Department of Orthopaedic Surgery

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General Summary

Basic research

The research carried out in our department, from basic studies on connective tissue cells to application of their results in clinical settings, has been highly appraised in the scientific world, both in Japan and other countries. Moreover, our research has been published in many English-language journals and has constantly received competitive scientific grants. The amount of academic funds awarded has markedly increased during this academic year, and 8 large scientific grants have been awarded to our researchers during the last 5 years.

Clinical research

The validity of our clinical projects, strongly backed by basic research and carried out in cooperation with many academic institutions, has been well established, to such a degree that comments related to our studies have been published in *Nature*-related journals. As a result, foreign scientists have further evaluated our findings, and, therefore, the validity of our research has become even more evident. Hence, a fundamental truth cultivated in our department has been proven correct: "an orthopaedic surgeon, a specialist dealing with bones, cartilages, ligaments, tendons, vessels and skin shall validate his/her everyday clinical concerns through a basic research". From now on and with the above truth in mind, the department's vision is to progress into the well-established direction and produce research findings that are original to our department, first in the world, and in accordance with international academic standards.

Research Activities

A new plate system for the treatment of proximal humeral fractures

We introduced a new plate system for proximal humeral fractures and reviewed the outcomes of 7 patients who underwent procedures using the new system. In all patients bone union was obtained without displacement or necrosis, although a varus deformity developed after surgery in one patient. The new system resolves problems related to the treatment of anatomical fractures and of 3-part fractures with a broken great tuberosity.

A novel pedicle screw for osteoporotic spine

We designed a new screw with side holes for polymethylmetacrylate augmentation for treatment of patients with osteoporosis and performed a pullout test to evaluate its

efficacy in lumbar vertebrae obtained from fresh cadavers with osteoporosis. The mean pullout force of the designed screw was 853.4 N (1.74 times higher than that of conventional screws). The results show that the newly designed screw is useful for polymethylmetacrylate augmentation in patients with osteoporosis.

Femoral detorsion osteotomy for osteoarthritis due to developmental dysplasia of the hip in adults

Although femoral detorsion osteotomy is indicated for the treatment of developmental dysplasia of the hip (DDH) in children, its usefulness for osteoarthritis due to DDH in adults is not known. We performed femoral detorsion osteotomy in combination with acetabular procedures, such as rotational osteotomy, Chiari osteotomy, and the shelf operation, in 8 patients with DDH. Good short-term results were obtained both clinically and radiographically in all patients. The morphological and biomechanical advantages of femoral detorsion osteotomy include decreasing the femoral neck-shaft angle, increasing the femoral head offset, medialization/descent of the femoral head location, and lateralization of the greater trochanter. All of these factors can increase centripetal force and the stability of the hip joint.

Patient-specific templating technique in total knee arthroplasty

In our department, we have performed various analyses using computer-assisted surgery in total knee arthroplasty and have been developing a total knee arthroplasty system that uses a patient-specific templating method based on advanced computer graphic technology. The accuracy of component positioning is being evaluated. A computer navigation system in total knee arthroplasty allows proper positioning of the femoral and tibial components, but the complex registration process, lengthening of the operation time, increased cost, the steep learning curve, and the exposure to radiation remain as disadvantages. We have developed an approach in which patient-tailored knee guides may eliminate some of these shortcomings and allow correct placement of components of the artificial knee joint.

Development of osteotomy plates for hallux valgus

Hypermobility of the first ray has recently been identified a predisposing factor in hallux valgus deformity. According to our previous studies, in hallux valgus deformity the first ray deviates dorsomedially during weight-bearing movements, and both longitudinal and transverse arches become flat. To correct this deformity, 3-dimensional osteotomy of the first metatarsal is necessary. Starting last year, we have been developing specialized osteotomy-locking plates. Their configuration and size variations, directions, number, and osteotomy angles were examined. With the development of the osteotomy-locking plates, any type of hallux valgus operation can be performed with the same method, and improvements in postoperative results can be expected.

Collagen cross-links in aging and as a cause of bone fragility in osteoporosis and diabetes mellitus

Collagen cross-linking, a major posttranslational modification of collagen, plays an

important role in maintaining the biological and biomechanical features of bone. Our recent studies emphasize the important aspects of bone collagen cross-linking with regard to aging and bone fragility in osteoporosis and diabetes. Recent basic and clinical studies of collagen cross-links have entered a new era. For example, on the basis of the results of our basic research *in vitro* and *in vivo,* measurements of levels of pentosidine in serum and urine are now being used to predict fracture risk in patients with osteoporosis and diabetes.

Clinical outcomes of giant cell bone tumors of the radius

We studied clinical outcomes of giant cell bone tumors of the distal radius. The examined cases were all grade 3 according to the Campanacci classification. After aggressive curettage and adjuvant therapy with 99% ethanol, iliac bone grafting with plates and external fixation was performed. Recurrence and osteoarthritis were observed in 1 case. An average score of Enneking's limb function test was 80%. This surgical method is simple, allows good local control, and, thus, is a useful initial treatment for giant bone tumors of the radial bone.

Generation of bone in vivo for revision surgery using beta-tricalcium phosphate and bone morphogenetic protein 2

The objective of this study is to develop a new technique to generate a large quantity of transplantable osseous tissue near the joints, and investigate whether this tissue may be used to repair segmental bone defects in a rabbit model. A bone-growth factor, recombinant human bone morphogenetic protein 2, and β-tricalcium phosphate were implanted to the bone tissue near the joint. New bone tissue developed and was then implanted in a bone defect, which healed with cortical bone within 12 weeks after implantation. Our results suggest that this technique is minimally invasive and may be useful for the surgical revision of joints.

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