EDITORIAL

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MICROSURGERY IN CHILDREN: HISTORY, INDICATIONS, PRECAUTIONS, AND DIFFERENCES FROM THAT OF ADULTS

Microsurgery in the 20th century enabled surgeons to operate on very fine structures. Nylen (1892–1978),[1] performed the first ear operation in a human in November 1921. Holmgren (1875–1954), modified Nylen's idea by utilizing a binocular Zeiss microscope in 1922.[2] Other specialities (neurosurgery or plastic and reconstructive surgery) only adopted microsurgical instruments and techniques in the 1960s. One of the more important events in the development of microsurgery was the anastomosis of blood vessels with diameters between 1.6 and 3.2 mm by Jacobson and Suarez in 1960, with a relatively high rate of postoperative patency.[2] Microsurgical technique is now extensively used in all realms of surgery. It is applied in two broad fields: in transplantation with vascular anastomosis of various free tissues, including the omentum, segments of intestine, muscles, bones, joints, skin, and subcutaneous tissues, and in branches of surgery, such as cardiovascular surgery, brain surgery, urology, obstetrics and gynecology, and surgery of the lymphatic system.[3] Reconstructive microsurgery has progressed from its initial ability to achieve wound coverage using free tissue transfer to a new level of sophistication with regard to restoration of function and aesthetics when dealing with acquired or congenital problems in all body regions. The ability to select an optimal reconstructive procedure using suitable donor tissue and to transfer this tissue directly to the sites of tissue and/or functional defects has permanently altered many reconstructive methods and has expanded the indications for microsurgery. Advances in anatomy, concerning vascular and nerve supply, established the unique role of free tissue transfer in reconstructive surgery. As the success rate of free flaps has improved, in my personal experience, to above 90%, indications for these procedures have changed from a last resort reconstructive option to one that achieves the best reconstruction possible. The goal in the reconstructive microsurgery is to obtain the best possible result according to the functional and aesthetic outcomes, with minimal donor site morbidity. It is known that the major role of free flaps is the coverage of difficult wound caused by severe injury, burns, tumor resection; however, after the first successful functioning neurovascular muscle transfer on experimental animals in 1970, the work in this area has led to exciting concepts on the capability of functioning muscle transfer to restore facial expression, to improve extremity flexion or extension, to augment cardiac compression, or to replace paralyzed bladder detrusor.

Microsurgery in the pediatric age group was attempted for the first time in the mid 1970s, only a few years after it was applied in adult age group.[4–6] The first article was published at that time discussing the importance and applicability of microsurgery in children.[4,7,8] Free tissue transfer has become the preferred treatment option for reconstruction of extensive tissue defects in current algorithm of reconstructive surgery at many centers. This choice of reconstruction has similar indications in both adult and pediatric age groups. However, pediatric procedures are unique in many ways and have to be studied separately from the adult patient group. The preoperative assessment of the child requires a relaxed rapport between the child and the examiner. Frequently, the child cannot readily demonstrate activities that the examiner wishes to see. Certain tasks may require encouragement, particularly in hand surgery. Appropriate games and toys in the examining room are helpful, as well as the cooperation and understanding of the

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parents. The clinical examination may have to be repeated to gain adequate information regarding the abilities of the child.

Once a surgical course has been outlined, it is imperative that the parents and child understand the nature of surgery and the specific environmental changes that the child will undergo. The reconstructive pediatric surgeon must not only deal with acquired traumatic deformities, but also address difficult congenital anomalies. Many conditions that were formerly fraught with surgical failure and disappointment may now be better served through the use of microsurgery.

At the time of surgery, several technical factors must be taken into consideration. The most obvious is the vessel size. Blood vessels in children are surprisingly large when one compares total body weight with that of the adult. The operative time, blood loss, and size of surgical wound are much smaller than that of the adult. During the microsurgical transfer itself, as with adults, it is critical to maintain warmth, hydration, and a normocarbic state. The physiological response of children to prolonged anesthetic is much the same as that of an adult, although their metabolic requirements are slightly higher. Thus, ventilation must be more rapid and fluid requirements slightly increased. With children, the margin of error is smaller, and consequently careful monitoring is imperative. An arterial line is mandatory for constant blood pressure monitoring and for ease of blood sampling. This is supplemented with a blood pressure cuff and Doppler. A reliable large bore intravenous line is used for fluid replacement. A central venous line is helpful to assess intravascular volume and catheterization is useful for measuring hourly urine output. The temperature is measured either rectally or through the esophagus, and expired carbon dioxide monitored with an endotracheal carbon dioxide monitor.

It is imperative to sustain an adequate temperature, and so warming blankets are used on the upper surface of the child. A triple mattress is used beneath the child to prevent pressure sores. All fluids are warmed and the ventilation system includes a heated humidifier. Cooperation and discussion between the surgeon and anesthetist are imperative so that each clinician understands the other's problems and needs.

The postoperative monitoring of microvascular flaps in children is much the same as in adults. The transfer may require added protection as the child may not understand the need for cooperation. Extra care is required for dressings, such as those of the hand, which are extended above the elbow to prevent them from slipping. During the postoperative phase, it is mandatory to keep the parents and the child well informed as to the various maneuvers and manipulations that are necessary to monitor the flap. Understanding is a major step towards cooperation. Parents are encouraged to stay with the child and help with their child's care and positioning. The child himself is stimulated as much as his level of growth and development allows with suitable play equipment. Once the trust and cooperation of the child has been obtained, everything else seems to fall into place.[9] During followup, the surgical outcome is evident earlier than for the adult. The length of the limb, the size of the flap, the power of growth, the generation rate makes the final outcome in children better than that of adults. As it may be difficult for the child follow orders, the physiotherapist should be patient enough to deal with pediatric problems. Pediatric microsurgery cases are increasing due to the development of better equipment, finer surgical technique, and a better understanding of the unique characteristics of pediatric cases.

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