chicken skin instead.
— In 1895, Milas found pig skin too expensive since in compliance with the 1876 Anti-vivisection Act the animal had to be put to death first.
— In 1888, the Frenchman Redard took skin from the undersite of chicken wings.
— In 1843, Aldrich of America took tissue from pigeons.
— Altramirano of South America used skin tissue from the chicken larynx.
— In 1887, Raven performed the first ever transplantation of pig skin to a girl who had suffered a burn.

In this book on plastic surgery of 1919 Davis described the use of zoografts from different animals, e. g. rats, rabbits, young dogs, guinea-pigs, chickens and pigeons observing that "they also have the same power of stimulating epithelial growth from the edges, then placed on granulating wounds as do other grafts ... Nevertheless ... these grafts ... suddenly and with no apparent cause have begun to melt away and have soon disappeared".

38 years later, Silvetti et al. used cow embryos temporarily as a biological means for burn treatment. In 1965, Bromberg et al. reported the re-use of pig skin in burns.

Rogers and Converse just as much as Switzer explored the biological properties of cow embryo skin to serve as biological protection against infection.

J. H.

REFERENCES

1. **Reverdin, J. L.:** Greffe Epidermic. Bull. de la soc. imp. chir. de Paris, 1 : 511, 1869.
2. **Ollier, L., Xavier, E. L.:** Greffes cutanées ou Autoplastiques. Bull. Acad. Méd. de Paris, 1 : 243, 1872.
3. **Thiersch, C.:** Über Hauptverpflanzung. Verhandl. deutsch. Gesellsch. f. Chir., 15 : 17, 1886.
4. **Wolfe, J. R.:** A new Method of Performing Plastic Operation. Brit. med. J., 20 : 360, 1875.
5. **Lawson, G.:** On the Transplantation of Portions of Skin for the Closure of Large Granulating Surfaces. Trans. Clin. Soc. (London), 4 : 49, 1871.
6. **Krause, F.:** Über die Transplantation großer, ungestielter Hauptlappen. Verhandl. deutsch. Gesellsch. f. Chir., Berlin, 22 : 46, 1893.
7. **Davis, J. S.:** Skin Transplantation. John Hopkins Hopital Reports, 15 : 307.
8. **Venable, C. S.:** The Use of Pig Skin in Extensive Grafts. Southwest J. Med. Surg., 22 : 341, 1914.
9. **Davis, J. S.:** The Story of Plastic Surgery. Ann. Surg., 113 : 641, 1941.
10. **Davis, J. S.:** Plastic Surgery, Its Principles and Practice. P. Blackiston's Songs and Co., Philadelphia, 1919.

The rest of reference available from the author.

Dr. D. J. Hauben,
Academic Hospital, Dept. of Plastic Surgery,
Dr. Molewaterplein 40, 3015 GD Rotterdam,
The Netherlands

Academic Hospital, Rotterdam (The Netherlands)
Department of Plastic Surgery

THE HISTORY OF MAMMAPLASTY

D. J. HAUBEN

The first known clinical description of reduction mammaplasty comes from Paul Aegineta (625—690).

The operations were then intended to correct gynaecomastia. In volume VI of his epitomé Paul wrote: "When, however, the breasts are pendulous like in women perhaps for their size, we make two crescent-shaped incision meeting at the extremities so that the smaller one can be overlapped by the larger one, and, after the previous removal of skin as well as fat, we make the sutures likewise."

Ali ibn Abbas (died in 994) was the author of "el-Maliki" or the "Royal Book" where he described treatment for gynaecomastia devised by Paul Aegineta.

In the 11th centry, Albucasis published his "Altasrif", a medical-surgical book where he reported on the surgical correction of gynaecomastia.

in his "Voyages et Apologie" Paré confirms the first such plastic operations to have been ventured by Paul Aegineta and Albucacis. Paré thought the mammaplasties performed by former Greek and Arab surgeons had been made on female breasts.

In his classical treatise Tagliacozzi makes no mention of mammaplasty.

Will Durston claimed in 1669 to have performed the first ever mammplasty in order to reduce massive hypertrophy of female breasts. Knowledge of Durston's first mammaplasty has been preserved for us in three letters which he wrote to the "Royal Society" of London. In their book about Durtson, Letterman and Schurter tried to bring evidence to show that Durston was unlikely to have performed any breast reconstruction operation. Their thesis was based on writings by Yonge, who wished to prove the contrary.

Riesenberger mentions the first mammaplasty saying that it was first performed by Hans Schaller, a surgeon of Augsburg, and this assertion has received the support of other historians of medicine.

Theodore Guillard Thomas (1831—1903) reintroduced the strategy of leading the inframammal incisions along a finely scarred line to hide them under the mammary fold.

The "Bulletin et Mémoires de la Société de Chirurgie de Paris" where, in 1897, Pousson reported on operations for breast hypertrophy correction.

In 1898, Verchère described a triangular skin and subcutaneous tissue excision and its eventual closure in the shape of the figure "4".

In 1905, Morestin (1869—1919) published a method of incision on the submammary fold deep into the retromammary space up to the excision of the whole gland.

Max Thorek reported on the first ever transplantation of the nipples during the reconstruction of the breasts.

J. H.

REFERENCES

1. **Aegineta, P.:** Libri septem, quibus medendi ratio ac via tam in Diatetico, quam Pharmaceutico et Chirurgico genere compendio continetur. Basilea 1538.

2. **Aegineta, P.:** The seven books of Paulus Aegineta, Vol. 2, Book 6, Sec. 46, p. 334: translated from the Greek by Francis Adams, Sydenham Society, London 1847.

3. **Park, R.:** An Epitome of the history of medicine (2nd ed.), Davis, Philadelphia 1899, S. 61.

4. **Spink, M., Lewis, G.:** Albucasis on surgery and instruments. University of California Press, Berkeley, 1973.

5. **Campbell Donald, E. H.:** Arabian medicine and its influence on the Middle Ages, 2 Bde, Kegan, Paul Trench, Trübner. London, 1926.

6. **Leclerc, L.:** La chirurgie d'Albucasis. J. B. Baillière, Paris 1861, S. 128.

7. **Keynes, G. (Hrsg.):** The apology and treatise of Ambrosie Paré. Dover, New York 1968.

8. **Packard, F.:** Life and times of Ambroise Paré with a new translation of his apalogy and account of his journey in diverse places. Hoeber, New York, 1921.

9. **Webster, P., Gnudi, M.:** The life and times of Gaspare Tagliacozzi, surgeon of Bologna. Reichner, New York, 1950.

10. **Durston, W.:** Concerning a very sudden and excessive swelling of a woman's breasts. Philos. Trans. R. Soc., London IV (1670), S. 1047.

Dr. D. J. Hauben, Academic Hospital,
Department of Plastic Surgery,
Dr. Molewaterplain 40,
3015 GD Rotterdam, The Netherlands

J. E. Purkyně University Medical Faculty, Brno (Czechoslovakia)
1st Surgical Department
Head Prof. B. Potrusil, M. D., DrSc.
Department of Plastic Surgery
Head Prof. V. Kubáček, M. D., DrSc.
Research Institute for Clinical and Experimental Oncology
Head Prof. J. Švejda, M. D., DrSc.

FREE-TRANSFER OMENTAL FLAP FOLLOW-UP

An experimental study

J. VESELÝ, J. ŽALOUDÍK, J. HEMZA, J. NOVÁK

Many authors have studied the properties of the greater omentum. Its resorption function was described already by Hippocrates, later on by Rubin and Wilkie, its secretion role by Malpighi, its protective function by Morison and its immunological properties were best examined by Walker, Thompson and Gray.

As early as 1936, O'Shaugnessy used the greater omentum for myocardial revascularization. The development of omentoplasty did not begin until 1953 when Kiricuta covered radionecrotic skin defects with the ometum taken on a pedicle from the abdominal cavity. The greater omentum has also been used for the protection of oesophageal anastomoses (Goldsmith, 1968), for the coverage of post-injury cranial defects (Mc Lean, Buncke, 1971), for the drainage of lymphedema (Goldsmith, 1974), for ischaemic extremity revascularization (Nishimura, 1977, Goldsmith, 1980), for plastic surgery for hemifacial atrophy (Upton, 1980). In 1981, the greater omentum transfer was first modified as a free omento-cutaneous flap (Shen Zuyao).

The Brno Research Institute for Clinical and Experimental Oncology has had good experience with Kiricuta's operation for radionecrosis after breast removal. The omentum drawn out there produces, within a few days, a granulation surface which is then covered using Tiersch's plastic operation.

The classical technique of subcutaneous omentum transfer depends on the method of lengthening (Das, 1976), and is, therefore, not always feasible to cover distant defects. At the same time, there is an increased risk of infection spreading from the subcutis along the vascular pedicle into the peritoneal cavity. The purpose of our study was to ascertain experimentally the behaviour of an autotransplanted omentum sutured in with the microsurgical method.

METHOD

The experiments were made on 23 dogs weighing 8 to 18 kg, divided into 3 groups and operate on in general anaesthesia using Thiopental 15 mg/kg supplemented with nitrous oxide.

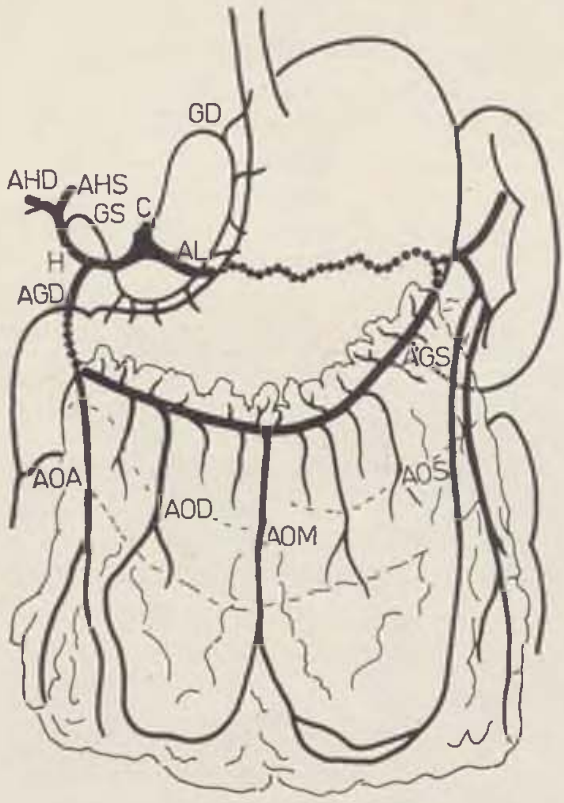


Fig. 1. Diagram of type E omental vessels architectonic pattern C — truncus coeliacus, H — a. hepatica, AL — a. linealis, AGD — a. gastroepiploica dextra, AGS — a. gastroepiploica sinistra, AOA — a. omentalis accessoria, AOD — a. omentalis dextra, AOM — a. omentalis media, AOS — a. omentalis sinistra

Alday and Goldsmith (1972) descirbed 5 basic variants of the omental vessels architectonic pattern. The dog omentum is the most like type E (Fig. 1) with the a. gastroepiploica sin. and the a. omentalis sin. arising from the lineal vessels. The a. omentalis dextra and the a. omentalis accessoria are both well developed. The a. omentalis media in the dog is, as a rule, substituted by several omental arteries.

We use median laparotomy to isolate the right-hand half of the anterior fold of the omentum separating it from the greater curvature of stomach. The vascular pedicle is made up of the vasa gastroepiploica dx. The omental flap is transferred to the inner side of the right-hand thigh and its vessels are sutured end-to-side to the ramus muscularis inf. from the vasa femoralis. The

transferred omental flap is then tucked into a subcutaneous pocket, and the skin over the omentum is united using linear suture.

Fig. 2. Exposed and spread greater omentum

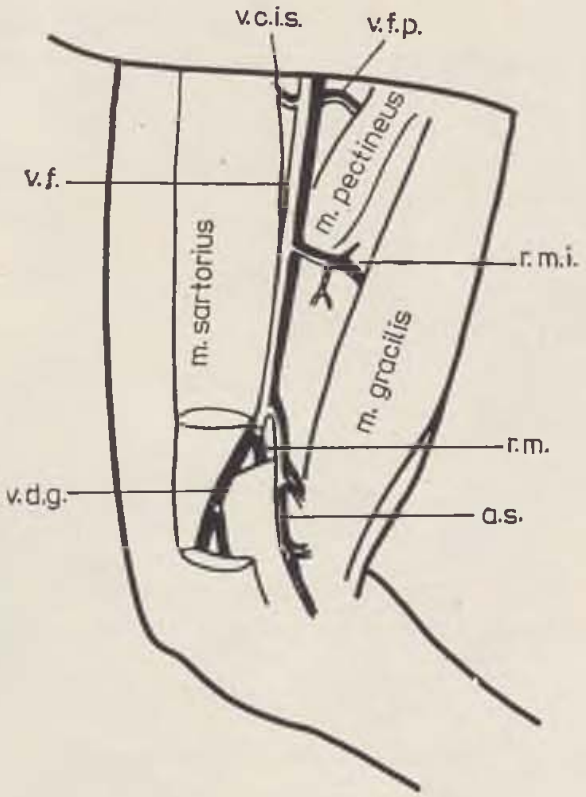


Fig. 3. Diagram of anatomical relations on the inside thigh of the dog. V. f. — vasa femoralis, v.c.i.s. — vasa circumflexa ilium superficialis, v.f.p. — vasa femoris profunda, r.m.i. — ramus muscularis inferior, v.d.g. — vasa descenden: ganus, a.s. — arteria saphena, r.m. — ramus muscularis

Doppler's apparatus is then introduced to test the omental flap vascular pedicle flow after isolation, then the recipient artery flow and the right-sided gastroepiploic artery flow after the omental flap has been sutured in.

Fig. 4. Omental flap prior to suture

Fig. 5. Situation after the completion of vascular anastomoses

In the second group of dogs involving three cases we implanted the omentum into a subcutaneous pocket on the left-hand thigh without suturing in the vessels.

In the post-operative course, the omental flaps were followed-up and revised at different intervals of time ranging from 14 days up to 6 months. The aim of the second-look operation was to perform macroscopic and histological

examination of the transferred omentum. In successful cases the omentum pedicle artery blood flow was measured using the Doppler set. In one case, angiopraphy of the omental flap was made during the revision.

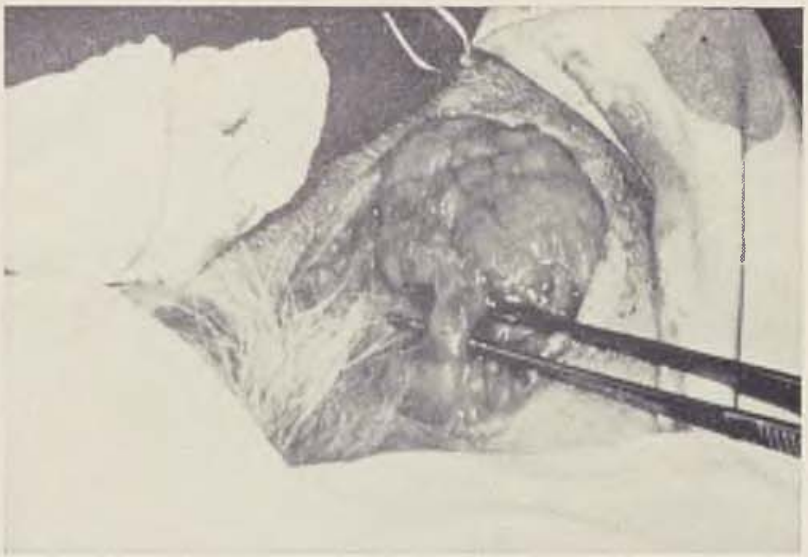


Fig. 6. Very good result at revision, seen above pincers is the vascular pedicle of adipovascular omental flap

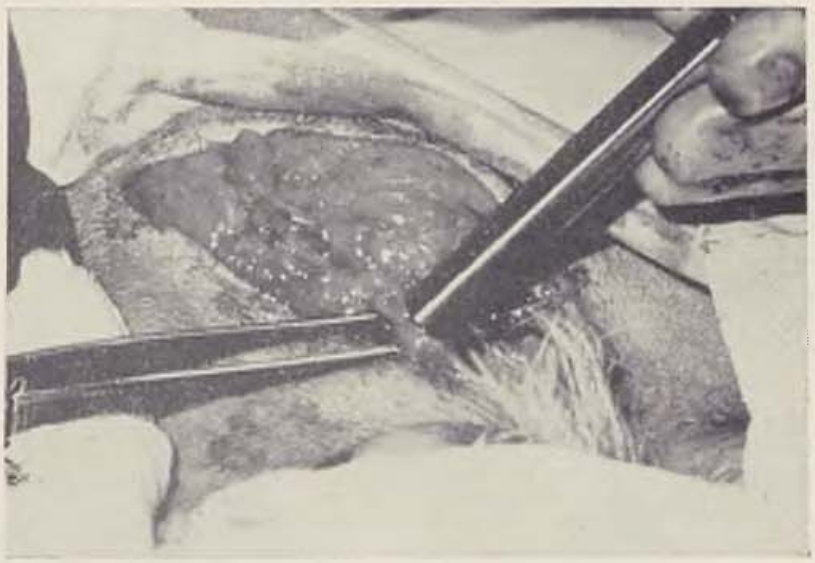


Fig. 7. Omental artery flow measurement at revision

5 dogs of the third group had the omentocutaneous flap transferred to the left-hand thigh simultaneously with the transfer of the omentum. The first three omentocutaneous flaps were transferred in two phases. In the first stage, the omentum with its intact vascular pedicle was implanted into a subcutaneous

pocket of the left-sided mesogastrium. In the second phase, the omentum complete with the adjacent skin was transferred free onto the left thigh after a period of 3 to 4 weeks. The vessels were anastomosed end-to-side to the inferior muscular branch of the vasa femoralis. Two more flaps were transferred using the Shen Zuyao "delayed" modification.

Fig. 8. Omentocutaneous flap with areola transferred. State after completion of vascular anastomoses

Fig. 9. Omentocutaneous flap with transferred areola healed in to the thigh

RESULTS

In the first group of three dogs the omentum was transferred for purposes of practice. In the 20 dogs of the 2nd and 3rd groups the transfers were performed with a view to studying the flap behaviour.

Operation wound dehiscence and subsequent infection of the flap were encountered in five cases. There was one case of necrosis of the flap for thrombosis in the venous anastomosis, and three cases of slight venostasis resulting post-operatively in the flap swelling. Flap necrosis for arterial thrombosis constituted the remainder of the unsuccessful transfers — i.e. a total of 6 transfers.

At the time of revision, the result was rated as good when there was a well preserved flap with patent vessels, albeit with greater or lesser connective tissue transformation and size reduction. The result was rated very successful when the omentum had preserved its adipovascular character. At revision, the finding was rated unsuccessful so long as the vascular anastomoses had been thrombotized and only a thin connective tissue layer on the muscular fascia had remained of thee necrotizing omental flap.

In the 2nd group of 12 dogs, successful transfer was achieved in 6 animals (i.e. 50 %). Thereof, two cases were rated as very good (16.6 %) and four as good (34.4 %). 6 cases were unsucessful (50 %).

In the third group of 8 dogs, successful transfer was noted in 7 animals (87.5 %); thereof, three cases were rated as very good (37.5 %), and four as good (50 %). In one case, the transfer was studied for necrosis (12.5 %).

Free transfer of the omentocutaneous flap, using the two-phase procedure, proved to be a failure as the first three flaps became necrotized. Further on, we used the three-phase technique according to Shen Zuyao, a decision resulting in success.

Vascular flow was measured, using an ultrasonic flowmeter, in the 2nd group in dogs No. 6—12 and in all the dogs of the 3rd group. The graphic recordings of the flow values show that the flow through the omental artery pedicle was invariably greater than through the recipient vessels even though the vascular lumina were mostly identical or were greater in the thigh, a fact which we put down to differences in the vascular tone. In the majority of cases, the omental artery flow following the suture was identical with the recipient artery flow, the reverse being true of only 3 cases. At revision, the omental artery flow was identical with that after the suture with only one exception when it was found greater.

DISCUSSION

Post-irradiation defects with poor granulation, infection and minimal tendency to healing can for years resist all manner of treatment in oncologically cured patients. In those cases, we regard as more advantageous to use the omentum than the now classical free transfers of cutaneous and musculocutaneous flaps since the omentum is capable of active antibody production, re-

vascularization and drainage. Depending on how the omentum is placed, the thickness of the flap can effectively be determined at will.

By our experience, the omentum placed free in a subcutaneous pocket exhibits a tendency to tubing to reduce its surface to a minimum; consequently, the omentum has to be fixed for the preparation of omentocutaneous flaps and for shaping them as required.

The results of our experiments stand to show that in uncomplicated cases the transferred omentum can preserve its adipovascular character without any flap size reduction. The omental tissue responded to unfavourable conditions by connective tisue proliferation depending on the degree of damage. This particular response was practically uniform regardless of whether infection, wound dehiscence or mild venostasis were involved. In those cases the flap size was to a certain extent reduced. The fibrous tissue proliferation was at its maximum during the first fortnight, then fibroadipose retraction set in until 6 months later there was a minimum amount of fibrous tissue and all that remained was healed-in adipovascular tissue.

In the second group we were able to reach no more than 50 % success of the free transfer operations, which we put down mainly to the following two factors:

— using Thiopental narcosis only, the dogs kept on sleeping 24 to 48 hours after an operation lasting several hours. In the absence of fluid and food supply, the animal's dehydration and increased tendency to thrombotization are a most likely consequence. The addition of nitrous oxide to Thiopental appeared to offer more advantage. The animals woke up soon after the operation and were ready to take food the following day.

— pre-suture perfusion of the flap vessels must be regarded as inadvisable. While preparing omentocutaneous flaps it is necessary to use the "delayed" mode of procedure; attempts to speed up the process proved inadequate as the flaps became necrotized.

We regard as important the finding that, following suture, the omental vascular flow is equal to that in the recipient bundle. In our view, pre-operative blood flow measurement and the subsequent suturing of the omentum to a suitable artery can enhance the revascularization capacity of the omental flap.

CONCLUSION

Our experiments were designed to gather experimental experience with free omental flaps. Practically all kind of complication was encountered. The results were evaluated by macroscopical, histological and physical means. Step by step, an optimum surgical strategy and omental transfer technique were developed for potential clinical use.

J. H.

SUMMARY

23 dogs were used for the experimenal modelling of free transfer of omental and omentocutaneous flaps. The flaps were followed up and revised

at intervals ranging from 14 days to 6 months. The results were evaluated macroscopically and histologically, and the vascular relations were tested using an ultrasound flowmeter. The experiments showed the omentum as behaving differently under optimum and adverse conditions, and helped to develop a good surgical strategy as well as a technique for omental flap transfer.

RESUME

Observation des lobes omentaux librement transposés — l'étude expérimentale

Veselý, J., Žaloudík, J., Hamza, J., Novák, J.

Dans les conditions expérimentales, on a exécuté des transpositions de lobes omentaux et omento-cutanés libres, sur 23 chiens. Des lobes ont été observés et revisés aux intervalles arbitraires, de 14 jours à 6 mois. Les résultats ont été évalués par des examens macroscopiques et histologiques, l'état des artères a été testé par un débitmetre ultra-sonique. Les expériences ont prouvé le comportement d'omentum différent aux conditions optimales ou défavourables, ont même contribué à l'élaboration d'une bonne technique opératoire et d'une technique de transposition des lobes omentaux.

ZUSAMMENFASSUNG

Eine Beobachtung frei übertragener Omentallappen — Experimetalstudie

Veselý, J., Žaloudík, J., Hamza, J., Novák, J.

An 23 Hunden wurden als Experiment freie Übertragungen von Omental- und Omentokutanlappen modelliert. Die Lappen wurden dann beobachtet und in verschiedenen Zeitintervallen von 14 Tagen bis zu 6 Monaten revidiert. Die Ergebnisse wurden makroskopisch und histologisch eingeschätzt und die Gefässverhältnisse mit einem Ultraschall-Durchflussmesser getestet. Die Versuche zeigten verschiedenes Verhalten der Omenta unter optimalen und ungünstigen Bedingungen und verhalfen zur Ausarbeitung einer guten Operationstaktik und -technik der Omentoübertragungen.

RESUMEN

Seguimiento de los lóbulos omentales libremente trasladados — estudio experimental

Veselý, J., Žaloudík, J., Hamza, J., Novák, J.

En 23 perros, como modelo, se hicieron libres transplantes de lóbulos omentales y omentocutáneos. Los lóbulos fueron controlados y revisados en diferentes intervalos de tiempo de 14 días a 6 meses. Los resultados fueron apreciados macroscópicamente e histológicamente y las condiciones vasculares fueron controlados mediante un medidor de flujo ultrasónico. Los experimentos demonstraron el comportamiento distinto del omento en condiciones óptimas y desfavorables, contribuyendo así a elaborar una buena táctica operativa y técnica de transplantes omentales.

REFERENCES

1. **Alday, E. S., Goldsmith, H. S.:** Surgical technique for omental lengthening based on arterial anatomy. Surg. Gynec. Obstet., 135; 103, 1972.

2. **Das, S. K.:** The size of the human omentum and methods of lengthening it for transplantation. Brit. J. plast. Surg., 29; 170, 1976.

3. **Goldsmith, H. S.:** Salvage of stage ischemic extremities by intact omentum. Surgery, 88; 732, 1980.

4. **Goldsmith, H. S., Kiely, A. A., Randall,**

H. T.: Protection of intrathoracic oesophageal anastomoses by omentum. Surgery, 63; 654, 1968.

5. **McLean, D. H., Buncke, H. J. Jr.:** Autotransplant of omentum to a large scalp defect with microsurgical revascularization. Plast. reconstr. Surg., 49; 268, 1972.

6. **Petit, J. Y., Lacour, J., Margulis, A., Reed, W. P.:** Indication and results of omental pedicle grafts in oncology. Cancer, 44; 2343, 1979.

7. **Shen, Z., Wang, S., Cheng, X., Lu, J., Yin, D., Sun, Y., Wang, X.:** Greater omentum-cutaneous axial flap — a method to create transferrable skin flap. China med. J., 94; 718, 1981.

8. **Upton, J., Mulliken, J. B., Hicks, P. D., Murray, J. E.:** Restoration of fascial contour using free vascularized omental transfer. Plast. reconstr. Surg., 66, 4; 560, 1980.

9. **Walker, F. C., Thomson, J. D., Gray, J. G.:** Antibody formation by the greater omentum. Brit. J. Surg., 48; 89, 1960.

Dr. J. Veselý,
Dept. of Plastic Surgery,
Berkova 34, 612 00 Brno, Czechoslovakia

S. M. Kirov's Academy of the War Medicine, Leningrad (USSR)
Department of the War Traumatology and Orthopaedics
Head Prof. S. S. Tkatchenko

REORGANIZATION OF THE BLOOD CIRCULATION AFTER REVASCULARIZATION OF MICROSURGICAL FREE GRAFTS

A. E. BELOUSOV, I. A. MEZENTSEV

Free transfer of composite grafts using microsurgical anastomoses of vessels and nerves has considerably broaden possibilities of plastic and reconstructive surgery of the supporting-locomotive apparatus (5, 6). In 25 such operations, performed on 24 patients, the following tissues were grafted: a flap from the dorsum pedis (4), m. latissimus dorsi with the skin (5), m. gracilis with the skin (3), m. tensor fasciae latae (2), fibula (3), the second metatarsophalangeal joint (3), fingers of the foot (3) and a cutaneo-adipose flap from the ulnar aspect of the digit IV of the hand (3). 3 operations were unsuccesful and the post-operative periods of 2 patients are not long enough.

Clinical experience has shown that both during a surgical intervention and post-operatively there occurs reorganization of the blood circulation in grafts. A serious task of plastic surgery is to foresee and properly evaluate such changes and to prevent their dangerous consequences. We have approached this problem clinically as well as experimentally.

METHODS AND RESULTS

8 outbred dogs weighing from 12 to 16 kilograms were used in 8 experiments, performed under intravenous penthotal anesthesia. Oval fascio-cutaneous flap of the size 18 × 9 cm was cut out of the iliac region without transecting its vascular pedicle (a.and.v. epigastrica superficialis inferior). The flap was grafted orthotopically and its blood circulation was evaluated at the end as well as 3, 6, 10 and 14 days after the surgery clinically (skin colour, promptness of the capillary response to the point compression, severity of the oedema) and also quantitatively by determining velocity of the local blood flow in the graft using the halftime of a microdose (0.01 μCu) of the radioactive $Na^{131}I$ (Kety, 1949). The standard dose of the radioisotope, dissolved in 0.1 ml of saline, was administered subcutaneously at the site of the vascular pedicle

and at the periphery of the graft. Changes of the radioactivity were followed using the radiometer DRGZ-01. Corresponding sites of the contralateral limb were used as controls. Moreover, the area of the microcirculatory ring of some parts of the graft was measured using the method of Rybatchenko (1979).

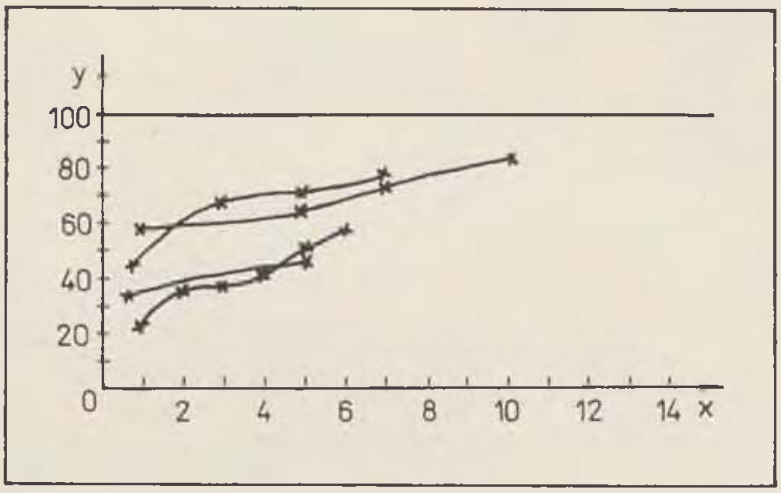


Fig. 1. Experiment with dogs, changes of the regional circulation in the centre of the cutaneo-adipose flap after the surgery; x — observation time (in days), y — blood flow (%)

Our experiments have shown that immediately after formation of the flap its blood circulation becomes defficient with a gradient from the vascular pedicle to the periphery ($P<0.01$) and the maximum value of the local blood flow is always lower than that of a control site ($P<0.001$). The size of functioning microcirculatory ring is decreased in the same way ($P<0.001$).

These alterations combined with the oedema of the graft, are the most intensive from 3 to 6 days after the surgery. They are attributable, obviously, to disconnecting of secondary sources of the blood supply by cutting out the graft, with the resulting axial pattern of the blood flow and necessarily reduced blood supply to the periphery. Elimination of one of the basic factors of the venous drainage — the skin venous plexus — reduces venous outflow, which, in combination with an inflammation, results in oedema formation. These disturbances recede when vascular connections between the graft and surrounding tissues are formed, and the blood flow in the graft is nearly normal within 10—14 days after the surgery (Fig. 1).

Similar changes of the blood flow have been observed in 19 composite free grafts transplanted in 19 patients using microanastomoses of nerves and vessels. In 9 grafts we have measured the local blood flow at the vascular pedicle, as well as at the periphery, using the radioisotope technique.

Clinical observations made possible to determine 3 periods of reorganization of the blood circulation in composite grafts with normally functioning microvascular anastomoses (Fig. 2). Period 1 (8—24 hours) is characterised by severe disturbances of the blood flow due, basically, to the following rea-

sons: 1. ischaemic changes of the graft, 2. the maximum reduction of sources of the blood supply (to one main nerve-vascular bundle), 3. the axial pattern of the blood flow in composite grafts, 4. haemodynamic changes induced by directed hypotony, 5. disturbed microcirculation due to drugs used for anesthe-

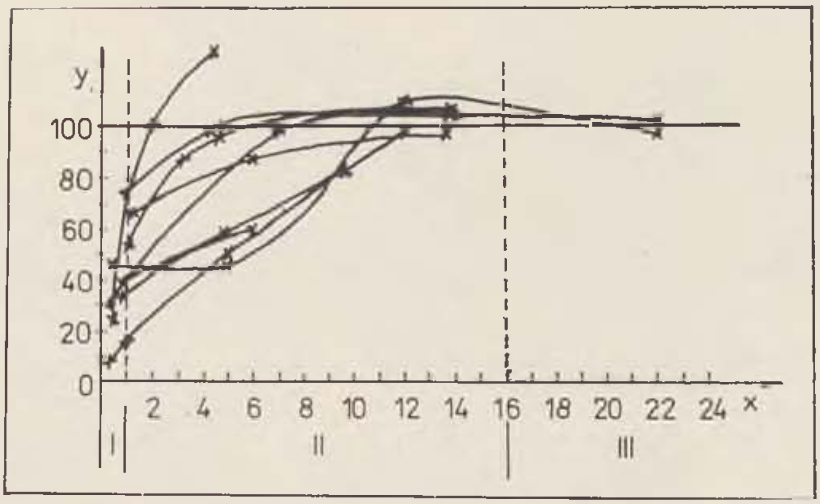
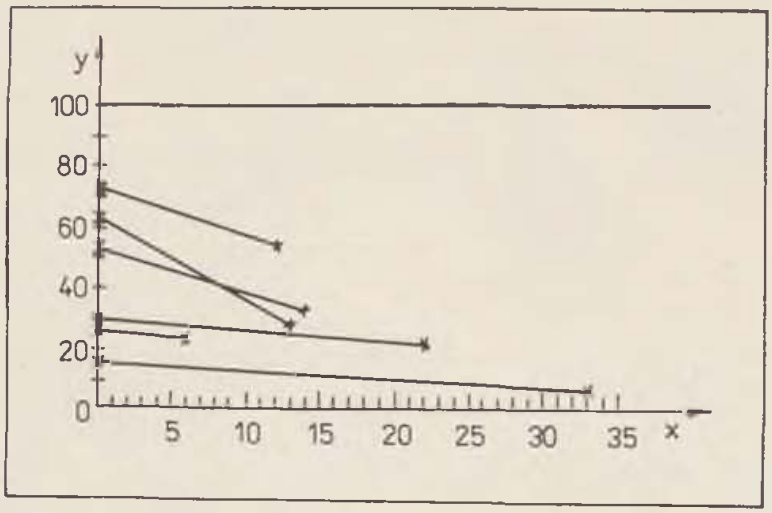


Fig. 2. Transplantation of composite tissue graft in man. Time course of changes of the regional circulation at the vascular pedicle entrance; x — observation time (in days), y — blood flow (%)

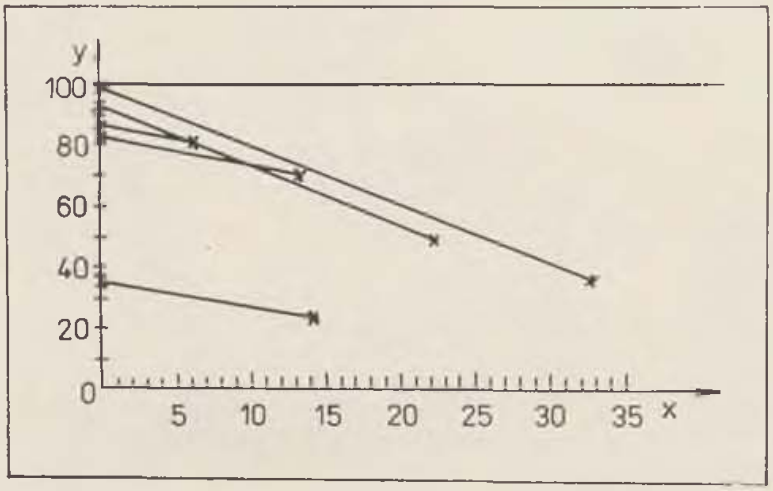
sia. The following are the main signs of this period: reduction of the local blood flow (2—4 times in comparison to control values, $P<0.05$); formation of a severe oedema, intensity and duration of which are determined, for the most part, by the volume of blood flow in the graft, duration of anoxia and sensitivity of transplanted tissues to it; existing venous insufficiency after remission of a severe oedema (from accelerated capillary response to point pressure to considerable oedema and cyanosis of the skin) and decreasing local blood flow in direction from the vascular pedicle to the periphery (Fig. 3a).

Within the 2nd period (formation of vascular connections between the graft and surrounding tissues) a gradual improvement of the blood circulation in the graft takes place: diminishing of the oedema, disappearence of the signs of venous insufficiency, an absolute increase of the local blood flow, decreasing difference between the blood flow at the vascular pedicle and periphery (see Fig. 2, 3b). Prolongation of the 2nd period is influenced by the mass of the graft, the area of its contact with the recipient bed, and extent of cicatrization. The period lasts from 10 to 16 days and represents the most perilious stage in which the graft is endangered by thrombosis of the arterial anastomoses and by death.

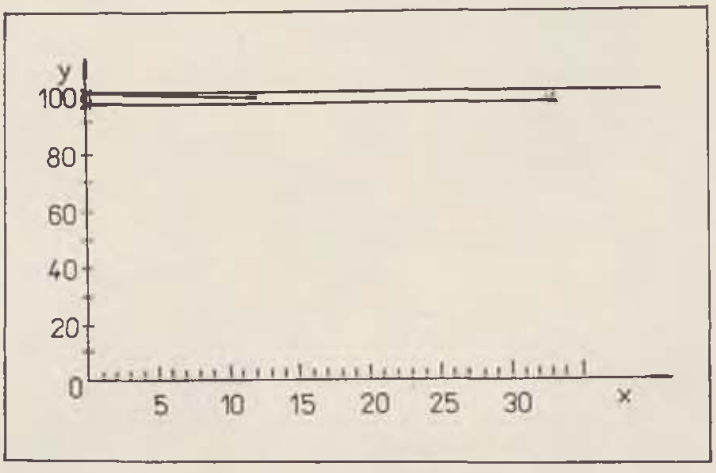
The 3rd period (the final reorganization of the blood circulation) extends up to several months and consists of the final reorganization of transplanted composite tissues following their denervation and consequent reinervation (not



a



b



c

Fig. 3. Parameters of the regional circulation in different parts of the graft. The zero level is the value of blood flow at the entrance of the vascular pedicle; x — l (cm), y — blood flow (%), a — 24 hours after the surgery, b — 5 days after the surgery, c — 21 days after the surgery

in all cases), and it is influenced decisively by the limb function. The local blood flow, in all parts of the graft, approaches control values (Fig. 2, 3c).

Results of dynamic evaluations of the blood circulation in composite grafts during their free transplantation as well as post-operatively have been used, in combination with analysis of literature data, to formulate a hypothesis concerning the role of the most important and closely interrelated factors underlying reconstruction of the blood circulation. They may help surgeons to choose the most optimum tactical variants and the most suitable operative techniques.

1. Arterial inflow to the transplant. Immediately after the surgery the blood vessels anastomosed to vessels of the recipient bed are the only source of the blood supply to transplanted tissues. It is known that the blood flow through the artery of the graft is determined by many factors: relation of diameters of the anastomosed vessels, perfusion pressure in the inflow artery, the mass of the composite graft, capacity of the venous outflow, hydrostatic pressure, and others (Petrovskii and Krilov, 1976, Folkov and Nil, 1976, O'Brien, 1977, Serafin and Buncke, 1979, Szilaygi et al., 1960).

During the operations it has been noted that if the inflow vessels of the recipient bed have considerably smaller diameter than vessels of the transplant, the blood circulation in the transplant is poor. Therefore, if branches of the main recipient arteries had insufficient diameter, anastomosis end to site of the main arterial path was used (3 cases). Also, in 1 patient, selection of the vascular suture type was influenced by risk of considerable disturbances of the limb periphery as a consequence of transection of the recipient bed artery preparatory to end to end suture. Advantage of this type of anastomosis is seen in decreasing the possibility of turbulent blood flow and, consequently, risk of thrombosis (Serafin and Buncke, 1979, Szilaygi et al., 1960).

2. Venous outflow from the graft. Reconstruction of the venous outflow is, in circumstances of sufficient arterial inflow, the most important condition determining success of the surgery. Signs of venous insufficiency resulting in the oedema of transplanted tissues (accelerated capillary response to the point pressure and cyanosis of the skin) have been observed in all cases, without regard to relation of diameters and number of sutured vessels.

These symptoms were significant in case of transplantation of myocutaneous flaps even if diameters of the anastomosed vessels were compatible. This was undoubtedly related to exclusion of the blood outflow via the skin venous plexus. Insufficient diameter or number of the recipient bed veins resulted in heavy oedema in 3 cases.

However, such changes were minimal when foot fingers were grafted to the hand and venous plexuses of the graft were used for reconstruction of the blood outflow. Therefore, in pre-operation planning the size of the graft not only its contractibility but also its structure, determining, for the most part, the extent of the oedema, were taken into consideration.

Magnitude of the oedema of revascularized composite grafts increased inversely to number of reconstructed veins. However, anastomosing all the veins was not the rule. In one patient — when a flap from the dorsum pedis in size 5.5 × 4 cm was transplanted to a finger of the hand — the venous outflow

via the commitant veins of the graft, after reconstruction of the arterial inflow, was, with regard to the size of the flap, too small. In this case anastomosing of both two commitant veins (of diameter 1.5—2 mm) would be a mistake resulting in considerable decrease of the velocity of the venous blood flow, decreased venous pressure and collapse of the venous walls, leading to significantly increased risk of thrombosis of microanastomoses. Therefore, only one vein was anastomosed.

Different situation arose when there was voluminous blood supply to the graft and it was technically impossible to use both commitant veins because only one vein was present in the recipient bed. In one instance — transplantation of m. gracilis to the forearm — a severe oedema of the graft, developing immediately during the operation, had to be managed by anastomosing the second commitant vein of the graft to a more distant recipient vein. Similarly to other situations, disappearance of the skin pattern served as the criterion of the dangerous level of disturbed venous outflow.

3. The hydrostatic pressure in tissues. Changes of extremity position with regard to the trunk influence decisively its blood circulation by changing the hydrostatic pressure (Folkov and Nil, 1976, O'Brien, 1977). Therefore, changing the position of the segment covered by the graft is quite effective, simple and the only available method for regulation of the blood circulation. By lifting the extremity it was possible to decrease the arterial inflow and, simultaneously, to increase the venous outflow, and vice versa. The optimal venous outflow — a slightly higher than normally — was maintained by lifting and lowering the extremity. This method decreased the risk of thrombosis of the venous anastomoses by distending slightly the veins without causing significant oedema. Moreover, lowering of the extremity dilates arteries and can be used for managing arterial spasms in the graft (O'Brien, 1977).

With transplants to lower extremities, change from a horizontal to vertical position of the limb resulted in significant oedema of the graft. In one patient, with transplanted thoracodorsal flap to the tibial region, the early loading of the limb at the end of the third post-operative week caused opening of the sutures at several sites of the wound. Complementary sutures had to be used. Therefore, in other patients with grafts to the tibial region, the wound was sutured with outmost care and the stitches were removed later than usually (after 3 and more weeks) when a solid dermal scar was formed. Also, the vertical loading of the limb was increased only gradually.

CONCLUSIONS

1. Free transplantation of composite tissue grafts using vascular microanastomoses is accompanied by reorganization of the blood circulation in the graft. The process of reorganization consists of 3 periods. 1 — severe disturbances of the blood flow (8—24 hours), 2 — formation of vascular connections between the graft and surrounding tissues (10—16 days), 3 — final reorganization of the blood circulation in the graft (several months). In the 1st and 2nd period, thrombosis of vessels nourishing the graft could result in its necrosis.

2. The proper blood supply of the freely transplanted graft must be secured using alternative tactics and technical approaches, choice of which is based on analysis of many interrelated factors determining the absolute values of indicators of the blood flow in individual composite grafts.

M. D.

SUMMARY

The paper deals with experimental and clinical studies proving that free transplantation of composite grafts using microvascular anastomoses is followed by three basic periods of reorganization of the blood circulation in the graft: a) period of severe disturbances of the blood flow (8—24 hours); b) period of formation of the vascular conections between the graft and surrounding tissues (10—16 days); c) period of the final reorganization of the blood circulation in the graft (up to several months). Within the 1st and 2nd period thrombosis of nourishing vessels threatens the graft with necrosis. The influence of number of factors on the blood circulation in the graft is discussed.

RESUME

Transformation de la circulation sanguine au cours de la revascularisation des greffes microchirurgicales libres

Belooussov, A. E., Mezenntsev, I. A.

S'appuyant sur les résultats expérimentaux et les observations cliniques, les auteurs prouvent que pendant une transplantation libre des complexes de tissu, effectuée par la méthode des anastomoses microvasculaires, on arrive à une transformation de la circulation sanguine de la greffe. On peut distinguer trois phases élémentaires de la transformation:

a) phase de coupure aiguë de la circulation sanguine (8—24 heures),
b) phase d'établissement de la jonction du système vasculaire de la greffe avec les tissus voisins (10—16 jours)
c) phase de transformation finale de la circulation sanguine du greffon (dans plusieurs mois).

Dans la 1ère et 2ème phase, la thrombose menace les vaisseaux alimentants la greffe, ce qui pourrait avoir pour résultat la nécrose succédante du greffon. Egalement, le travail discute l'influence d'autres facteurs sur l'alimentation sanguine du greffon.

ZUSAMMENFASSUNG

Umgestaltung des Blutkreislaufes bei der Revaskularisation freier mikrochirurgischer Propfen

Belousow, A. E., Mesentsew, I. A.

Auf Grund von Forschungsergebnissen und klinischen Beobachtungen wurde nachgewiesen, dass es bei freier Übertragung von Gewebekomplexen mittels der Methode von Mikrogefässanastomosen zu einer Umgestaltung des Blutkreislaufes des Transplantates kommt. Man kann hierbei drei grundlegende Perioden der Umgestaltung unterscheiden: a) die Periode der akuten Störung des Blutkreislaufes (8—24 Std.), b) die Periode des Anschlusses des Gefässbettes des Transplantates und des umliegenden Gewebes (10—16 Tage), c) die Periode der endgültigen Umgestaltung des Blutkreis-

laufes der Transplantates (mehrere Monate). Während der ersten und zweiten Periode droht eine Trombosis der das Transplantat ernährenden Gefässe sowie eine darauffolgende Nekrosis. In der Arbeit werden weiterhin die Einflüsse noch anderer Faktoren auf die Blutversorgung des Transplantates diskutiert.

RESUMEN

Reconstitución de la circulación de sangre producto de la revascularización de los injertos microquirúrgicos libres

Belousov, A. E., Mezentsev, I. A.

En base a resultados experimentales y observaciones clínicas se demuestra que al transplantar libremente los complejos de tejidos mediante el método de anastomosis microvasculares se produce una reconstitución de la circulación de sangre en el transplante. Se puede diferir entre tres períodos básicos de dicha reconstitución: a) el de trastornos agudos de la circulación de sangre (8 a 24 horas), b) el de conexión del cauce vascular del transplante con los tejidos aledaños (10 a 16 días), c) el de la reconstitución final de la circulación en el transplante (en varios meses). En el período uno y dos hay riesgo de trombosis de los vasos que alimentan el transplante y de su necrosis resultante. En el trabajo igualmente se discute la influencia de otros factores sobre la alimentación sanguínea del transplante.

REFERENCES

1. **Petrovskii, B. V., Krilov, V. S.:** Microsurgery. M., Nauka, 1976.
2. **Ribatchenko, P. V.:** Microcirculatory ring of the myenteric plexus of the large intestine in the norm, after sympathetic decentralization and experimental perforating wounds. Thesis, Ivano-Frankovsk, 1979.
3. **Folkov, B., Nil, E.:** Blood circulation. Translated into Russian, M., Medicina, 1976.
4. **Kety, S. S.:** Measurement of regional circulation by the local clearence of radioactive sodium. Amer. Heart J., 39:321, 1949.
5. **O'Brien, V. M.:** Microvascular reconstructive surgery. Edinburg, London and New York, Churchill Livingstone, 1977.
6. **Serafin, D., Buncke, H. J.:** Microsurgical composite tissue transplantation. St. Louis-Toronto-London, The C. V. Mosby Co., 1979.
7. **Szilaygi, D. E., Whitcomb, J. G., Schenker, W., Waibel, P.:** The laws of fluid flow and arterial grafting. Surgery, 46:55, 1960.

Dr. A. E. Belousov,
S. M. Kirov's War Medicine Academy,
Leningrad, USSR

Laboratory "Polymers in the Medicine"
Director Prof. Dr. T. T. Daurova
A. V. Vishnevskii's Institute of Surgery of the AMS USSR
Director Academician M. I. Kuzin
Central Scientific-Research Institute of Stomatology, Moscow (USSR)
Director Dr. V. M. Bezrukov

OLIGOSILOXANS IN RECONSTRUCTIVE SURGERY OF THE FACE

T. T. DAUROVA, FV. M. KHITROV, L. A. BRUSOVA, N. I. OSTRETSOVA, I. K. TEBLOYEV

Silicon implants obtained by thermic or radiative vulcanization are currently used in reconstructive surgery of the face. They are used succesfully for covering defects of the facial skeleton (1), but their density makes them unsuitable for covering defects of soft tissues. For this purpose gel materials prepared by "cold" vulcanization (2) or combined implants including silicon gels are recommended (3). New allomaterials, based on oligosiloxans and having properties similar to the muscle and adipose tissues were developed in the Vishnevskii's Institute of Surgery of the AMS USSR. These materials (their general name Elastosil MI means: elastic silicon materials medical injectable) are liquids solidifying after their injection into the organism. The suitability of these materials was verified clinically when used for repair of deformities of the chest (2).

The present paper deals with the use of Elastosil MI for plastic reconstructions of defects of the soft facial tissues of various aetiology and localization.

Elatosil MI is a compound consisting of two components: basic polymer and a hardener. For the basic polymer the oligosiloxan -α, w-diol of the initial viscosity of 2 poases, and for the hardener a mixture (1:1) of lead octoate and tetraetoxisilan were used. Concentration of the hardener, given as the weight ratio, ranging between 0.9:100 and 1.5:100, enabled us to obtain materials of different elasticity (tab. 1). The hardener was added to the polymer in drops under continual stirring. (Conversion of the weight ratio to the number of drops is given in table 1). Elastosil MI was injected subcutaneously using syringes Record with a firm nut union of needles of the diameter 1,5—2,0 mm. The amount of Elastosil MI necessary to fill a defect was estimated 2—3 days before the operation using injections of novocaine or wax models. Elastosil MI was injected under an intravenous neuroleptanaesthesia or without any anaesthesia.

38 patients (33 women and 5 men) aged from 18 to 50 years with deformities of soft facial tissues were treated surgically at the Department of Surgical Stomatology of the Central Scientific-Research Institute of Stomatology.

In cases of hemiatrophy and lipodystrophy of the face the surgical treatment was performed after completion of atrophic processes.

With regard to the aetiology of the defects three groups of patients were distinguished: 1. bilateral lipodystrophy of the face (22 patients), 2. hemiatrophy of the face (7 patients), 3. combined deformities of the facial skeleton and soft tissues (9 patients). Defects and deformities of soft tissues of the face were source of intense mental and physical suffering of the patients.

Characteristic features of bilateral lipodystrophy (Barraquer-Simons's disease) are the following, disappearence of the adipose tissue of the face, upper parts of the trunk, arm girdle, proximal parts of the arms, and its redistribution to the pelvic girdle and thigs. At present, no exact explanation of aetiology of this disease exists. Its main feature — the disturbed metabolism of the adipose tissue — suggests, however, that a diencephalic disorder is involved (4).

All our patients suffering from lipodystrophy were women. The age of lipodystrophy occurrence ranged from 6 to 17 years, the most frequent age being 8—10 years. The illness was developing gradually, the first symptom was atrophy of the face. Usually it was impossible to find any cause of the disease. In bilateral dystrophy the face looses its rounded shape and the cheeks are sunken because of the subcutaneous adipose tissue disappearence. The facial muscles have sharp contours. The skin is porous, sometimes slightly hyperpigmented, and its turgour is decreased. Astheno-neurotic syndrome of various intensity is caused by the feeling of physical inferiority as well as by the cosmetic defect. Pharmacotherapy of facial lipodystrophy has only limited effects and it is used to remove simultaneously occurring disturbances of the neural and endocrine systems.

In cases of bilateral lipodystrophy deformities of the soft tissues were removed by bilateral subcutaneous injection of 10—30 ml of Elastosil MI. Depending on the extent of the defect, altogether 20—60 ml of the polymer were injected into the suborbito-cervical regions. The site of the injecion was treated with collodium.

The main clinical feature of progressive hemiatrophy is the continuous thinning of one half of the face due to atrophy of the skin and subcutaneous adipose tissue. Dystrophy of muscles is not exceptional, the cartilages and bones are affected rarely. The patients are mainly children of school and preschool age. In our 7 patients suffering from hemiatrophy of the face the first sign of the illness occurred at the age of 5—17 years; the cause of the illness was not identified. Hemiatrophy affected the left side of the face in 5 patients, the middle and lower face atrophied in 5, the whole face in 2 patients. Due to trophic disturbances the skin was thin, wrinkled, and without subcutaneous adipose tissue. Dystrophy of muscles is not exceptional, the cartilages and function was normal. The pronounced cosmetic defect resulted in astheno-neurotic syndrome.

The patients suffering from hemiatrophy of the face were treated by injecting 12—45 ml of Elastosil MI through several punctures.

Tab. 1. The hardener concentration and consistency of Elastosil MI

Concentration of the hardener		Material produced in vitro
Weight ratio to the basic polymer	Drops[1]) for 10 ml of the basic polymer	
0.9 : 100	18	gel
1.0 : 100	20	gel
1.1 : 100	22	gel
1.2 : 100	24	soft resin
1.3 : 100	26	soft resin
1.4 : 100	28	soft resin
1.5 : 100	30	soft resin

[1]) Weight of 1 drop is 0.0075 gram

The 3rd group of defects consisted of traumatic deformities of the facial skeleton and soft tissues (2 patients), osteomyelitis of the mandible (2 patients) and congenital anomalies (5 patients).

The speciality of treatment in this group was determined by the necessity to reconstruct soft tissues after previous removal of skeletal deformities. Therefore, plastic reconstruction of the mandible and zygomatico-infraorbital region, using silicon implants, was performed in 7 patients preparatory to injecting 2—68 ml of Elastosil MI to remove deformities of the soft tissues.

After the polymer administration the patients had to stay in bed for 24 hours. Within this period the hardening of Elastosil MI in the organism was usually completed. The postoperative course was satisfactory. The body temperature was either normal or increased to 37.5 degrees C. Oedema of the face reached its maximum within 2—3 days and then slowly receded. It decreased considerably after 2—3 weeks and the patients were dismissed in a good condition. Cosmetic results were good on examination 6 and 12 months

Tab. 2. The hardener concentration and viability of Elastosil MI

Concentration of the hardener weight ratio to the basic polymer	Viability[1]) in minutes
0.8 : 100	120
0.9 : 100	45
1.0 : 100	30
1.2 : 100	20
1.5 : 100	15
2.0 : 100	10

[1]) Viability — time of liquid consistency

Tab. 3. Elasticity of soft tissues and Elastosil MI hardening products

Material	Modul of elasticity, MPa.
Biological tissues	
subcutaneous adipose tissue	0.10
muscles (various)	0.20—0.60
Elastosil MI (content of the suturing system, the weight ratio of the hardener and polymer)	
0.9 : 100	0.13
1.2 : 100	0.29
1.5 : 100	0.30

after the operation. The oedema disappeared completely. In 4 patients (of the second group mainly) a part of the injected material was lost. This was caused by the low weight ratio — 0.9:100 — of the hardener, advantage of which had been seen in a long lasting consistency of the liquid (tab. 2) and its final hardening into a material as far as elasticity is concerned very similar to the adipose tissue (tab. 3). On the other hand, the hardening of the 0.9:100

Fig. 1. Patients K. Diagnosis: bilateral facial lipodystrophy, a — before the operation, b — after the operation

Fig. 2. Patient G. Diagnosis: Maxillo-facial dysostosis; a, b — before the operation, c, d — after the operation

mixture in the organism being rather slow, it tends to escape from the site of injection to adjacent tissues. We have found that good results can be guaranteed only with Elastosil MI with at least 1.2:100 weight ratio of the hardener and basic polymer; such compounds remain in the organism liquid for a minimum time (tab. 2).

In 34 patients the long-termed postoperative results had been observed: in 7 patients for 5 years, in 14 patients for 4 years, in 9 patients for 3 years and in 4 patients for 2 years. In all of them the relief of the facial soft tissues was restored and the skin colour and function of the masticatory and facial muscles were normal. Good results were obtained with 28 patients, satisfactory results with 6 patients, which were mainly patients with facial hemiatrophy where symmetry of the face was not restored and a part of the silicon implant was transposed to the eyelids (in 3 patients). We have to say, however, that restoration of the face symmetry in patients suffering from hemiatrophy is rather difficult, for the atrophic skin prevents us from injecting the required dose of the silicon to straighten the skin over the defect. Nevertheless, all the patients were satisfied with the results of the surgery. Their astheno-neurotic reactions were treated and they felt to be full-value members of the society (fig. 1 and 2). Thus, results of the clinical application of Elastosil MI have shown that the compound based on oligosiloxan with the hardener in the weight ratio 1.2—1.5:100 meets requirements for injectable allomaterials used to reconstruct soft tissues. We can recommend its clinical use in treatment of lipodystrophy of the face and of secondary deformities of soft tissues resulting from plastic reconstructions of the face as well. In treatment of hemiatrophy of the face Elastosil MI should be combined with other methods of reconstructive surgery.

M. D.

SUMMARY

The injectable silicon compound Elastosil MI, hardening in the organism, has been used for reconstruction of soft tissues of the face of various aetiology. 38 patients were treated : 22 patients with bilateral lipodystrophy, 7 patients with facial hemiatrophy and 9 patients with secondary deformities of facial soft tissues. The operative results observed for 5 years have shown that treatment with Elastosil MI secures permanent cosmetic results. The compound is recommended for clinical use.

RESUME

L'utilisation des oligosiloxanes en chirurgie reconstructive de la face

Daurova, T. T., Khitrov, F. M., Brusova, L. A., Ostretsova, N. I., Tebloyev, I. K.

Le polymère du silicone (Elastosil MI) qui se solidifie seulement après sa pénétration dans l'organisme, ce qui est convenable pour l'application à injection, a été utilisé pour les reconstructions plastiques des défauts de la face, de l'étiologie variée. On a traité 38 malades: 22 malades avec la lipodystrophie bilatérale, 7 malades avec l'hémiatrophie du visage et 9 malades présentaient les défauts secondaires des tissus

mous. Les résultats du traitement ont été observés pendant 5 ans et ont prouvé que l'utilisation d'Elastosil MI assure un bon et durable effet cosmétique. Le matériel est recommendé pour l'application clinique.

ZUSAMMENFASSUNG

Die Verwendung von Oligosiloxanen bei der rekonstruktiven Chirurgie des Gesichts

Daurova, T. T., Khitrov, F. M., Brusowa, L. A., Ostretsowa, N. I., Tebloyev, I. K.

Das Silikonpolymer (Elastosil MI), das erst im Organismus erstarrt und sich daher zur Anwendung als Injektion eigener, wurde bei plastischen Rekonstruktionen von Gesichtsdefekten verschiedener Ätiologie verwendet. Von 38 so behandelten Patienten litten 22 Patienten an bilateraler Lipodystrophie, 7 Patienten an Hemiatrophie des Gesichts und 9 Patienten an sekundären Defekten der weichen Gesichtsgewebe. Die Ergebnisse der Behandlung wurden 5 Jahre lang beobachtet und erwiesen, dass die Anwendung von Elastosil MI einen guten und dauernden kosmetischen Effekt garantiert. Das Material wird daher zur klinischen Verwendung empfohlen.

RESUMEN

Utilización de oligosiloxanos en la cirujía reconstructiva de la cara

Daurova, T. T., Khitrov, F. M., Brusova, L. A., Ostretsova, N. I., Tebloyev, I. K.

El polímero de silicona (Elastosil MI) que se solidifica sólo después de ser introducido en el organismo y es, pues, adecuando para ser introducido mediante inyecciones, fue utilizado en las reconstrucciones plásticas de los defectos de la cara de diferente etiológía. De 38 pacientes sometidos al tratamiento, 22 padecieron de lipodistrofia bilateral, 7 de hemiatrofia de la cara y 9 de defectos secundarios de las parles blandas de los tejidos faciales. Los resultados del tratamiento fueron controlados durante 5 años, demonstrándose que la utilización de Elastosil MI garantiza un efecto cosmético bueno y duradero. El material es recomendado para la utilización clinica.

REFERENCES

1. **Brusova, L. A., Tebloyev, I. K.:** Treatment of Barraquer-Simon's disease and of progressive hemiatrophy of the face. Acta Chir. plast., 18, 2:49, 1976.

2. **Daurova, T. T., Ostretsova, N. I., Neverov, A. N.:** Silicons in voluminous plasty of soft tissues, their properties after implantation. Polymers in Medicine, PNR, 6, 3:123, 1976.

3. French Patent No. 2 419 065, 1979.

4. **Tikhonova, E. P.: Hypothalamo-hypo**physeal diseases accompanied by lipodystrophy or obesity. Mannual of Endocrinology, M., p. 83, 1973.

Prof. T. T. Daurova, A. V. Vishnevskii's,
Institute of Surgery of the AMS USSR,
B. Serpukhovskaya 27, 113093 Moscow, USSR.

Medical Academy, Łódź (Poland)
Department of Plastic Surgery
Head As. Prof. J. Kruk, M. D.
Department of Pathological Anatomy
Head Prof. A. Kurnatowski, M. D.

GIANT CONGENITAL NEVUS AS A BASIS FOR THE DEVELOPMENT OF MALIGNANT MELANOMA

A. ZIELINSKI, M. PRUSZCZYNSKI

Although pigmented nevi are relatively frequent lesions, large congenital nevi taking the form of monstrous fibrous tumours are rather rare.

Kopf (5) suggested a classification of nevi based on their diameter: small — up to 1.4 cm, medium — 1.5—19.9 cm, large — over 20 cm. Since the size of the nevus changes as the child grows, this is hardly a precise classification. Greely (2) considered a nevus large when it covered an area larger than 900 cm^2 or involved a considerable part of the face, hand or trunk. Other defined a large nevus as a lesion, the excision of which either causes significant deformity or is impossible to perform in a single operation (2).

Large pigmented nevi (LPN) usually exhibit a tendency to follow the distribution pattern of dermatomes, or they may occur in bathing-trunk-, vest-, sleeve- or stocking patterns (1). If their characteristic appearance — extensive, hyperpigmented, usually hairy thickening of the skin — is accompanied by considerable proliferation of fibrous tissue and by hemostasis, LPN become monstrous in size. The clinical picture may suggest neurofibromatosis or elephantiasis neuromatosa, in the course of which hyperpigmentation can often be observed. However, the basic factor in diagnosis is the result of histological examination. LPN contain various elements of neural crest origin, differentiating superficially in the dermis into melanocytes or nevocytes and, deep in the skin or in the subcutaneous tissue, into neuroid structures resembling neurofibroma of the skin or fibrous histiocytoma. The latter component, resulting from desmoplasia, is responsible for the rubbery consistency as well as for the considerable thickness of the tumour (3). It is stressed that malignant melanomas originating from LPN differ from other melanomas of the skin in their unusual histological features with a variety of diverse components; they can even contain heterologous mesenchymal components differentiating into rhabdomyosarcoma and liposarcoma (3).

When a nevus involves the head and neck it may coexist with leptomeningeal melanocytosis, which makes the prognosis worse as it may lead to cerebrospinal fluid resorption impairment and/or to malignant transformation (1, 6). The frequency of LPN progression into malignant melanoma is estimated at 2 to 42 per cent (1, 2, 3, 4, 5, 6). According to Reed (6), 39 cases of malignant transformation in patients with LPN had been described by 1965. It is worth stressing that 40 per cent of malignant melanomas in children develop on the basis of LPN (Fish — after 1). LPN mainly occur before maturity, an adult, though, cannot be said to be free from any such danger. Kaplan (4) reported that in his series 60 per cent of all melanoma cases developed from LPN during the first decade of life, 10 per cent in the second, and 30 per cent occurred thereafter.

It is difficult to trace the histogenesis of malignant melanoma in such cases. Reed was able to establish it in only one third of his patients. It is though that the starting point for malignant proliferation can be the marginal component of the nevus or a blue nevus, though some authors claim that the neuroid element deep in the subcutaneous tissue or in the dermis may also undergo malignant transformation (1, 3). Therefore, careful biopsy is an important indication for any future surgical treatment.

CASE REPORT

A. W., a 31 year old man (clin. notes No. 2024) was admitted to the Department of Plastic Surgery, Medical Academy of Łódź, in March 1982 with a large

Fig. 1. Preoperative front view demonstrating a giant tumour covering the whole back and shoulders.

deformity of the trunk, pain in the lumbar region and limited physical activity. On examination, a giant tumour hanging down in the form of a two-part rucksack covering the back from the nape and shoulders down to the lumbar region was found (Fig. 1, 2). The weight of the excess tissue mass was estimated at

Fig. 2. Preoperative posterior view demonstrating a giant tumour hanging down in the form of a two-part rucksack

about 40 kilograms. The skin covering the tumour was light-brown, with numerous tiny hyperpigmented spots, rough, hyperkeratotic, with scanty hair. Moreover, multiple dispersed small pigmented nevi were found on the skin of the chest, arms, and buttocks. Signs of gynecomastia were also noticed. The patient's mother reported that immediately after childbirth she noticed a large, flat hyperpigmented area on the skin of the newborn, roughly corresponding to the peduncle of the present tumour. Some time later, numerous spots of more intensive pigmentation appeared. When the child was about 10 years old, his mother noticed a protrusion of the nevus without any change in its size. The most intensive rate of growth was observed from the age of 15 to 18. The present size was reached at the age of 25. During that period, the patient was successively admitted to several surgical departments. However, no treatment was undertaken. It was decided at our department to resect the tumour gradually. During the first operation, a lower part of the tumour weighing 10 kg was excised. The histological diagnosis was then: intradermal and subdermal pigmented nevus with neuroneval components accompanied by diffuse fibrosis and

hyalinization (Fig. 3, 4). Postoperative suppuration required the patient's hospitalization at the surgical department for 3 months. After 15 months, another operation was performed, and 2-kg part of the tumour hanging down from the medioposterior part of the left shoulder was excised. The healing went without

Fig. 5 Nodular melanoma developed in the giant congenital nevus (arrow)

complications. The patient reappeared at our department several months later complaining of weakness and considerable pain in the lumbo-sacral region of the spine, as well as of ulceration of the tumour. During the clinical examination, a blue-black nodule 4 cm in diameter and 2 cm thick with several oozing ulcerations was noticed (Fig. 5). In the right axilla, a group of enlarged lymph nodes was found. The patient was hospitalized because of excruciating pain in his spine which was reduced only after the extrameningeal administration of morphine. Surgical treatment with adjuvant chemotherapy was planned. During the operation, part of the tumour with a strongly hyperpigmented neoplasm was widely resected, and several lymph nodes, each 5 by 5 cm in size, were removed from the axilla. The histological diagnosis was: pigmented exulcerated malignant melanoma of the nodular type (Clark IV) with metastases into numerous lymph nodes. A picture consistent with intradermal and subdermal nevi was found in the resection lines (Fig. 6, 7). The wound suppurated; the patient died with symptoms of sepsis in the second post-operative week. Autopsy confirmed the clinical diagnosis and, in addition, metastases of melanoma were identified in the lungs and the mediastinal lymph nodes.

DISCUSSION

We found no literary description of a nevus covering 20 % of the body surface, i.e. 4,000 cm^2 comparable to the case of our patient. The extremely intensive growth of the neurofibrous part of the tumour, activated at adolescence, not only disfigured the patient but also limited his physical activity owing to the monstrous, pendulous tumour mass compressing its peduncle, thus causing impairment of his blood circulation. Most authors are in favour of radical treatment of cases of LPN. Despite attempted surgical treatment, our patient died of sepsis with metastatic malignant spread. As no metastases were found during the postmortem either in the spinal meninges or in the vertebral column, it can be assumed that the lumbar pain was caused by compression or by neoplastic infiltration of the nerve trunks in the tumour itself and in the subjacent tissues. From the microscopic picture it can be concluded that the intradermal or subdermal parts of the tumour must have become malignant as no functional activity of the nevus was found. In our case, it is most unlikely that the attempted treatment could have influenced the activation of the nevus or its final malignization. It is certain, however, that treatment was undertaken far too late. An earlier histological verification of the lesion would have permitted the operation to be performed under much more favourable conditions. The final diagnosis was established much too late for the lesion suggested the presence of neurofibromatosis rather than a pigmented nevus. It was only after biopsy and histological examination that the true nature of the tumour was finally identified. In literature, the importance of early histological examination is duly stressed (3).

J. H.

SUMMARY

The case of a 31-year old man with a giant congenital pigmented nevus covering the whole back and shoulders is described. Surgical treatment was started, and part of the tumour weighing 10 and 2 kg were successively excised. During the course of treatment a malignant melanoma developed. The patient died of sepsis and melanomatous metastases. In the authors' opinion, treatment was started too late.

RESUME

L'immense naevus congénital comme fondement du développement du mélanome malignisant

Zieliński, A., Pruszczynski, M.

Description du cas d'un malade de 31 ans avec un immense naevus congénital couvrant, tout le dos et les épaules. On a exécuté un traitement chirurgical duquel résultait un enlèvement réussi des parties du naevus, pesantes 10 et 2 kg. Au court du traitement ultérieur, un mélanome malignisant s'est développé. La malade est décédé par suite de la septicémie et des métastases du mélanome. Selon l'oppinion des auteurs, le traitement a été entrepris trop tard.

ZUSAMMENFASSUNG

Ein riesiger angeborener Naevus als Ursache der Ausbildung eines malignisierenden Melanoms

Zieliński, A., Pruszczynski, M.

Beschrieben wird ein 31-jähriger Patient mit einem riesigen angeborenen Naevus, das den ganzen Rücken und die Schultern bedeckt. Der Naevus wurde chirurgisch behandelt und Teile von 10 kg und 2 kg Masse erfolgreich beseitigt. Während der Behandlung entwickelte sich ein malignisierendes Melanom, und der Patient starb an Sepsis und Metastasis des Melanoms. Nach Ansicht der Autoren wurde die Behandlung viel zu spät unternommen.

RESUMEN

Gigantesco nevo congénito como base para la evolución de un melanoma malignizante

Zieliński, A., Pruszczynski, M.

Se describe un enfermo de 31 años de edad con un nevo gigantesco innato que cubre toda la espalda y los hombros. Se procedió a un tratamiento quirúrgico eliminándose con éxito partes del nevo, de un peso de 10 y 2 kgs. Durante el tratamiento evolucióno un melanoma malignizante. El paciente se murió de sépsis y metástasis producto del melanoma. Según la opinión de los autores se debió a un comienzo tardío del tratamiento.

REFERENCES

1. **Mc Govern, V. J.:** Melanoma — histological diagnosis and prognosis. Biopsy interpretation series. Raven Press, New York 1983, p. 69.

2. **Greeley, P. W., Middleton, A. G., Curtin, J. W.:** Incidence of malignancy in giant pigmented nevi. Plast. reconstr. Surg., 36. 26, 1965.

3. **Hendrickson, M. R., Ross, J. C.:** Neoplasmas arising in congenital giant nevi. Amer. J. Surg. Path., 5: 109, 1981.

4. **Kaplan, E. N.:** The risk of malignancy in large congenital nevi. Plast. reconstr. Surg., 53: 421, 1974.

5. **Kopf, A. W., Bart, R. S., Hennesey, P.:** Congenital nevocytic nevi and malignant melanomas. J. Amer. Acad. Dermat., 1: 123, 1979.

6. **Reed, W. B., Becker, S. W. Jr., Becker, S. W. Jr., Neckel, W. R.:** Giant pigmented nevi, melanoma and meningeal melanocytosis. Arch. Dermatol., 91: 100, 1965.

Dr. A. Zieliński,
Department of Plastic Surgery,
Kopcińskiego 22, 90-153 Łódź, Poland

J. E. Purkyně University Medical Faculty, Brno (Czechoslovakia)
Department of Plastic Surgery
Head Prof. V. Kubáček, M.D., DrSc.

SENSITIVE FASCIOCUTANEOUS FLAPS WITH NERVUS CUTANEUS FEMORIS LATERALIS AND NERVUS SAPHENUS. A PREPARATORY STUDY.

V. RIEBELOVÁ, A. NĚMEC

Inadequate sensitivity is a major disadvantage of distant flaps, particularly in the hands and the sole of the foot. In the hands there is loss of grip perception resulting in easy injury or burns. Soles are susceptible to the development of "trophic" ulcers — decubitus ulcers.

For those reasons, sensitive flap transfer operations have been developed of late — i.e., transplantations of the skin and subcutis complete with the nerve supply and the corresponding sensitive nerves which are anastomosed to the stumps of sensitive nerves in the recipient area. They are transferred by means of microsurgery and local advancement. Most of the sensitive flaps so far reported suffer from certain disadvantages: they are either very small or, owing to the muscle transplanted simultaneously, excessively powerful. Nor do the character of their skin and sensitivity always adequately match those of the recipient site, or again secondary defects give rise to more deformation and major functional impairment.

Hence why we have to look for sensitive flaps providing large quantities of material with a thin layer of fat, with the type of skin and sensitivity as close to those of the recipient area as possible, and ones that would not provoke major functional disorder and deformation in the donor area.

There are two sensitive areas capable, to a large extent, of meeting those requirements:

the innervation zone of the lateral cutaneous nerve of the thigh, and the lower-leg portion of the innervation zone of the saphenous nerve.

The aim of the present study is to develop a surgical method for the transfer of the two innervation zones to the distant regions of the hand and the sole of the foot.

A n a t o m y

The anatomic situation in the two regions were studied in the relevant literature and in seven cadavers.

Anatomy of the lateral cutaneous nerve of the thigh:

The nerve takes its origin under the lateral edge of the m. psoas major to run via the caudalmost part of the m. quadratus lumborum and via the iliac muscle — covered with fasciae only — obliquely to the anterior superior

Fig. 1. Diagram of the innervation zone of the n. cutaneus femoris lateralis on the right-hand thigh in a cadaver. — Fig. 2. Preparation of the peripheral stump of the n. cutaneus femoris lateralis ramified into many branches, and of its entry into the marked fasciocutaneous flap with distal pedicle on the left-hand thigh (cadaver)

iliac spine. It then enters beneath or into the inguinal ligament and into the lacuna musculorum. From there it emerges, as a rule, in close vicinity to the anterior superior iliac spine, though it may also run substantially more medialward. Having pased beneath the inguinal ligament and the deep artery it emerges on the anterior side of the thigh to run between the two sheets of the fascia lata, though it can also extend beyond or via the sartorius muscle. The lateral cutaneous nerve of the thigh is soon ramified into the stronger ventral and more delicate dorsal branches which separately penetrate the fascia: the dorsal branch running via the m. tensor fasciae latae dorsalward as far as the gluteal region, the ventral branch passing along the anterior sur-

face of the m. vastus lateralis as far as the lateral side of the knee to supply the whole of this cutaneous area with its branches.

The lateral cutaneous nerve of the thigh is a general sensory nerve designed to supply the lateraly and adjacent part of the anterior surface of

Fig. 3. Diagram of the innervation zone of the saphenous nerve on the left-hand lower leg. — Fig. 4. Detail of a preparation of the saphenous nerve and its branches on the inside surface of the knee as they enter the proximal portion of a direct crural sensitive fasciocutaneous flap on the left lower extremity (cadaver)

the thigh down to the knee except for a 6 cm stripe adjacent to the inguinal furrow. The latter belongs already to the innervation zone of the iliohypogastric nerve. This is also where the vascular supply divide is found. The above mentioned band of skin is supplied from the superficial circumflex femoral artery (inguinal flap). Interruption of the lateral cutaneous nerve of the thigh may result in reduced sensibility throughout the zone. Complete loss of sensitivity will develop solely in a small band in the proximal half of the iliotibial tract.

The whole innervation zone is supplied with blood from the lateral femoral circumflex artery, a branch of the femoral artery, via the m. tensor

fasciae latae and the cutaneous branch of the arteria perforans III, a branch of the deep femoral artery.

Anatomy of the saphenous nerve:

This is the longest cutaneous branch of the femoral nerve running the most medialward of all the branches. It passes through the adductor canal, subsequently to penetrate — along with the a. genus descendens — the lamina vastoadductoria and then to descend — while still enveloped in the fascia and covered with the sartorius muscle — distalward along the sulcus between the m. vastus medialis and the m. adductor magnus to the medial side of the knee. This is where it penetrates the fascia to run along the sartorius muscle tendon towards the great saphenous vein which it then accompanies across the exterior surface of the pes anserinus and then across the medial surface of the leg via the medial ankle to the inside area of the leg.

The saphenous nerve gives out the infrapatellar branch towards the skin in the medial side of the knee as far as the anterior surface of the patella, then the medial crural cutaneous branches to supply the skin of the inside of the lower leg and to its medial edge. Thus, in conjunction with the anterior cutaneous branches of the femoral nerve it supplies the skin on the anterior and, especially, the lateral side of the extremity about half way down the inside edge of the leg. Damage to the nerve results in sensibility disorders on the anteromedial surface of the leg.

The innervation zone of the saphenous nerve is in its proximal part — on the medial surface of the knee and in the neighbouring third of the leg — supplied by a specific vascular pedicle made of the saphenous artery and its ramifications. The rest of the skin cover of the leg has no specific vascular pedicle.

Receptor nerves

Serving as receptor structures in the upper extremity are the sensitive axons of the median and ulnar nerves, in the lower extremity — axons of the sural nerve or also of the contralateral saphenous nerve.

Principles of sensitive flap transfer

The above anatomical facts are conducive to certain important conclusions determining the principles of transfer from both sensitive regions. To check them we performed model operations on seven cadavers.

1. Both innervation territories have to be transferred in the form of classical pedicle flaps since with the exception of the proximal portion of the crural flap they have no specific vascular pedicles.

2. Both nerves are intimately connected with the deep fasciae of their regions; hence why they have to be transferred complete with those fasciae as fasciocutaneous flaps.

Fasciocutaneous flaps were introduced in reconstructive surgery as a special entity by Pontén in 1981. He was followed by more plastic surgeons and theoreticians. However, research into fasciocutaneous flaps was not directly motivated by the idea of transferring the nervous systems of the transplanted material. The point was to have flaps with safe vascular supply such

as could be advanced into defects in a single operation without "practising". Fasciocutaneous flaps were found to have two vascular plexuses more than conventional flaps consisting of the skin and subcutis alone, namely the subfascial and fascial plexuses acting as perforators for the skin. However, the fascial plexus is not equally developed everywhere. There is practically none of it in the regions of myocutaneous flaps. It is best developed over long and flat muscles. There are other specific features, too: in the fascia lata there is a third vascular plexus — the interfascial plexus. Cormack and Lamberty recently discovered new objective laws governing fasciocutaneous flaps: a flap supplied from fasciocutaneous perforators will survive in greater length only provided the long axis of the flap runs along the dominant direction of circulation in the plexus. Tolhurst and coworkers (2, 18) proved on clinical cases that the lower leg permits the safe single-time transfer of fasciocutaneous flaps provided their width:length ratio was 1 : 3. Single-time advancement has also been tried out in flaps with a ratio of 1 : 4, though, according to Barclay, at the risk of marginal necroses.

The results of those studies are useful for dealing with the problem of transfer of sensitive flaps. A single-time transfer of crural flap pedicles, even at a ratio of 1 : 3, would simplify and shorten the process apart from reducing sclerotization in the tissues transferred and enhancing the restitution of the nerve elements.

3. The direct flap will be the only acceptable type of pedicled flap transfer in sensitive fasciocutaneous flaps. In the rope forms, even a deep fascia would roll in, and unrolling it might impair the nerve supply to the flap. The only exception there is the tubed groundwork for the reconstruction of the thumb.

4. The moot points are:

a) access to, identification and preparation of the supply nerves, and
b) the appropriate time for nerve anastomosis.

a) Surgical access to, identification and preparation of the lateral cutaneous nerve of the thigh.

Incision running parallel to the inguinal groove is started about 6 to 8 cm distal to the anterior superior iliac spine and finished at the dividing line between the lateral and medial halves of the thigh. Then we cut down to the deep femoral fascia to lift the skin and subcutis proximal to the anterior superior iliac spine. The n. cutaneous femoris lateralis will usually appear next to it, under or in the inguinal ligament. If this is not the case we continue carefully along the inguinal ligament medialward until we expose the nerve. We then cut it at the level of the inguinal ligament and isolate its periferal stump distalward as far as the lower edge of the incision. This is where the peripheral stump of the nerve should be turned over distalward. Proximal to its insertion in the muscle fascia we cut the femoral fascia transversely until we discover entry to the space between the muscles and the fascia. From there it will be easy to lift the whole proximal pedicle complete with the fascia and the exposed nerve in the distal direction and to cut it

off the surrounding structures. We then suture the stump of the n. cutaneus femoris lateralis, about 6 to 8 cm long, to the stump of the sensitive receptor nerve in the hand. Only then do we suture in the flap pedicle.

Surgical access, identification and preparation of the saphenous nerve.

Proceeding from a longitudinal incision along the dorsal edge of the inside surface of the knee as a continuation of the anterior marginal incision of the flap we penetrate to the trunk of the saphenous nerve situated in close vicinity to the v. saphena magna on the outward surface of the deep fascia. We then isolate the nerve complete with whatever branches there may be at a length of about 7 to 9 cm, cutting it proximalmost and suturing the peripheral stump to the contralateral sural nerve or to the saphenous nerve, the pedicle being the last to suture.

b) Determining the surgical stage of nerve anastomosis.

Both supply sensitive nerves enter their zones proximally, thus automatically becoming parts of the proximal pedicle of the flap. This would seem to determine definitively also the surgical stage of nerve anastomosis. However, to do so in the 2nd stage of the flap transfer is taxed with some disadvantages.

1) Difficult access to the future nerve pedicle due to the fixation of the hand or foot to the donor site.

2) Granulation surfaces beneath the proximal pedicle likely to have an adverse effect on the restoration of the nerve function through tissue infection and sclerotization. For that reason it might offer more advantage to transfer those flaps on the distal pedicle with a view to exposing the nerve pedicle and performing anastomosis already at the time of the first operation in sterile surroundings and in an operating field which is easy to survey. This approach is not possible except in the sensitive fasciocutaneous flap with the n. cutaneous femoris lateralis. This is because thanks to the cutaneous branch of the arteria perforans III there is an excellent blood supply at the site of the future distal pedicle — in the medial portion of the lateral area of the thigh. However, the proximal edge of the flap must not overlap the inguinal flap zone — i.e. it must not be allowed to exceed the line running about 6 to 8 cm away from the anterior superior iliac spine.

Blood in the lower leg, including the fascial vascular plexuses, circulated distalward, which makes the transfer of the crural flap on the distal pedicle a risk-ridden and unrealistic affair. This made us develop a variant for the transfer of the nerve anastomosis of the saphenous nerve already in the first stage of the flap transfer, at the time of the distal part of the flap implantation in the foot. The saphenous nerve runs close to the anterior edge of the crural flap. If the incision is extended along the nerve to the medial surface of the knee the saphenous nerve can easily be identified and exposed without damage to the accompanying vessels in order to obtain a sufficiently long peripheral stump of the nerve well clear of the flap area proper. The nerve can then be tucked under the distal part of the flap and sutured to the recipient nerve.

5. Secondary defects can in neither case be sutured and will have to be covered with dermoepithelial grafts. The resulting scars on the thigh should pose no more than a cosmetic problem. The actual loss of sensitivity is negligible.

Defects after the innervation territory of the saphenous nerve present a more serious problem. True, the secondary defect has a localization which we are used to seeing in routine crural direct flaps and which we know give most patients no particular trouble. The extra problems here include loss of sensitivity and defect of the fascia. Our experience with similar traumatic lesions makes us believe, however, that these should be no contraindication for this type of transfer.

DISCUSSSION

Sensitive flap advancement and transfer are nothing new. The point now is rather to look for new sensitive zones suitable for such transfer or advancement, and to develop new surgical methods. There is little doubt that local advancement and microsurgical transfers are the most effective and the most rapid, albeit burdened with some disadvantages which we referred to before. The disadvantages of the classical pedicle flap transfers are only too well known — protractedness, multiple operations, demands on nursing, many weeks of stress for the patient, etc. Those were, in fact, the reasons which urged plastic surgeons to look for more rapid and economical methods of tissue transfer. This is not to say, though, that the discovery of new surgical techniques should make the traditional approaches disappear entirely from the operating programme. We are most likely to encounter situations where no suitable flap with a specific pedicle and a sensitive nerve will be available and where the surgeon will have no option other than to resort to the old type of flaps with non-specific pedicles, and to the classical forms of transfer. And this, as we believe, is exactly the case of transfers of direct sensitive fasciocutaneous flaps with the lateral cutaneous nerve of the thigh and the saphenous nerve. In our opinion, theirs will be a limited range of indications; they are likely to be considered in major defects of soft tissues on the hand and the sole of the foot where it will be found impossible to transfer the required sensitive material in any other way and from any other site.

CONCLUSION

Using anatomical studies and model operations on cadavers we were able to see that it was technically feasible to transfer the sensitive zone of the lateral cutaneous nerve of the thigh and the crural part of the innervation zone of the saphenous nerve to the hand and the sole of the foot with a modified form of direct pedicle flaps. The flaps were lifted complete with the deep fascia and the supplying sensitive nerves, the stumps of which were sutured in the recipient area to the corresponding sensitive structures. The flaps should be indicated in major defects of the soft tissues of the hand and sole of the foot where sensitive material could not be advanced in any other way.

J. H.

SUMMARY

The authors present the principles and surgical technique of transferring the sensitive zone of the n. cutaneus femoris lateralis and the crural part of the innervation zone of the n. saphenus to the hands and the sole of the foot. For that purpose they modified the classical form of direct pedicle flaps, involving in the flaps the respective deep fasciae and supplying sensitive nerves, the peripheral stumps of which they sutured to the recipient sensitive structures in the primary defect zone. Indications include: major soft tissue defects in the hands and the soles of the foot, and unfeasibility to transfer sensitive material in any other way. The report is a preparatory study on cadavers prior to clinical utilization.

RESUME

Lobes fasciocutanés sensitifs avec «nervus cutaneus femoris lateralis» et avec «nervus saphenus». L'étude préparatoire

Riebelová, V., Němec, A.

Le travail allègue les principles et la technique de transposition de la région sensitive de «nervus cutaneus femoris lateralis» et de la partie crurale de la région inervée de «nervus saphenus» sur les mains et sur les pieds. A cet effet, les auteurs ont modifié une forme classique des lobes directes pédiculés. Les lobes comprendent de profonds fascias compétants et des nerfs sensitifs de conduit, dont moignons périphériques sont suturés avec des structures sensitives receveuses, sur des régions à combler. Comme indication pour ces interventions, on recommende de vastes défauts des tissus mous sur les mains et sur les pieds et l'impossibilité de transposition d'un matériel sensitif par une autre voie. Le travail présente l'étude préparatoire, exercée sur des cadavres, avant qu'elle soit appliquée en clinique.

ZUSAMMENFASSUNG

Sensitive fasciokutane Lappen mit nervus cutaneus femoris lateralis und mit nervus saphenus. Vorbereitende Studie

Riebelová, V., Němec, A.

Es werden die Grundsatze und die Operationstechnik einer Übertragung des sensitiven Territoriums des nervus cutaneus femoris lateralis und des Unterschenkelteils des Inervationsgebiets des nervus saphenus an der Hand und der Fusssohle angeführt. Zu diesem Zweck haben die Autoren die klassische Form der direkten Stiellappen modifiziert, indem sie zu den Lappen auch die entsprechenden tiefen fascie und die zuführenden sensitiven Nerven dazunahmen, deren periphere Stumpfe sie mit den sensitiven Aufnahmestrukturen in den Aufnahmegebieten zusammennähen. Als Indikation werden ausgedehnte Defekte der weichen Gewebe an den Händen und Fusssohlen angeführt sowie die Unmöglichkeit einer Übertragung des sensitiven Materials auf anderem Wege. Die Arbeit ist eine vorbereitende Studie an Leichen vor der Anwendung in der Klinik.

RESUMEN

Lóbulos sensitivos fasciocutaneos con el nervus cutaneus femoris lateralis y con el nervus saphenus. Un estudio preparatorio

Riebelová, V., Němec, A.

En el trabajo se presentan los principios y la técnica operativa de transposición del territorio sensitivo del nervus cutaneus femoris lateralis y la parte crural de

la zone inervada del nervus saphenus en la mano y las plantas de los pies. Para tal efecto, los autores han modificado la forma clásica de trabajo con lóbulos directos sobre pecíolo. Añadieron a los lóbulos las respectivas fascias profundas y los nervios sensitivos de admisión, cuyos muñones periféricos juntan mediante costura con las estructuras sensitivas receptoras en las zonas de recepción. Como indicaciones se señalan extensos defectos de los tejidos blandos en las manos y las plantas de los pies y la imposibilidad de trasladar el material sensitivo por otra vía. El trabajo es un estudio preparatorio basado en cadáveres antes de ser utilizado en la clínica.

REFERENCES

1. **Acland, R. D., Schusterman, M., Oodina, M., Eder, E., Taylor, S. I., Carlisle, I.:** The saphenous neurovascular free flap. Plast. reconstr. Surg., 67 : 763, 1981.

2. **Barclay, T. J.:** Discussion. Plast. reconstr. Surg., 71 : 606, 1983.

3. **Buncke, Jr., H. J., Cohen, E. B.:** An island flap from the first web space of the foot to cover plantar ulcers. Brit. J. plast. Surg., 33 : 242, 1980.

4. **Clara, M.:** Das Nervensystem des Menschen. Barth, J. A. (Leipzig) 1953.

5. **Cohen, B. E., Cronin, E. D.:** An innervated cross-finger flap for fingertip reconstruction. Plast. reconstr. Surg., 72 : 688, 1983.

6. **Cormack, G. C., Lamberty, B. G. H.:** The anatomical vascular basis of the axillary fasciocutaneous pedicled flap. Brit. J. plast. Surg., 36 : 452, 1983.

7. **Česaný, P.:** Innervated cross-finger flap (in Czech). Congress of Plastic Surgeons, Czechoslovakia 1982.

8. **Daniel, R. K., Terzis, J., Schwartz, G.:** Neurovascular free flaps: Preliminary report. Plast. reconstr. Surg., 56 : 13, 1975.

9. **Daniel, R. K., Terzis, J., Cunningham, D. M.:** Sensory skin flaps for coverage of pressure sores in paraplegic patients. Plast. reconstr. Surg., 58 : 317, 1976.

10. **Descapt, B., Saucier, T., Botta, Y., Masson, C. L.:** Microneurovascular free flaps. Int. J. Surg., 66 : 23, 1981.

More literature available with the author.

Dr. V. Riebelová, Dept. of Plastic Surgery, Berkova 34, 612 00 Brno, Czechoslovakia

J. E. Purkyně University Medical Faculty, Brno (Czechoslovakia)
Department of Plastic Surgery

Head Prof. V. Kubáček, M. D., DrSc.

SENSITIVE FASCIOCUTANEOUS FLAP WITH NERVUS SAPHENUS

Preliminary report

V. RIEBELOVÁ, A. NĚMEC

In our previous preparatory study we reported on the indications for sensitive flap transfer, their types and forms of transfer proposing the transfer of the crural part on the n. saphenus sensitive territory into defects on the sole of the foot for the following reasons: the territory offers a large amount of material, the quality of its skin is similar to that of the sole of the foot, and there is a thin layer of fat. We also included a detailed anatomical description of the saphenus nerve and of the extent of its innervation territory.

We established the principles of the transfer of the crural portion of the nervus saphenus innervation territory, which we wish to recapitulate here. The flap is transferred:

1. in the form of a pedicle flap since it has no specific vascular pedicle except for the proximal portion supplied from the a. saphena,
2. as a fasciocutaneous flap as its nervous system rests intimately on the deep fascia and might sustain damage during separation,
3. as a direct flap to prevent the tubing of the deep fascia and, consequently, the nervous system, too,
4. thanks to the involvement of the fascia, the flap is good for single-time transfer even at the width-length ratio of 1:3.

Working on cadavers we developed the surgical technique for the access to, identification and isolation of the saphenous nerve and for the mode of its transfer complete with the flap.

In the present study we bring case reports on the first two patients operated on in the above described fashion.

Patient S. K., 18 yrs, apprentice, clin. notes No. 62210, was admitted with a chronic ulcer in the deforming scar over the defective head of the calcaneus and parts of the sole of the foot. In April 1983, following preparatory lifting, we transferred the distal portion of the saphenous nerve innervated fasciocutaneous flap, 25 by 10 cm in size, from the left leg into the defect on the sole and heel of the right-hand foot. On May 24, 1984, after the implanted part

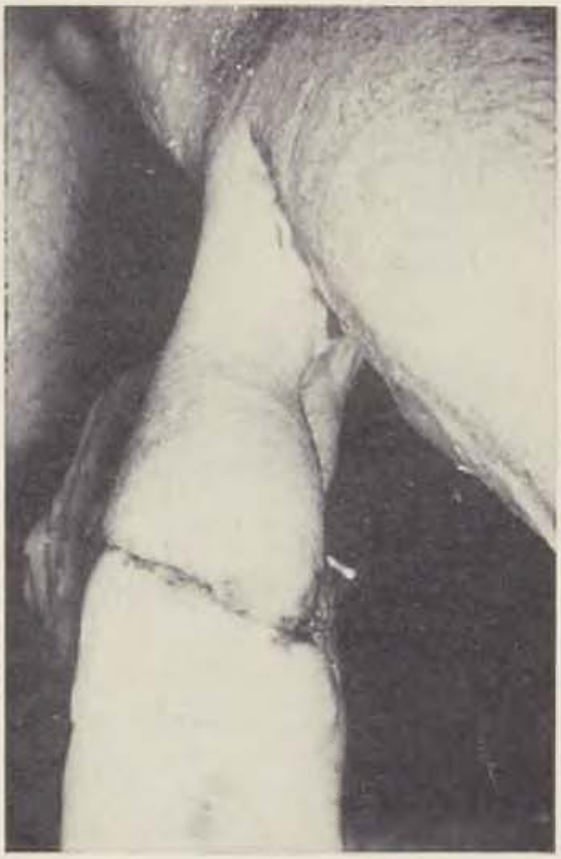


Fig. 1. Innervated fasciocutaneous direct flap on the left leg ready to be transferred into a defect on the sole of the right foot in an 18-year old apprentice. — Fig. 2. Distal part of the flap united with the defect site.

of the flap had healed in, we found the saphenous nerve while cutting off the proximal pedicle, transsecting it at knee level to suture its peripheral stump to the sural nerve stump behind the outer ankle of the right lower extremity. The supply to the flap remained unimpaired during the transfer. There was only slower healing in the suture of the severed proximal pedicle. Sensitivity began to appear in the fourth months after the nerve anastomosis. In the ninth post-anastomosis month, the patient had sensitivity restored throughout the extent of the flap, being able to localize the point of touch, perceiving pain and differences in temperature. The sweat test is negative.

Patient M. V., 13 yrs, a schoolboy, cl. n. No. 67003, was admitted with a scarry deformation of the right-hand calcaneous region and the adjacent portion of the sole of the foot, the result of denudation in his early childhood. The scar was of the atrophic type adhering close to the bone. On Aug. 5, 1983, without any preparatory operation, we used the distal part of the planned sensitive fasciocutaneous flap, 15 by 8 cm in size, from the left-hand crural area, complete with the saphenous nerve, to transfer it directly into the defect on the sole and heel, a defect resulting from the excision of the scar and from the ablation of the bony prominences on the calcaneus. Prior to suturing in the

Fig. 3. Flap detached from the left-leg calf with the peripheral stump of the saphenous nerve exposed. — Fig. 4. Anastomosis of the stumps of the saphenous and sural nerves

flap, however, we looked up the saphenous nerve from the prolonged anterior incision of the flap on the inner side of the knee to wind its 9 cm long peripheral stump round the calcaneus and to attach it to the already exposed stump of the sural nerve. The nerve anastomosis was performed just off the flap pedicle behind the outer ankle. There were no healing complications. In 4 weeks time, we were able to cut off the proximal pedicle on the left leg. Though there were no marginal necroses in its suture the healing took a long time to complete. Four months later, the patient began to feel touch in the flap. After six months, there was still hypaesthesia in that part of the flap situated farthermost from the anastomosis.

RESULTS

The transfer of the nervus saphenus innervated fasciocutaneous flaps proved to be technically feasible in both patients. Nerve function resistution was satisfactory, too. This proved the feasibility of our method. However, the transfer of what is a fine nerve trunk introduced into the conventional surgical procedures a large number of minor changes and complications which the surgeon must come level with step by step. For that reason, we used different surgical tactics in both our patients.

Fig. 5. Healed-in flap 9 months after nerve anastomosis. The patient can feel touch anywhere throughout the flap, perceive pain and tell between heat and cold. — Fig. 6. Scarry deformation of the right-hand calcaneous region resulting from denudation in a 13 year old schoolboy. Sketch plan for a left-sided sensitive fasciocutaneous direct flap with the saphenous nerve

Due to the foot fixation to the contralateral leg and owing to poor accessibility to and surveyability of the operating field there are great difficulties in identifying and isolating the saphenous nerve in the second phase of the flap transfer. The complete cutting off of the proximal pedicle of the flap and the subsequent need for identifying in it the saphenous nerve might easily result in failure to identify the nerve, quite apart from the fact that the saphenous nerve stump must project some 6 to 8 cm off the edge of the flap. The situation would be simpler if it were possible to transfer the flap on the distal pedicle without any prior operation. We admit, we did not dare do that for fear of necrosis in part of the flap. We could not be persuaded either by some authors' assurances of improved vascular supply to fasciocutaneous flap. Hence why, in the second patient, we decided to transfer the saphenous nerve and to anastomose the nerve already in the initial phase of the planned surgery simultaneously with the implantation of the distal portion of the flap to the sole of the foot. Then, identification and isolation of the saphenous nerve was an easy affair. Nor were there any major difficulties involved in the execution of the

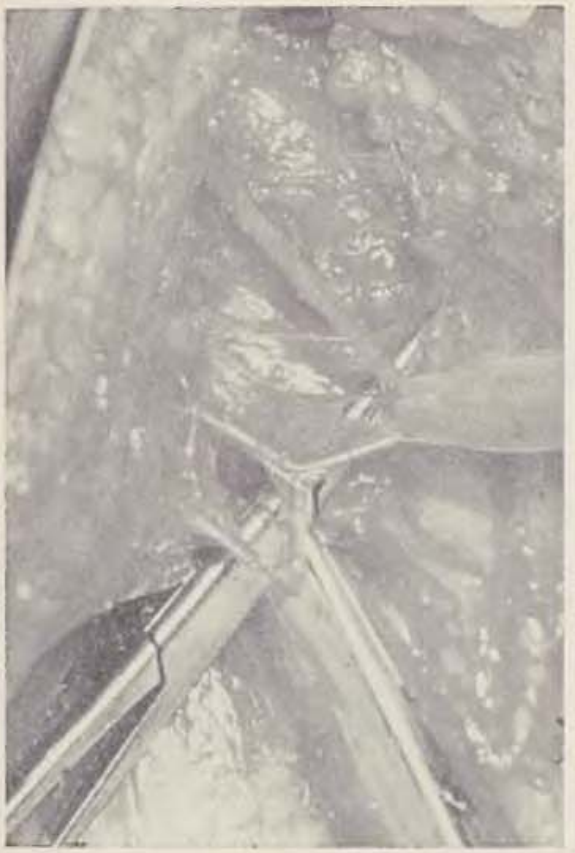


Fig. 7. Saphenous nerve isolated on the inner surface of the knee close to the anterior edge of the flap. Close-up. — Fig. 8. Distal part of flap partially sutured into defect on the heel. The saphenous and sural nerve stumps prepared for anastomosis

nerve anastomosis. Thanks to the saphenous nerve trunk running parallel and close to the edge of the flap, the need to isolate it posed no major threat to the blood supply to the flap.

While there were no necroses in either of the two patients' sutures of the transsected proximal flap pedicles, the sutures were just "gaping" at around a fortnight after showing no tendency to hear. The secondary defects were in both cases covered with dermoepithelial grafts. So far, there are no problems there nor with the loss of sensitivity in the donor area.

DISCUSSION

The proposed method is then clinically feasible with good functional results. All that requires consideration is whether there is any clinical justification for it in the era of free flaps. This is a weighty question. Ackland et al. (1) developed the technique of the saphenous neurovascular free flap which would place our own method in the sphere of "historical" procedures. However, as the authors themselves reported, the free saphenous flap — unless used in a small site — leaves an unfavourable secondary defect, which is why they

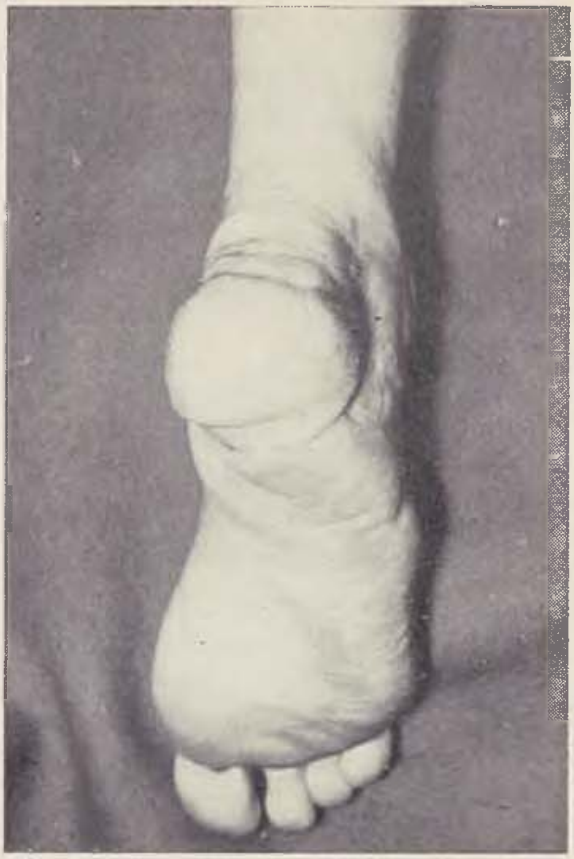


Fig. 9. Nerve anastomosis. — Fig. 10. Flap healed in 6 months after nerve anastomosis. Patient can perceive touch. Hypaesthesia in flap parts lying the farthest from the nerve anastomosis

warn against the use of large free saphenous flaps. These, it appears, offer the greatest advantage when they are chosen for covering small-size defects. Moreover, in three cases the authors failed to find a vascular pedicle for the saphenous flap. Though admittedly more labour consuming our method can safer replace the free saphenous flap. Moreover, it offers a more favourable localization for the secondary defect which should not affect the patient's functions. We believe then that while the method described above will have a limited range of indications it will come in useful for the coverage of major defects on the sole of the foot in the absence or unavailability of a better suited and more modern technique of transfer.

This seems to be corroborated by Nappi (2), who used a cross-leg innervated fascio-cutaneous flap with the n. cutaneus femoris lateralis to deal with a defect in the sole of the foot in a child.

CONCLUSION

Two of our patients had crural parts of the sensitive territories of the saphenous nerve transferred to defects in the soles of the feet using a modified

form of direct fasciocutaneous pedicle flaps. The method is effective and safe. It will, however, have a limited range of indications for covering extensive defects in the sole of the foot in cases where no better type of sensitive flap transferred in a more up-to date way will be available.

J. H.

SUMMARY

A description is presented of the transfer of crural parts of the saphenous-innervated areas into defects on the sole of the foot using a modified form of direct fasciocutaneous pedicle flaps. The nerve functions were satisfactorily restored. The method, while rather laborious, proved to be safe and effective. Its range of indications will, however, be limited to cases needing the coverage of large defects in the soft tissues of the sole of the foot where not other, better suited type of innervated flap transferred in a more modern way will be available.

RESUME

Lobe sensitif fasciocutané possédant le nerf saphène.
Rapport préalable.

Riebelová, V., Němec, A.

Le travail décrit une transposition de régions sensitives de la jambe, avec le nerf saphène, sur les défauts des pieds, effectuée par une forme adaptée des lobes fasciocutanés directes. La restitution de fonctions des nerfs s'est produit d'une façon satisfaisante. Il est vrai que les méthodes décrites soient laborieuses, mais quand même sûres et efficaces. Cependant, le champ d'indication pour le recouvrement de vastes défauts des tissus moux sur les pieds sera réduit aux cas, où il n'y aura pas d'autre matériel, un type de lobe sensitif plus convenable et transposé d'une façon plus moderne.

ZUSAMMENFASSUNG

Ein sensitiver Fasciokutanlappen mit nervus saphenus. —
Vorläufiger Bericht.

Riebelová, V., Němec, A.

In der Arbeit wird die Übertragung von Unterschenkelteilen sensitiver Gegenden des nervus saphenus mittels angepasster Form direkter Fasciokutanlappen auf Defekte an den Beinflächen beschrieben. Die Wiederherstellung der nervlichen Funktionen verlief zufriedenstellend. Die beschriebene Methode ist zwar mühsam, jedoch sicher und wirkungsvoll. Sie wird jedoch nur einen begrenzten Indikationsbereich haben und zwar bei Fällen des Bedeckens ausgedehnter Defekte von Weichteilen der Beinflächen, wenn kein anderer, eher entsprechender Typ eines sensitiven Lappens zur Hand ist, der auf modernere Weise übertragen werden kann.

RESUMEN

Lóbulo sensitivo fasciocutáneo con nervus saphenus.
Comunicación preliminar.

Riebelová, V., Němec, A.

En el trabajo se describe el transplante de las partes crurales desde las zonas sensitivas del nervus saphenus en forma adaptada de lóbulos directos fasciocutáneos

hacia los defectos en las plantas de los pies. La restitución de las funciones de nervios se desarrolló en forma satisfactoria. Por un lado, la metodología descrita es trabajosa pero al mismo tiempo segura y eficaz. Tendrá, sin embargo, una zona de indicación muy limitada para ser aplicada en los casos de cubrimiento de los amplios defectos de los tejidos blandos en las plantas de los pies, ano ser que se tenga a disposición otro tipo más conveniente de lóbulos sensitivos, transplantados en forma más moderna.

REFERENCES

1. **Acland, R. D., Schusterman, M., Godina, M., Eder, E., Taylor, G. I., Garlisle, I.:** The saphenous neurovascular free flap. Plast. reconstr. Surg., 67: 736, 1981.

2. **Nappi, J. P., Ruberg, R. L., Berggren, R. S.:** Innervated crossleg tensor fascia lata fasciocutaneous flap for foot reconstruction. Ann. plast. Surg., 10: 411, 1983.

3. **Riebelová, V., Němec, A.:** Sensitive fasciocutaneous flaps using the n. cutaneus femoris lateralis and n. saphenus. A preparatory study. Acta Chir. plast. 2, 1985.

Dr. V. Riebelová,
Department of Plastic Surgery,
Berkova 34, 612 00 Brno, Czechoslovakia

J. E. Purkyně University Medical Faculty, Brno (Czechoslovakia)
Department of Plastic Surgery
Head Prof. V. Kubáček, M. D., DrSc.

SENSITIVE FASCIOCUTANEOUS FLAP WITH NERVUS CUTANEUS FEMORIS LATERALIS

Preliminary report

V. RIEBELOVÁ, A. NĚMEC

In our previous preliminary study we discussed the indications for sensitive flap transfer, the types of transfer, their advantages and disadvantages. We proposed the transfer to the hand of the sensitive area of the nervus cutaneus femoris lateralis since it offers an abundance of material, the quality of the skin is similar to that of the hand and the layer of fat there is relatively thin. We described in detail the anatomy of the nervus cutaneous femoris lateralis as well as the extent of its territory. The following principles of transfer were established:

The sensitive area of the nervus cutaneus femoris lateralis has to be transferred:

1. in the form of a pedicle flap since the elimination of the musculus tensor fasciae latae deprives the area of the desired pedicle,
2. as a fasciocutaneous flap since the nervous system there is inseparably linked with the fascia lata,
3. as a direct transfer flap to avoid the convolution of the deep fascia. Tubed groundwork for the neoplasty of the thumb or supporting finger constitutes an exception.

Operating on cadavers we developed a surgical technique for the access to, identification and isolation of the nervus cutaneus femoris lateralis and a method for its transfer with the flap.

In the present study we report on the first two clinical cases.

Patient M. J., 41 yrs, a sewage removal truck driver, clin. notes No. 61871, was admitted with an afunctional torso of the right hand following gaseous cellulitis. All that remains of the hand is a rigid little finger and rudiments of the 4th digit. This part of the hand has remained normally sensitive. The rest of the digits are missing, their residual skeleton covered with atrophic insensitive scarry tissue. In November 1982 we started the direct transfer of a right-sided sensitive fasciocutaneous flap with the nervus cu-

Fig. 1. Post-dilaceration deformation of the right hand in an 18-year old apprentice. Defect of the thumb and index finger. Scarry block over the 3rd metacarpus. Median zone anaesthesia. — Fig. 2. Sketch plan for direct sensitive fasciocutaneous flap with distal pedicle on the right-hand thigh showing the probable course of the n. cutaneus femoris lateralis

taneus femoris lateralis 15 by 30 cm in size. The flap was transferred on a proximal pedicle, and the distal part of the flap was prepared by lifting. On Dec. 28, 1982, while cutting off the proximal pedicle of the flap, we exposed the nervus cutaneus femoris lateralis to transfer its peripheral stump along with the flap pedicle to the hand where we sutured in to the proximal stump of nervus medianus on the forearm. Postoperatively, the tip of the transferred pedicle with part of the fascia became necrotized, thus jeopardizing the viability of the nerve transferred. There was very poor restoration of sensitivity. A year later now, the patient can feel touch in only half the flap. The sweat test is negative. Recapitulating the surgical procedure we realized having made two major mistakes. We had included in the proximal pedicle a part which, in circulatory terms, belongs to the inguinal flap territory, and, second, we had attached the nervus cutaneous femoris lateralis to the median nerve stump in a "blind" suture having no apparatus at our disposal with which to identify the sensitive axons.

Fig. 3. Detected and isolated n. cutaneus femoris lateralis rising from beneath the inguinal ligament close to the superior anterior iliac spine, ready for cutting at inguinal ligament level. — Fig. 4. Anastomosis of the stump of n. cutaneus femoris lateralis to that of the digital volar nerve of the thumb

Patient M. R., 18 yrs, apprentice, cl.n.No. 67022, was addmitted with defective thumb and second digit, with a scarry block in the palm of the hand, and with disordered flexion and loss of sensitivity in the remaining fingers following a right-hand injury. The transposition of any of the remaining finger in place of the thumb proved unfeasible. For those reasons, in August 1983, we started the direct transfer of a 20 by 15 cm sensitive fasciocutaneous flap with the nervus cutaneus femoris lateralis to the hand using the distal pedicle. As a first step, with no preparatory surgery, we lifted the proximal portion of the planned flap complete with the peripheral stump of the nervus cutaneus femoris lateralis and with the fascia, tubing the flap in part to create the groundwork for the future thumb. The peripheral stump of the n. cutaneus femoris lateralis was sutured to the proximal stumps of the volar digital nerves of the thumb. The anastomosis was covered with the flap pedicle. By the end of the ensuing six weeks we had complete the transfer by the step-by-step cutting off of the distal pedicle until the blind closure of the flap. The secondary defect was covered with a dermoepithelial meshgraft. Except for the slightly protracted healing process in the blindly closed part of the flap, the course

of the transfer was without complications. Four months after the nerve anastomosis now, the patients beginning to develop feeling even in the free end of the flap. The base of the flap on the palmar side is showing the first signs

Fig. 5. Healed-in sensitive fasciocutaneous flap with the n. cutaneus femoris lateralis six months after nerve anastomosis with sensitivity already restored full-scale and with hypersensitivity noticeable in the basal parts of the flap. A bone graft is planned for implantation in the flap after the nerve restitution processes are over

of hypersensitivity. Six months after the operation the whole flap is very well sensitive now, with the zone of hyperaesthesia having spread all over the proximal portion of the flap. The sweat test is negative. The secondary defect consolidation is progressing well, and the patient has no problems there.

RESULTS AND DISCUSSION

Transfers of the sensitive area of the n. cutaneus femoris lateralis using the form of modified fasciocutaneous direct transfer proved to be technically feasible without any major difficulties even under clinical conditions, which is in

agreement with Nappi's experience (1). As for the first patient, we admit having made two major mistakes, as already mentioned. In spite of that, sensitivity in half the flap had been restored by the end of the first postoperative year. As for the second patient, the transfer took a substantially more favourable course in spite of the fact that the flap was transferred on the distal pedicle. As regards vascular supply, a favourable part may have been played there by the cutaneous branch of the arteria perforans III. The sensitivity of the flap was restored at a faster rate than in the first surgical patient. As for the appearance of hyperaesthesia we regard it as a normal phase of nerve restitution. The secondary defects in both patients have become well consolidated, and there are no problems there despite the partial loss of sensitivity in the thigh.

Both cases appear to show the feasibility of the proposed technique of transfer of the sensitive area of the n. cutaneus femoris lateralis. Following an error-free operation, the nervous function of the cutaneous nervous system can be expected to be restored to the desirable extent.

It seems that this method will come useful as an option in cases of severely deformed hands where a large quantity of soft tissues requires replacement, and in cases of thumb or supporting finger neoplasty where there is no option for transposition of microtransfer of another digit or a free sensitive flap.

CONCLUSION

Two patients had the sensitive area of the nervus cutaneus femoris lateralis transferred to the hand using the modified form of fasciocutaneous direct flaps combined with the anastomosis of the respective afferent sensitive nerves with the median nerve stumps. Owing to certain mistakes at the time of operation, the first patient had the sensitivity of the hand restored only partially, while in the second patient sensitivity had been restored within 6 months. The use of this method will be considered in cases requiring the replacement of major soft tissue defects in the hand and in cases of total loss of the thumb where neither a transposition of another digit to replace the thumb nor a microtransfer of the digit nor the transfer of a free sensitive flap are feasible.

J. H.

SUMMARY

The transfers are described of sensitive fasciocutaneous direct flaps with the nervus cutaneus femoris lateralis into defects on the hands of two patients. One had sensitivity restored only partially owing to inadequacies of technique, the other was found to have sensitivity restituted within 6 months. The use of this method can be considered for the replacement of extensive soft tissue defects in the hand and in cases of total loss of thumb where neither transposition nor microtransfer of another digit or free neurovascular flap transfer are possible.

RESUME

Lobe sensitif fasciocutané et nervus cutaneus femoris lateralis. Rapport préalable.

Riebelová, V., Němec, A.

Le travail décrit des transpositions de lobes sensitifs fasciocutanés directes avec nervus cutaneus femoris lateralis aux endroits des défauts sur les mains, chez deux malades. Causé par un procédé faux, la sensibilité du second malade est revenue dans 6 mois. L' utilisation de cette méthode mérite considération aux cas, où il faut compenser de vastes défauts des tissus moux sur la main ou chez la perte totale du pouce où il n'y a pas de possibilité d'exécuter soit une transposition, soit une microtransposition d'un autre doigt, soit une transposition du lobe neurovasculaire libre.

ZUSAMMENFASSUNG

Ein sensitiver Fasciokutanlappen mit nervus cutaneus femoris lateralis. — Vorläufiger Bericht

Riebelová, V., Němec, A.

In der Arbeit werden Übertragungen sensitiver Fasciokutanlappen mit nervus cutaneus femoris lateralis auf Defekte an den Händen zweier Patienten beschrieben. Beim ersten Patienten erneuerte sich die Empfindlichkeit infolge eines fehlerhaften Vorgehens nur teilweise, jedoch beim zweiten Patienten kam es zur Rückkehr der Empfindlichkeit binnen 6 Monaten. Die Anwendung dieser Methode kommt in Frage beim Ersetzen ausgedehnter Defekte weicher Teile an den Händen sowie bei totalem Verlust des Daumens, wo eine Transposition oder eine Mikroübertragung eines anderen Fingers oder eine Übertragung eines freien neurovaskularen Lappens nicht möglich ist.

RESUMEN

Lóbulo sensitivo fasciocutáneo con el nervus sutaneus femoris lateralis. Informe preliminar.

Riebelová, V., Němec, A.

En el estudio se describen los transplantes de los lóbulos sensitivos directos fasciocutáneos con el nervus cutaneus femoris lateralis hacia los lugares de los defectos en las manos de dos pacientes. En el primero, como resultado de un procedimiento erróneo, la sensibilidad fue recuperada sólo parcialmente, en el segundo ésta se restituyó en 6 meses. La utilización de este método puede considerarse al restituir amplios defectos de las partes blandas de la mano y en casos de pérdidas totales del pulgar donde no puede procederse a la transposición o sea microtransporte de otro dedo o transplante de un lóbulo libre neurovascular.

REFERENCES

2. **Riebelová, V., Němec, A.:** Sensitive fasciocutaneous flaps with nervus cutaneus femoris lateralis and nervus saphenus. A preparatory study. Acta Chir. plast., 2, 1985.

1. **Nappi, J. P., Ruberg, R. L., Berggren, R. S.:** Innervated cross-leg tensor fascia lata fasciocutaneous flap for foot reconstruction. Ann. plast. Surg., 10: 411, 1983.

Dr.V. Riebelová,
Department of Plastic Surgery,
Berkova 34, 612 00 Brno, Czechoslovakia

Book review

The Biological Principles of Tissue Withdrawal and Preservation by Rudolf Klen, M.D., DrSc.

Co-authors:

Chapt. 6.5.1.1	G. O. Phillips, Ph.D., D.Sc.Chem., FRIC, The North Wales Institute of Higher Education, Clwyd, U.K.
Chapt. 10.10.1, 10.2, 10.3	L. Vávra, BSc., P. Měřička, M.D., R. Klen, M.D., DrSc., Hradec Králové Teaching Hospital, Tissue Bank
Chapt. 10.3.2, 10.3.2.1, 10.3.2.2, 10.3.2.3	D. E. Pegg, M.D., MRC Medical Cryobiology Group, University Department of Surgery, Cambridge, U.K.
Chapt. 10.3.2.4, 10.3.2.5	T. J. Milson, Jr. PhD., and D. Greiff, Sc.D., Department of Pathology, The Medical College of Wisconsin, Milwaukee, U.S.A.

Pergamon Press, 1982, 264 pages divided into 16 chapters + index, 16 drawings, 77 pictures

The author of the monograph "The Biological Principles of Tissue Withdrawal and Preservation", Rudolf Klen, M.D., DrSc., started a tissue bank at the Hradec Králové Teaching Hospital back in 1952. Five years later, the first edition of his monograph on tissue preservation was published in the Czech language. Five years later on, a revised edition of his monograph appeared in Russian. After another 17 years of continuous activity in research and clinical application we are presented with a new, substantially revised edition of the book carrying the title of BIOLOGICAL PRINCIPLES OF TISSUE WITHDRAWAL AND PRESERVATION, this time in the English language. The text of the monograph as well as the references to different chapters prove that the author, at first a self-trained man, has grown into an expert of world reputation over more than a quarter of a century of hard work.

Dr. R. Klen, DrSc., has developed in his new monograph the biological principles of the withdrawal, conditioning, preservation and clinical application of auto- and xeno-transplants. In 16 chapters he covers in great detail all that the science and practice of preserved tissue transplantation can now offer the clinician. No problem has been ignored, and the clinician is presented with an attractive account of all the facts that are of interest to him — from legal regulations up to a critical treatise of what a tissue bank should be.

Of particular interest is information in Chapter 8 on the conditioning of different types of tissue for transplantation. This conditioning takes two forms: morphological and biological. The former means shaping the transplant so as to require a minimum of adaptation at the time of implantation. Most tissues need modifying their biological characteristics. This is necessary with a view to abating the adverse reactions caused by the foreign tissue of the transplant in the recipient organism (rejection, resorption, poor resistance of the transplant, inflammation). The biological conditioning of xeno-transplants of bone, hyaline cartilage,

skin, nerve, vessels, heart valves, bone marrow, cornea, amnion, and the washing or rehydration and other conditioning of autologous transplants are described on pages 136 to 156 along with references.

The surgeon will find more information of extraordinary relevance in Chapter 10, pages 233—240: The Transplant — Its Role of an Antigen. This is a key problem of xenotransplantation resisting solution to this day. What we do know, however, is that successful xenotransplantation is hampered by the genetic relationship between recipient and donor, a mechanism controlling the direction of immunological reactions. Transplantation immunology has developed into an independent branch of immunology. The complete discovery and solution to the immunological problems of transplantation will be one of the most important triumphs of medicine. For the time being, resesearchers are trying hard to find at least ways and means of reducing antigenicity. The author gives a brief list of laboratory experiments conducted for that purpose. Of interest here is a report by Velley [65], who noted antigenicity changes correlated to the period of time for which the transplants had been kept frozen. At first, antigenicity increased only to drop after 6 to 8 days. Freeze-drying was found to change the immunogenicity of histocompatible antigens in cells and tissues but the actual mechanism of the change has yet to be discovered.

I can warmy recommend the book to all surgeons as they are bound to find in it a wealth of basic and practical knowledge. My warm congratulations are due to Dr. Klen for his hard and consistent work of more than 30 years standing. I wish to thank him on behalf of surgeons and their patients whose health could be restored thanks to transplants from Hradec Králové.

Prof. Š. Demjén, M.D., DrSc.,
Department of Plastic Surgery,
800 00 Bratislava,
Czechoslovakia

CONTENTS

STOP FOR A MOMENT AND CONSIDER YOUR HEALTH

DAY AFTER DAY AND YEAR AFTER YEAR YOU ARE CONSTANTLY CHASING SOME AIM OR ANOTHER, YOU STRETCH THE MAINSPRING OF YOUR HEALTH TO THE VERY MAXIMUM. AND HOW LONG DO YOU THING YOU CAN CONTINUE TO DO SO? REMEMBER THAT YOU HAVE ONLY ONE HEALTH AND FINALLY MAKE UP YOUR MIND TO GRANT IT, AT A VERY REASONABLE PRICE, WHAT IT DESERVES: COMPLEX TREATMENT AT ONE OF THE OLDEST AND THE MOST WIDELY RECOGNIZED SPAS IN EUROPE.

CZECHOSLOVAK SPAS — OASES OF HEALTH,
QUIET AND INSPIRATION

KARLOVY VARY — FRANTIŠKOVY LÁZNĚ — MARIÁNSKÉ LÁZNĚ — JÁCHYMOV — TEPLICE V ČECHÁCH — PODĚBRADY — JANSKÉ LÁZNĚ — TŘEBOŇ — JESENÍK LUHAČOVICE — TEPLICE NAD BEČVOU

BALNEA
PRAHA

BALNEA PRAHA - REPRESENTATION OF CZECHOSLOVAK SPAS AND MINERAL SPRINGS
110 01 PRAHA 1, PAŘÍŽSKÁ 11 - TELEX: 122 215 - CZECHOSLOVAKIA