Krukenberg's chopsticks

The Krukenberg operation is named after the German surgeon who first suggested that a forearm stump could be made into a functional limb by separating the radius and ulna and so providing the patients with a pair of muscle-powered pincers. Sixty years on the procedure is a good example of a simple practical operation that is sufficiently rare in civilian practice to merit occasional readvertisement. It is, sadly, also one of the long line of medical innovations born out of war and bred by the continuing effects of military strife. Guerrilla fighters learning to use grenades or crawling through antipersonnel minefields may forfeit their hands and sight. Bangladesh and Vietnam have provided the most recent crops of these injuries in young men, and their rehabilitation has recently been reviewed.[1 2]

Surgeons who use the Krukenberg operation admit the ugliness of the functioning pincers, but they counter this by pointing out that such a stump does not preclude wearing a cosmetic prosthesis—and may even improve the management of a functional one. Furthermore, if the victim is blind then the sensory feedback from the Krukenberg stump will be invaluable. Even sighted amputees find many practical benefits from having a functional stump with sensation. American orthopaedic surgeons, who made substantial contributions to this subject in Vietnam, have filmed bilateral Krukenberg amputees performing many difficult tasks with these useful stumps, including the expert use of chopsticks.

Though most candidates for the Krukenberg operation come from military sources, patients do lose their hands in industrial accidents, which are becoming more frequent in developing countries. Workers on the land learning to use powered agricultural machinery have a high accident rate, while the proliferation of light industrial plants in villages is also creating more work for the surgeons. When both arms are damaged any procedure, however bizarre in appearance, will be welcome if it provides prehension and tactile sensation without the investment of time and money required for the fitting of a conventional prosthesis.

In developed societies such as Britain orthopaedic surgeons are only too familiar with the cable-operated split-hook or "functional" hand which is kept in the cupboard and dusted off for occasional parade to the doctor. The single upper limb amputee tends to survive in the Welfare State by a mixture of dependence on the remaining limb and disability registration. Wheelchairs may provide an irreversible disincentive to lower limb amputees to relearn mobility, and there is a similar parallel whereby television may give a passive alternative to more active hobbies for forearm amputees in the privacy of their own homes. Yet patients can use such beginnings to acquire the confidence to use a versatile stump for more gainful pursuits, and a Krukenberg procedure might bring some two-handed tasks within the grasp of single-arm amputees.

These two papers offer good bibliographies and useful technical advice. Both authorities emphasise the importance of a careful myoplastic approach, with gentle separation and reinsertion of radially and ulnarly disposed muscles to their respective bones. If skin grafting of the interosseous cleft can be avoided, much better sensation is provided for the opposing surfaces, and Nathan and Trung[2] describe in detail how to excise the correct amount of muscle, so allowing primary closure. The minimum recommended length of stump is 8 cm from the insertion of the biceps; the optimum is 12 cm or more. This procedure seems likely to be of great practical value in developing countries for the rest of this century; and it is not impossible that a "Krukenberg Klub" may succeed "McIndoe's guinea-pigs" in achieving cosmetic acceptability and restored function in more affluent societies.

[1] Garst, R J, *The Disabled in Developing Countries. Proceedings of a Symposium on Appropriate Technology and Delivery of Health and Welfare Services for the Disabled in Developing Countries*, p 16. London, Commonwealth Foundation, 1977.
[2] Nathan, P A, and Trung, N B, *Journal of Hand Surgery*, 1977, **2**, 127.

Testing monocyte function

The monocyte-macrophage system is of critical importance to host defence. It begins in the bone marrow with the differentiation of the monoblast from precursor stem cell lines and continues with the differentiation of the mature peripheral blood monocyte, which later transforms into the tissue macrophage.

The connection between the peripheral blood monocyte and the tissue macrophage was suggested by the classical studies of Metchnikoff[1] and Aschoff[2] and later shown conclusively by Lewis[3] and Ebert and Florey.[4] Since these early studies experimental pathologists have concentrated their attention on the tissue macrophage, which in its "activated" form is the most important functional part of the host's defence system, and the blood monocyte has been neglected. This and the fact that the blood monocyte is a short-lived transition cell help to explain why monocyte function tests have been slow to develop. Nevertheless, we now know that the monocyte is a cell with a highly developed phagocytic potential of great practical importance in man and in most mammals. It is the major defence system against intracellular pathogenic bacteria, fungi, and various intracellular parasites; it plays a part in antigen processing; and it interacts with lymphoid cells in cell-mediated immunity. Recent evidence suggests that the monocyte may provide a defence system against some tumours,[5 6] and in addition that it may be the source of the colony-stimulating activity required for granulopoiesis.[7 8]

The development of granulocyte function tests helped to focus attention on the monocyte, and Territo and Cline[9] have described a group of monocyte function tests which are both simple and reproducible. One of the particular difficulties of testing monocyte function has been getting relatively pure suspensions of monocytes; Territo and Cline have separated monocytes from granulocytes with a Ficoll-Hypaque density gradient. Lymphocytes are then removed by adhesion to the surface of a plastic Petri dish and repeatedly washed. Using some of the principles established in tests of granulocyte function and some new techniques, they have devised methods[9] for measuring chemotaxis, adhesion, spreading, and phagocytosis. To evaluate fungal and bacterial killing they used *Candida pseudotropicalis*, which is killed by a myeloperoxidase-independent mechanism, and *C albicans*, which requires myeloperoxidase for effective killing. Both systems need to be tested, since myeloperoxidase is lost as the human monocyte develops into the mature macrophage. Territo and Cline claim that their tests give basic information about the state of the host's defences and about the degree of monocyte activation and yet can be performed in any haematology laboratory. Other monocyte functions can be measured, including cell surface receptors, tumour killing and cytotoxicity, enzyme activity, and pinocytosis; but for the time