Department of Plastic and Reconstructive Surgery

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General Summary

Research in the Department of Plastic and Reconstructive Surgery is focused on 4 basic areas: 1) the causes and treatment of craniofacial anomalies, 2) the causes and treatment of hand and foot anomalies, 3) the mechanism of wound healing and the grafting of skin and bone, and 4) microsurgical transplantation. The faculty of our department consists of surgeons representing virtually all areas of plastic surgery and clinicians from related disciplines. This diversity provides the stimulating atmosphere necessary for productive research. The participation of plastic surgery residents and postresidency fellows in research studies provides them with important experience and expands their understanding of anatomical and physiological factors involved in these special areas of surgery.

Research Activities

Gene analysis and staged surgical procedures in patients with syndromic craniosynostosis

Apert syndrome, or acrocephalosyndactyly I, is an autosomal dominant disease caused by allelic mutations of fibroblast growth factor receptor 2 (FGFR2). Two regions (Ser 252 Trp and Pro 253 Arg) of the FGFR2 gene are believed to be responsible for syndromic craniosynostosis. Four monoclonal antibodies that respond only to peptides derived from mice with a mutation of Pro 253 Arg have been successfully prepared.

Treatment after total necrosis of free flap reconstruction for head and neck cancer

Of more than 300 patients who underwent free flap reconstruction after excision of head and neck cancers from January 2005 through December 2009, less than 5% of the patients had total flap necrosis. The flaps with total necrosis included 7 free jejunum flaps, 3 rectus abdominis musculocutaneous flaps, 2 anterolateral thigh flaps, and 2 fibular bone flaps. As soon as the necrosis of free jejunum flaps was recognized, salvage procedures were performed. Free flap reconstruction was performed in 6 patients, and the graft survived in 5 patients. Considering functional and cosmetic aspects, free flap retransplantation is desirable as a salvage strategy for total flap necrosis. When free flap reconstruction is difficult, a pedicled flap may be an option if some degree of function and cosmetic effects can be maintained.

Evaluation of flap vascularization with intraoperative and postoperative infrared thermal imaging

Success rates of free flap reconstruction of large defects due to excision of malignant

tumors are high (at least 95%). Wound dehiscence and other complications, however, are occasionally seen, especially in patients who have received radiation or chemotherapy or both. Infrared thermography (TVS-200EX, NEC Avio Infrared Technologies, Ltd., Tokyo) is a reliable, noninvasive technique for assessing the vascularization and viability of free flaps and surrounding tissue. It is a useful method for monitoring free flaps and provides valuable information for avoiding complications.

Ilizarov Minifixator

The Ilizarov minifixator is a useful device in various areas of hand surgery. Its clinical usefulness was demonstrated in the treatment of fractures (open fracture, comminuted fracture, fracture adjacent to the joint), joint contractures, malunion of fractures, and pathological fractures caused by enchondroma. It was also used with good results for bone distraction and temporary traction of joints. Use of the Ilizarov minifixator is an effective and noninvasive method and is highly recommended in selected cases.

Distraction osteogenesis

The use of distraction osteogenesis in reconstruction continues to expand and evolve. The effects of the various rates and frequencies of distraction have been studied, and a rate of 1 to 2 mm per day has been found to be adequate for the craniofacial skeleton. The division of daily distractions into smaller, more frequent distractions accelerates bone formation. We have developed a device with a built-in motor which can produce continuous distraction. Results of experiments using newly developed devices are being investigated.

Tissue engineering

Flaps lined with mucosa are in great demand for nasal, oral, tracheal, and urogenital reconstruction. Fascia lined by mucosal tissue has already been developed as a new reconstructive material. Sublingual mucosa was obtained from Japanese white rabbits, and separated mucosal cells were subcultured twice for 4 weeks. The cells were transplanted to the fascia of the femoral muscles in the same rabbits. Histological examination confirmed the growth of mucosal tissue. Fasciomucosal complex tissue developed. Fascia proved to be a useful scaffold that cross-links the transplanted mucosa and muscle.

Functional analysis of desert hedgehog in patients with macrodactyly

Mou reported in 2008 that the expression of the protein desert hedgehog in the hypertrophic parts of affected nerves was significantly greater in patients with macrodactyly than in patients with polydactyly. The purpose of the study was to detect expression of the messenger (m) RNA of desert hedgehog and immunohistochemical reactions for desert hedgehog and Patched2 in the fatty tissues of patients with macrodactyly. Immunohistochemical reactions for desert hedgehog were observed in the epidermis and adipocytes of patients with macrodactyly, whereas mRNA reactions were detected in the nervous systems of both patients with macrodactyly and patients with polydactyly. Whether the up-regulation of desert hedgehog is due to the disease itself or is a consequence of surgery is

unclear, and further investigation is planned.

Publications

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