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General Summary

Basic Research

Our studies of bone metabolism and osteogenesis have been highly acclaimed both in Japan and abroad. The research on bone metabolism has been focused on the relationship between osteoporosis and fracture risk: detailed studies have been performed to understand in which cases fractures occur and what pathological processes lead to weakness of the osteoporotic bone. Our studies of β -tricalcium phosphate (β -TCP) have played a pioneering role in the field of bone grafting. They led to the wide application of β -TCP in many clinical settings; e.g., due to its efficient bone formation profile, β -TCP has been used as a complementary filling material in repairs of bone defects. Furthermore, studies of the relationship between micropores and osteogenic factors, such as bone morphogenic proteins (BMPs), facilitated further understanding of the osteogenesis mechanism.

Clinical Research

Our clinical practice has been divided into 8 subspecialties to treat a wide range of musculoskeletal disorders and is managed by different specialist teams: knee joint, hip joint, spine, shoulder joint, hand surgery, foot surgery, trauma, osteoporosis, and rheumatic diseases. All teams maintain a high level of expertise and are actively involved in scientific activities. The spine team has demonstrated the effectiveness of minimally invasive spine stabilization with percutaneous pedicle screw fixation in the treatment of infectious spondylitis. The hip joint team has proven the importance of the obturator externus muscle in soft-tissue repair during posterior-approach total hip arthroplasty and obtained good outcomes by applying the surgical method they developed. The knee joint team has been performing total knee arthroplasties with patient-matched instrumentation and has analyzed the effectiveness of cutting-edge technologies even more advanced than the surgical navigation system itself. Through this wide range of clinical research activities, all teams fulfill their important roles at a clinical academic hospital, and their commitment has been highly evaluated.

Research Activities

Treatment methods for complete dislocation of the acromioclavicular joint

We reviewed results of the modified Cadenat procedure, surgery with a poly-L-lactic acid ligament augmentation device (PLLAD), and nonoperative treatment for grade III dislo-

cations of the acromioclavicular joint. There were 63, 10, and 30 patients in the respective groups, and they were followed up for an average of 27, 28, and 11 months, respectively. At final follow-up, the average JOA score was 93 points in patients who underwent the modified Cadenat procedure, 92 points in patients treated with the PLLAD device, and 94 points in patients who underwent nonoperative treatment. Two patients who underwent nonoperative treatment requested surgical treatment. There was no statistically significant difference in the incidence of osteolytic changes in the acromioclavicular joint; however, patients who underwent nonoperative treatment had a significantly lower percentage of subsequent calcification of the coracoclavicular ligament.

Improvement of diagnostic precision and establishment of a new therapy for giant cell tumor

We often have difficulty distinguishing giant cell tumor, which presents with a variety of magnetic resonance findings, from other tumors. Our study results suggest that combining ultrasonography and cystography with magnetic resonance may increase diagnostic precision. Giant cell tumor of bone has a high rate of recurrence after surgery and is often difficult to resect completely. For such reasons, novel therapies are needed. The receptor activator of nuclear factor kappa B (RANK) ligand-RANK pathway has been shown to be involved in giant cell tumor proliferation and survival. Therefore, we believe an antibody against RANK ligand might be used to treat giant cell tumor of bone.

Peak height velocity as a predictive factor for curve progression in patients with late-onset idiopathic scoliosis

The aim of this study was to investigate the relationship between the magnitude of the Cobb angle at peak height velocity and last treatment method in female patients with late-onset idiopathic scoliosis. Our findings indicate that a 32-degree curvature at peak height velocity is a significant predictive factor indicating curve progression to a magnitude requiring surgical treatment.

An investigation of radiographic changes and axial symptoms after cervical laminoplasty

We have examined axial symptoms and radiographic changes after cervical laminoplasty. The results suggest the possibility of maintaining sagittal alignment by preserving the C2 semispinalis cervicis muscle. We observed no difference in the severity of axial symptoms.

The efficacy of surgical treatment for infectious spondylitis with minimally invasive spine stabilization

The aim was to evaluate clinical outcomes of minimally invasive spine stabilization with the percutaneous pedicle screw system in the treatment of infectious spondylitis. The results showed that the minimally invasive spine stabilization procedure is extremely useful for treating infectious spondylitis.

Cementless femoral reconstruction in revision total hip arthroplasty: A comparison between modular and interlocking stems

Short-term clinical results of cementless femoral reconstructions in 120 revision total hip arthroplasties were evaluated, and outcomes of 2 stem systems were compared. Use of S-ROM stems (DePuy, Johnson & Johnson, Warsaw, IN, USA) was frequently complicated by fractures, but biological fixation was consistently achieved. Good long-term results could apparently be expected if meticulous treatment of the complicated fractures was not neglected. The interlocking stem, on the other hand, could be used safely with a low incidence of complications, even in femurs with severe bone defects. However, proper biological fixation was difficult to obtain because bone apposition around the proximal stem was usually not sufficient. We speculate that this problem can be solved with the interlocking stem to obtain long-term successful outcomes.

Patient-matched instrumentation method in total knee arthroplasty: a prospective study of the accuracy of different patient-specific bone cutting guides

Preoperative and intraoperative patient-specific templating has gained attention as the next technological development in knee surgery after computer-assisted surgery navigation systems. In our department, we have been evaluating the accuracy of implant positioning during total knee arthroplasty with patient-matched instruments and have been performing a comparative study against the computer-assisted navigation system. The evaluation also includes a comparative trial against conventional surgery, analysis of 3-dimensional reconstructions, and the development of more-accurate preoperative planning software. The comparative analysis of the accuracy of different patient-matched instruments is being performed in a prospective manner.

Treatment of navicular fractures of the foot

We reviewed the treatment of rare navicular fractures of the foot. A few fractures were isolated fractures, but most were accompanied by neighboring fractures or dislocations. With comminuted fractures of the navicular body, the medial column shortened owing to collapse of the articular surface or upper displacement of the fragments. In these fractures, adequate reduction and restoration of the original bone shape are generally difficult; therefore, bone collapse or arthrosis or both occasionally occur as complications after treatment. We believe that plate fixation or external fixation provides a satisfactory bone configuration with only mild postoperative pain.

Effects of microporous structure and local administration of recombinant human BMP-2 on bioresorption of β -TCP and new bone formation

Our study demonstrates that most collagen fibrils are located within micropores at an early stage following implantation of β -TCP. These findings suggest that micropores provide an environment for collagen formation, leading to deposition of apatite crystals, and indicate that micropores play important roles in β -TCP resorption and new bone formation.

Recombinant human (rh) BMP-2 induces bone formation but also stimulates bone resorption. The resorption rate of the β -TCP treated with rhBMP-2 was higher at every stage

of osteogenesis. The rate of new bone formation of β -TCP treated with rhBMP-2 was also significantly higher than without rhBMP-2 at 12 weeks. Thus, we have demonstrated that local rhBMP-2 administration accelerates both osteoclastic resorption of β -TCP and new bone formation.

A novel evaluation system to monitor bone formation and β -TCP resorption in opening high tibial osteotomy

The resorbability of β -TCP in osteotomy sites has not been well studied. The aim of this study was to establish an evaluation system to monitor bone formation and β -TCP resorption. Thirty-one patients were enrolled for evaluation. All patients underwent computed tomography (CT) at 2 weeks and at 6 years after surgery. The CT image data were divided into 4 areas, and the CT values for each area were analyzed with Osirix imaging software. The CT image analysis showed that β -TCP with 75% porosity was completely resorbed and replaced by bone. The β -TCP with 60% porosity was resorbed but approximately one-third remained even 6 years after surgery. The imaging software enabled scanning of the whole area to measure CT values. This system is useful for evaluating β -TCP resorption and bone formation in opening high tibial osteotomy.

Bone quality in chronic obstructive pulmonary disease

Both chronic obstructive pulmonary disease and diabetes are associated with increased risk of fracture. On the basis of the current definition, both bone density and quality, which encompass the structural and material properties of bone, are important factors in bone strength; diabetes reduces bone quality rather than density. Another factor playing an important role in bone strength is collagen cross-linking. Collagen cross-links can be divided into lysyl hydroxylase and lysyl oxidase-mediated enzymatic immature divalent cross-links, mature trivalent cross-links, and glycation- or oxidation-induced nonenzymatic cross-links (advanced glycation end products) such as pentosidine. On the basis of the results of our case-control study, we have provided the first evidence that both chronic obstructive pulmonary disease and diabetes impair formation of bone-collagen cross-links.

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