ment each other. In certain cases treatment begins with the closed plaster cast and concludes with skeletal traction; in others it begins with skeletal traction and concludes with the closed plaster cast.

In gunshot wounds union is protracted. To stimulate this process we make wide use of physical therapy, quartz, paraffin, and ozocerite, as well as the antireticular cytotoxic serum of Prof. Bogomoletz and the tissue therapy of Prof. Filatov.

Considerable importance is attached to good nutrition and the prescription of vitamins. At the earliest moment that the patient's health permits, general and specialized physiotherapy (gymnastics) are used in order to improve his general condition and prevent muscle debility, contractures, and limitation of joint mobility.

Complications

A variety of complications may occur in the treatment of bone injuries. These include: (1) abscess, phlegmon, pus pockets; (2) osteomyelitis; (3) haemorrhage; (4) delayed consolidation, non-union, and pseudarthrosis; (5) malunion; (6) contractures, limitation of mobility, and ankylosis of joints; (7) sepsis. Each of these complications demands timely discovery, diagnosis, and special treatment.

Conclusion

We consider that considerable success has been achieved in our treatment of gunshot fractures. More than 50% of our wounded with bone injuries are returned to the Army. Complications in wounds of the thigh and lower leg have sharply decreased and the number of amputations considerably diminished.

AMPUTATION OF THE EXTREMITIES, AND PROSTHESIS, IN THE U.S.S.R.

BY

Prof. NIKOLAI N. PRIOROV

In gunshot wounds, amputation of the extremities is in many cases the sole means of saving life. In comparison with previous wars the number of amputations in the present war, both in the rear and at the front, has diminished by half. The reasons for this decrease are as follows: (1) approximation of surgical aid to the wounded; (2) application of first aid soon after injury; (3) radical excision of the wound in medical sanitary stations near the front and in field hospitals; (4) the use of antitetanus serum in all cases of trauma and of anti-gas-gangrene serum in cases of severe trauma; (5) wide use of sulphonamide preparations; (6) employment of blood transfusion, without exception, where indicated; (7) the possibility of retaining patients with severe wounds of the extremities in front-line hospitals until their condition becomes less grave; (8) complete immobilization of the injured parts.

We consider the plaster cast the best method of immobilization. The majority of amputations are performed at the front, and only an insignificant number—approximately one-fifth of all amputations—are carried out at hospitals in the rear.

Reasons for Amputation

The first and chief reason for amputation (up to 40%) is severe destruction and crushing of soft tissue, bones, and joints, with acute disturbance to nutriment of the extremities. The second reason is the tearing away of an extremity by shell fragments, bombs, etc., the remaining part being connected to the body by a mere patch of skin, thus necessitating only completion of amputation. Third, the presence of sudden and rapidly developing gas infection, when other methods of controlling it are unsuccessful. Fourth, gangrene of the extremities, after injury to the blood vessels, burn, freezing, etc.: amputations of this type are not numerous (from 1 to 2% of the total). Fifth, the septic condition of the patient after trauma of the extremities, in the presence of phlegmon and purulent pockets, and in acute osteomyelitis, when all methods of treatment prove unsuccessful and it becomes necessary to sacrifice the injured part. Amputations as a result of these conditions constitute, according to our data, 7 to 9% of the total. They are performed in hospitals close to the rear.

Methods of Amputation

We use both chop and guillotine methods, but greatly prefer the latter because enough skin is saved to allow of a later skin graft. In individual cases we cut out one or two skin flaps, which, if conditions are favourable, can later be used to close the amputation wound. In order to protect the flap from infection it is rolled into tube form and sutured. Primary amputations are never sutured.

We consider the following safeguards obligatory in amputation: (1) To prevent the patient from becoming chilled during the operation and to provide him with heat (warm blankets, heat pads, etc.). (2) To give blood transfusions before and after operation. In primary amputation blood is transfused in large quantities; in secondary amputation it is transfused in small quantities. (3) To apply a tourniquet during the operation and not to lose a single drop of blood. (4) To operate under anaesthesia. We commonly use inhalation, intravenous, and local anaesthesia, and also freezing. (5) Observation and care, in the field hospitals where the amputation is performed, for a period of two or three days after operation.

Treatment of Stump

The reason for amputation, and the methods of amputation just indicated, determine subsequent treatment of the stump. An infected stump is never sutured. When it progresses favourably we recommend an initial dressing on the eighth or tenth day, preferably under anaesthesia. In such cases the amputation site is usually clean and covered with fresh granulation tissue, and inflammation is absent. Secondary suture, preferably with the use of plastic buttons, is possible, the edges of the wound being gradually approximated by tightening the suture. These measures guarantee a good stump for prosthesis and preclude the necessity for re-amputation.

When the stump does not progress favourably, owing to the presence of infection—phlegmon, osteomyelitis, phlebitis, etc.—the wound is treated by the usual surgical measures: supplementary excision, antiseptics (sulphonamide preparations, penicillin, gramicidin, bacteriophage, and others), and also by physiotherapeutic methods. The stump wound is treated with the aid of a Thomas brace in order to prevent the development of contractures.

A significant number (up to 80%) of amputation stumps are diseased or defective. Diseases of the stump comprise non-healing wounds, ulcers, osteomyelitis, ligature fistula, exostosis, neuritis, pains in the stump, phlebitis, disorders of the skin, and contracture. Defects of the stump consist of excessively long or short stumps, disarticulated stumps of the knee-joint, ankle-joint, wrist, and shoulder, stump scars with bone adhesions, conical stumps, ankylosis, and defects following osteoplastic operations.

In treating diseases of the stump and to remove defects, physiotherapy, heat, mud, tar, paraffin, and ozocerite are extensively used. Cases that do not respond to conservative treatment are dealt with as follows: (a) by skin grafting; (b) by grafting adjacent tissue; (c) by excision of scar tissue, with skin grafting; (d) by removal of adhesions and ligatures; (e) by removal of neuromas and neurolysis; (f) by sequestrectomy; (g) by re-amputation.

Re-amputations form from 40 to 60% of all operations on the amputation stump and need special attention. The three chief points arising with regard to re-amputation are: (1) indications for re-amputation; (2) time of re-amputation; (3) method of re-amputation. According to data compiled during the war by Soviet hospitals, indications for re-amputation have occurred in the following proportions: non-healing wounds, up to 60%; osteomyelitis, from 17 to 20%; extensive scars with bone adhesions, 10%; exostosis, pains, etc., 10%.

The time for re-amputation can never be a matter of indifference. From a wide experience we have reached the conclusion that the ideal time is the third month after primary amputation, when good granulation tissue exists, inflammation and oedema have disappeared, and dense scars are not present. In cases of gas infection re-amputation is delayed until the six to tenth month.

The bone, in re-amputation, is dealt with by the Bunge method. The bone canal is tamponed with a section of muscle, bleeding vessels are carefully tied, the nerve is cut at a fairly high level with a razor blade, and drainage tubes are inserted for one day. The use of the osteoplastic operations of Pirogov, Bier, Gritti-Stokes, and Kirschner is widely recommended.

Preparation of Stump for Prosthesis

From the very beginning of treatment very careful attention is given to the preparation of the stump for prosthesis. In the first stage of stump treatment binding scars, contractures, and limitation of motion must be prevented. In the second stage, after the wound has healed, physiotherapeutic methods of treatment are used; these include massage of the extremities—omitting the stump itself—contrast baths, and electric stimulation. Stump exercises and gymnastics for the amputee, stump-wrapping, and training to accustom the stump to withstand pressure are started early, and therapeutic prostheses are extensively used. Stump preparation continues for two to three months.

Organization of Prosthesis Supply

In the Soviet Union a network of special hospitals have been established for the purpose of supplying prostheses. Each hospital includes a department of orthopaedics where the stump is treated, a department of physiotherapy where it is prepared for prosthesis, and a prosthesis department where the artificial limbs are completed and fitted. Our prostheses are made of wood, leather, or emolyten, and in the main our system of supply is divided into two sections—the manufacture of parts and the assembly of the finished limb. Several factories exist for the manufacture of unassembled metal and wooden limbs. Assembly of the prostheses is done by regional workshops distributed throughout the Soviet Union.

Special attention is given to supplying prostheses for wounded men with bilateral arm amputations. Either a Krukenberg operation or phalangization is performed, and the amputee is provided with an active artificial hand.

A healed amputation stump and a suitable prosthesis are essential for re-establishing the patient's working capacity and providing him with employment. Up to 90% of our amputees, after being treated and supplied with artificial limbs, return to the factories, plants, and other establishments where they were employed prior to the war. Only work can complete their rehabilitation; only work can heal their severe psychic wounds and restore their shaken nerves.

OSTEOPLASTIC RE-AMPUTATION OF THE THIGH

BY

Dr. ALEXANDER KOTOV

Many surgeons in the U.S.S.R. and in other countries consider end-weight-bearing stumps preferable to other types from the prosthetic point of view. These permit an artificial limb to be lighter in weight and simple in construction, and in addition they guarantee stability in walking, due to the fact that the amputee in a way "feels the earth under his feet." Non-end-weight-bearing stumps in many cases involve permanent pressure on the tuber ischiadicum, which is difficult to support and which hampers walking.

The objections raised by critics of end-weight-bearing stumps lie not in their disagreement with what has just been stated but basically in that in course of time the supporting capacity of the stump lessens and even completely disappears. It seems to us, however, that this does not justify depriving the amputee of the possibility of using an end-weight-bearing stump, even if only for a limited period.

End-weight-bearing Stumps

We consider that below-knee amputations provide the best means of obtaining end-weight-bearing stumps by operative procedure. According to our observations in the Soviet Union, the Pirogov, Syme, Bier, and Kirschner operations all give

excellent results. Because of this they are widely used in our hospitals in cases requiring below-knee re-amputations. It was possible, by use of the methods mentioned, to provide the majority of patients with prostheses that reached no higher than the level of the knee-joint.

In re-amputation of the thigh there is less possibility of securing end-weight-bearing stumps. The Gritti-Stokes osteoplastic amputation, in the opinion of various authorities and according to our own observations, gives a good end-weight-bearing stump in the region of the lower third of the thigh. Some writers claim that they get a stable end-weight-bearing stump in the middle third of the thigh by that method. Conditions of war, however, especially in amputation centres, limit the use of this operation, both for thigh and for below-knee amputations. It is first of all excluded when thigh stumps do not include the patella; and, secondly, its use is seldom indicated on stumps of the upper third of the lower leg. Thus, in thigh re-amputations we do not regard the osteoplastic operation as an accepted method of securing an end-weight-bearing stump.

On the basis of data gathered from all hospitals under the control of the People's Commissariat of Health of the U.S.S.R., the number of thigh amputations following war trauma is approximately equal to the number of below-knee amputations. They constitute, however, a far more difficult group with respect to restoration of lost function.

Owing to the absence of two groups of major joints a thigh case finds walking much more difficult than a case with amputation of the lower leg. In addition, the surface that can be utilized to fasten the socket of the prosthesis is only one-half or one-third of that available in below-knee amputations. Finally, in non-end-weight-bearing stumps of the thigh the only anatomical point of pressure in walking with the prosthesis is the tuber ischiadicum. We are in agreement with those who, having observed the prostheses of patients with thigh amputations, point out that their adjustment to weight-bearing on the tuber ischii is often a lengthy and unpleasant procedure.

These factors forced us to seek a means of alleviating the condition of this group long before the outbreak of the present war. At the clinic of the Ukrainian Institute of Orthopaedics and Traumatology in Kharkov physiotherapeutic methods of accustoming the thigh to pressure after re-amputation were employed. Our observations showed that to secure an end-weight-bearing thigh stump by means of this method long and unwearying persistence was required, but the results completely justified the effort.

As a result of his training the patient with an end-weight-bearing thigh stump showed incomparably greater stability and ease in walking than when he had a non-weight-bearing stump. In addition the majority of amputees, after therapeutic treatment, began to walk with a mobile artificial knee-joint and refused to wear a lock, which they had previously insisted upon in order to prevent mobility. In some cases the end-weight-bearing stump enabled patients to abandon completely the use of the ischium for support.

During the war, which has made wide use of operative procedures for treatment of the stump possible, the idea arose of employing the osteoplastic method to increase the ability of the thigh stump to bear pressure. Our use of the Kirschner method for re-amputations of the lower leg in the amputee hospital at Seipolatinsk, Khazakstan, gave good results, and we decided to utilize the principle of this operation to obtain a pressure-bearing thigh stump. During ten months of work we performed 15 osteoplastic re-amputations of the thigh stump in the middle third. The post-operative wound healed very quickly in all these cases. We began educating the stump to weight-bearing on the twelfth to the fourteenth day after operation, exercising it a few times daily. At the beginning of the second month after operation the amputee was supplied with special crutches fitted with a platform for supporting the stump. The walking time was increased daily. Later this group of amputees were supplied with end-weight-bearing prostheses having free mobility of the knee-joint.

Technique

The technique we use in osteoplastic re-amputation is very simple. A flap of skin sufficient to cover the lower surface