

Below-knee amputation in patients with vascular disease and prosthetic fitting problems

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Abstract

A study was made of 544 cases with lower limb deficiencies caused by obliterative diseases; 262 cases were below-knee amputees. Of these, 106 (40%) were amputees transferred from other clinics for prosthetic fitting; in 156 cases (60%) the amputations were performed in the Institute.

Amputations were carried out using one of two techniques according to the state of arterial and collateral circulation. The posterior flap below-knee amputation (Burgess, 1969) was employed in 94 cases, the other 62 amputations were carried out using a modification of that technique which was characterized by the formation of a musculo-fascia-cutaneous flap.

The stump wound healed by first intention in 127 patients (81.4%), by second intention in 18 (11.5%) and in 11 cases (7.1%) the wounds failed to heal.

Successful prosthetic fitting and walking training was achieved in 91.3% of amputees and 67.2% were returned to productive work.

Introduction

This paper presents the results of treatment and prosthetic fitting of below-knee amputees with limb deficiencies resulting from obliterative vascular diseases.

A study was made of 544 cases with lower limb deficiencies caused by obliterative diseases; 262 cases were below-knee amputees: of these 106 amputees (40%) were transferred from other clinics for prosthetic fitting and in 156 cases (60%) the amputations were performed in the Ukrainian Research Institute.

Most of below-knee amputees in the group with obliterative endarteritis ranged from 30 to 40 years old and in the group with atherosclerotic occlusions and diabetic angiopathy from 60 to 70 years old.

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Gangrene often combined with secondary infection; acute intoxication with developing limb ischaemia; established rest pain together with demonstrable progressive ischaemia; ineffective conservative treatment or reconstructive surgery were considered as indications for amputation (Fig. 1).

Patient examination

Pre-operatively patients were thoroughly examined by means of both clinical and ancillary techniques. The results showed that patients with obliterative vascular diseases exhibit considerable changes in the blood coagulant system leading towards increasing coagulability and depression of fibrinolysis.

On the first post-operative day hypercoagulation increased in the said category of patients. By the fifth day the decrease of coagulability and the increased fibrinolysis activity could be observed although the main



Fig. 1. Indications for amputation-gangrene of the distal portion of the foot.

characteristics shown in the coagulogram still tended towards hypercoagulation. By the tenth day after the operation the coagulogram tended to be normal.

The results of medical examination indicated that the degree of the above mentioned changes were coincident with the severity of clinical manifestations and the tendency to hypercoagulation increased with the age of the patients.

When comparing coagulogram dynamics of different nosologic types it was observed that the most severe coagulation system disorders occurred in those patients with obliterative atherosclerosis in the older age groups.

Furthermore, the exhaustive clinical examination indicated significant immunological changes in most patients; they exhibited considerable immune reaction deficiency. To increase their resistance, passive and active immunization were carried out by means of staphylococcal gamma globulin and anatoxin injections. Patients received general care along with detoxicating, desensibilizing, sedative and vitamin treatment.

Amputation technique

Special attention was paid to level selection and amputation technique. The level of limb amputation was selected with respect to objective results of angiography, thermography, reovasography, capillaroscopy which were assessed together with the clinical evidence.

For selection of the amputation level consideration was given to both the location of the artery occlusion and the degree of collateral circulation development. Having considered the results of a comprehensive examination amputation was performed at the level showing sufficiently developed collaterals, e.g. in case of developed collateral circulation at knee joint level amputation was carried out in the upper third or quarter of the shank and the post-operative wound healed by first intention. Amputations were carried out by one of two techniques according to the state of arterial and collateral circulation. The first technique employed was the posterior flap below-knee amputation as described by Burgess (1969) and 94 (60.2%) below-knee amputations were performed using this technique. The remaining 62 (39.8%) amputations were carried out using a modification of that technique, developed at the

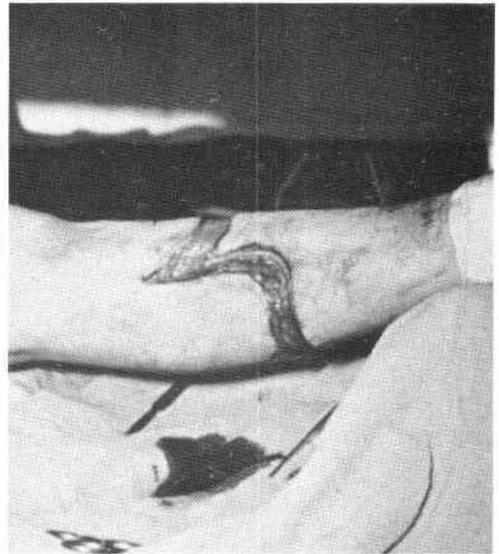


Fig. 2. Formation of posterior musculo-fascia-cutaneous flap; incision of the cutaneous and fascial tissues.

Institute, which was characterized by forming a musculo-fascia-cutaneous flap (Fig. 2).

It was observed that the surface layer of the below-knee posterior muscle group suffered less. Accordingly dissection was carried out up

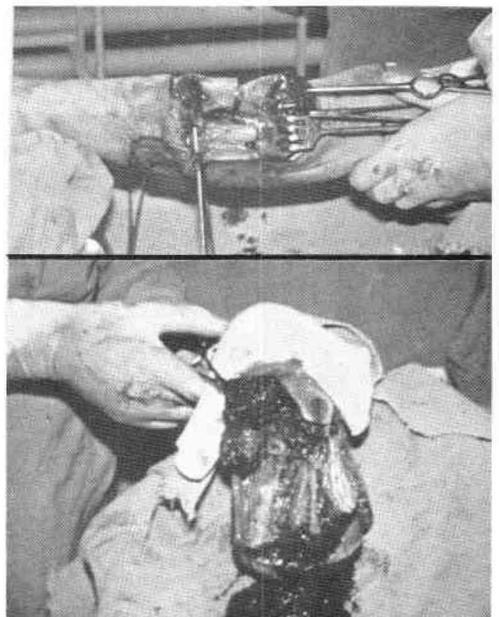


Fig. 3. Top, cutting of muscles, tibia and fibula. Bottom, shaped posterior musculo-fascia-cutaneous flap.

to the level of the residual bone in the case of both anterior and lateral muscle groups, the deep layer of the posterior group and the soleus muscle from the surface layers (Fig. 3). In a number of cases with insufficient circulation the major portion of the anterior and lateral shank muscle groups were excised and a thin musculo-fascial flap with viable circulation was formed. The fibula was frequently eliminated. Only the better vascularized inner portion of the musculus soleus was saved. The shaped, cut and thinned posterior musculo-fascial flap was sutured under slight tension to the thinned antero-lateral musculo-fascial flap fully covering the residual bones (Fig. 4). The subcutaneous cellular tissues and skin were secured with interrupted sutures. The wound was drained. Amputation was performed without tourniquet to spare the tissues. This technique makes it possible to construct a short below-knee stump, preserve knee joint function and increase the range of prosthetic functions.

In the post-operative period much attention was paid to prevention of post surgical complications, improvement of the general condition of a patient and the stump circulation.

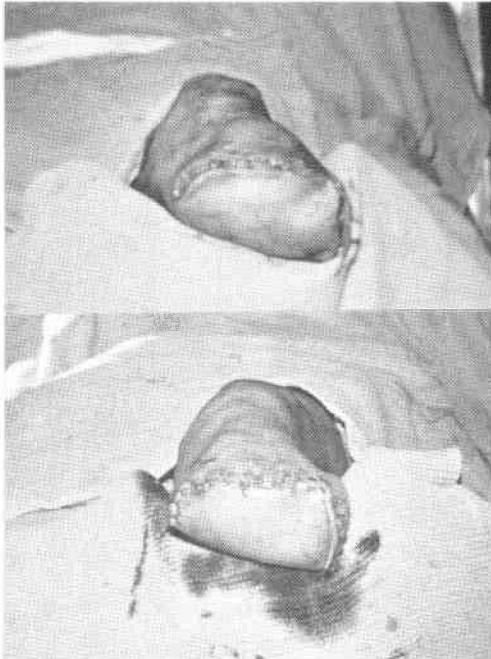


Fig. 4. Top, the thinned and shaped posterior musculo-fascial flap is sutured to the thinned antero-lateral musculo-fascial flap. Bottom, cutaneous sutures.

Post-operative treatment results indicated that the stump wound healed by first intention in 127 patients (81.4%), by second intention in 18 (11.5%) and in 11 cases (7.1%) wounds failed to heal.

This method of below-knee amputation permits preservation of the knee joint in those ischaemic cases when it is otherwise usually recommended to amputate at the above-knee level.

Prosthetic fitting

Prosthetic fitting is started within one or two weeks after taking out the stitches. To speed up the process of stump shaping physiotherapy techniques as well as exercise therapy and phantom pulse gymnastics are applied.

Temporary prostheses are employed and to manufacture these prostheses the same standard units and pre-fabricated parts as in permanent prostheses are used. Only the socket, which is changed as required with changing stump volume, is temporary. Once walking skills are mastered, stump volume stabilized and the gait pattern optimized fitting of a permanent prosthesis is then started.

In most cases (78.2%) below-knee PTB-type prostheses with a rigid receptacle socket are prescribed. The sockets are fabricated of gauze and polyamide lacquer, and metal-polymer



Fig. 5. Left, patient with short below-knee stump. Centre, prosthesis with thigh piece and ischial tuberosity bearing. Right, patient wearing prosthesis.

sockets are made of reinforced polyethylene and fitted into a modular prosthesis.

For the below-knee stump in the upper third the socket has to encompass the patella. In short painful stumps with trophic disorders the below-knee prostheses with a thigh piece and ischial tuberosity bearing is prescribed (Fig. 5). In certain cases a suspended leather socket for the below-knee stump may be used. In short below-knee stumps with persistent permanent flexion contracture shin prostheses for flexed knee are fabricated.

Special attention was paid to the receptacle socket fabricated individually by means of the negative plaster mould. The area of the patellar ligament, the patella, the head of the fibula, the condyles of the femur and the tibia, and the tibial tuberosity were all carefully highlighted. Total contact sockets which could be cushioned if necessary by a layer of foamed polyethylene were employed.

Results

In spite of the many problems so often encountered with this category of patients, amputation at the below-knee level was achieved in 58.9% of patients. Successful prosthetic fitting and walking training was achieved in 91.3% of amputees and 67.2% were returned to productive work. The results obtained in the above mentioned patients depend not only upon the quality of prosthetics but to a considerable extent are dependent on the general condition of the patient, the rate of progress of the disease process, the extent of circulation disorders both in the stump and in the contralateral limb as well as on the energy demands on the body in the use of the prosthesis and the level of function achieved.

REFERENCES

- BURGESS, E. M. (1969). The below-knee amputation. *Inter. Clin. Inf. Bull.* **8**(4), 1-21.