according to Denis et al. and the Classification of Fragility Fractures of the Pelvis (FFP) according to Rommens & Hofmann on the basis of CT and MRI images. All women underwent osteodensitometry using QCT in the lumbar spine. The vitamin-D levels were determined.

Results: Among all patients, there were 90 unilateral and 186 bilateral sacral fractures, 462 fracture zones in total, with a distribution of 42.4 % Denis 1, 4.2 % Denis 2, 43.3 % Denis 1 and 2, and 10.1 % Denis 1, 2 and 3. A FFP type II was found in 84.7 %, FFP type III in 4.8 % and FFP type IV in 10.5 % of the cases. The bone mineral density the lumbar spine was 12-74 (Ø 44.3) mg/ml in the unilateral fractures and 2 - 54 (Ø 30.3) mg/ml in the bilateral fractures. The vitamin-D value was 8 - 28 (Ø 13.1) nmol/l in the unilateral fractures and 0 - 18 (Ø 6.8) nmol/l in the bilateral fractures, the difference being significant ($p < 0.001$).

Conclusions: Fracture risk factors for the occurrence of sacral insufficiency fractures are the female sex, advanced age, the presence of osteoporosis, and a severe vitamin-D deficiency. The extent of the vitamin-D deficiency correlates with the severity of the fracture morphology in the sacrum. A sacral insufficiency fracture is a strong indicator for the presence of manifest osteoporosis.

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P031

Possible association of cortical thickness with spontaneous non-traumatic fracture patterns of the humeral shaft

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Purpose: This study aimed to clarify association of spontaneous non-traumatic humeral shaft fractures with cortical thickness of the humeral shaft at the fracture site.

Methods: This study included nine spontaneous non-traumatic humeral shaft fractures. While the fracture line was traced on the anteroposterior postoperative radiograph after reduction with surgical stabilization with reference to the preoperative radiograph, the positions of the fracture line running into the lateral and medial cortices of the humeral shaft were identified. The percentage of the fracture level on the lateral cortex in the entire length of the humerus was calculated. Cortical thickness index (CTI), which was defined as the ratio of the humeral diaphyseal diameter minus the intramedullary canal diameter to the humeral diaphyseal diameter, was analyzed on the same postoperative radiograph.

Results: Based on the fracture line extensions from the lateral cortex of the humeral shaft, five fractures with a spiral fracture line running from the lateral cortex downward to the distal medial cortex were classified as type A. Four fractures demonstrating a spiral fracture line that extended from the lateral cortex upward to the proximal medial cortex as well as downward to the distal medial cortex were classified as type B. The fracture locations on the lateral cortex of the humeral shaft were more proximal in type A (44.9 ± 5.8%) than those in type B (34.1 ± 4.1%) (P=0.016). CTI at the fracture site on the lateral humeral cortex was lower in type A (0.436 ± 0.041) than that in type B (0.534 ± 0.038) (P=0.008). There was no difference in CTI at the fracture level on the distal medial cortex between types A (0.511 ± 0.024) and B (0.552 ± 0.042) (P=0.107).

Conclusion: The cortical thickness of distal humerus at the fracture site could determine the types of spontaneous non-traumatic humeral shaft fractures.

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P032

Effects of streptozotocin-induced diabetes on strength of the humerus in rats of different ages

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Background: Physical chemical state of the bones in type 1 diabetes and LADA in animals of different ages are not well described.

Purpose: Purpose of the study is to investigate changes of humerus strength in streptozotocin-induced diabetic rats of different ages.

Methods: 210 male rats were selected for the experiment and three age groups were formed as follows: infantile animals (aged 1 month, body weight – 45-50 g), juvenile (aged 3 months, body weight – 135-150 g), and of pre-senile age (aged 17-18 months, body weight – 290-310 g). Streptozotocin-induced diabetes was caused by a single intraperitoneal injection of streptozotocin in dosage 55 mg/kg (35 animals in each age group). The controls for each group were the intact animals (35 animals in each age group). Strength testing was performed by means of three-point bending loading technique at a loading speed of 10 μm per minute. Strength features were calculated from resulting displacement curves.

Results: Strength of the humerus in streptozotocin-induced diabetic rats exhibited marked decrease mostly due to decrease of the values of ultimate stress, elasticity modulus, and fracture energy. This decrease grew with time in all age groups. In infantile diabetic rats the above mentioned values by the 90th day of the experiment were lower than those of the controls by 9.73%, 6.67%, and 9.28%. In juvenile diabetic rats these values decreased by 11.97%, 4.53%, and 10.59% and finally in pre-senile diabetic rats they decreased by 13.05%, 7.19% and 7.90%.

Conclusion: Strength of the humerus in streptozotocin-induced diabetic rats decreases due to decrease of ultimate stress, elasticity modulus, and fracture energy. In infantile rats strength decrease was observed in the period from the 7th to the 90th day of observation yet beginning from the 60th day restoration signs appeared. In older animals, especially in ones strength decrease only grew with time.

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P034

Bone quality in ovariectomized monkeys treated with two doses of teriparatide for either 18 months, or 12 months followed by withdrawal for 6 months

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Previous studies of ovariectomized monkeys, treated with recombinant human parathyroid hormone (PTH)(1-34) at 1 (clinically relevant) or 5 mg/kg/day for 18 months or for 12 months followed by 6 months withdrawal from treatment, displayed significant changes in the geometry, histomorphometry, and bone quality (albeit without strict tissue age criteria) of cortical bone of the midshaft humerus. Since bone quality significantly depends on tissue age amongst other factors, the aim of the present study was to establish the bone-turnover independent effects of two doses of PTH,

as well as the effects of treatment withdrawal on bone quality, by measuring bone material composition at precisely known tissue ages ranging from osteoid, to mineralized tissue older than 373 days. We also investigated the relationship between osteoid composition and the mineral content of the youngest formed mineralized tissue.

The variables considered in the present study were: i) the mineral / matrix ratio (correlates with bone bending stiffness); ii) the mineral content at the youngest tissue age; iii) tissue water content (correlates with bone toughness and strength); iv) glycosaminoglycan content (negative modulator of bone mineralization); v) mineral maturity/ crystallinity (inversely correlates with bone strength); vi) pyridinoline content (determinant of bone strength even in cases where bone mineral content does not correlate with fracture occurrence).

Raman microspectroscopic analysis of bone tissue from the mid-shaft humerus of ovariectomized monkeys demonstrated that effects of PTH administration for 18 months on bone quality are dependent on dose, while the clinically relevant one reverses the effects of ovariectomy. Additionally, both doses investigated in the present study restore the mineralization regulation mechanisms to SHAM levels. The experiments involving 12-month PTH treatment followed by 6 months of withdrawal showed that the beneficial effects induced by 12 months of clinically relevant PTH therapy were sustained after six months of therapy withdrawal.

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P035

Effects of hypobaric swimming training on trabecular bone volume and structure in old type 2 diabetic rats

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Background/introduction: We have studied the effects of hypobaric hypoxic training on athletes and people with lifestyle-related diseases. This training has beneficial effects on the cardiovascular system: it improves endurance and cardiac output, decreases blood pressure and peripheral vascular resistance, and promotes the expression of vasodilators and vascular endothelial growth factor.

Purpose: We examined the effects of hypobaric swimming exercise training on trabecular bone volume and architecture in old type 2 diabetic rats.

Methods: We used 23- to 24-month-old male type 2 diabetic GK rats (GK, n = 15) and normal rats (NC, n = 5). The GK rats performed swimming exercise (SE) for 30 min/d, 5 d/week, over a four-week period in a hypobaric chamber simulating 2,500 m above sea level (Hypo) or sea level (normal atmosphere; NA). The rats' tibiae and soleus (SOL) muscles were harvested at the age of 24 months and their wet weights were ascertained. Using a high-resolution micro-CT scanner, we measured the following aspects of their tibial bone microarchitecture: trabecular bone volume fraction (BV/TV, %), trabecular number (Tb.N, 1/mm), trabecular thickness (Tb.Th, mm), trabecular spacing (Tb.Sp, mm), and connection density (Conn.D, 1/mm^3).

Results: The BV/TB, Tb.N, and Conn.D measurements were significantly larger ($P < 0.05$) in the GK+SE+Hypo group than in the GK+SE+NA group, which in turn had larger measurements than the NC group. There were no significant differences in Tb.Th, Tb.Sp, or SOL wet weight between groups.

Conclusions: Hypobaric SE training improved trabecular bone volume by 37% relative to SE training at normal atmosphere in aged diabetic rats. This effect was particularly evident in aspects of the bone architecture such as trabecular connectivity.

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P037

Osteocyte lacunae in transiliac bone biopsy samples across life span

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Osteocytes play a central role in bone metabolism acting as mechanosensors, regulators of osteoblast/osteoclast activity and mineral homeostasis. We used quantitative backscattered electron imaging (qBEI) to investigate osteocyte lacunae sections (OLS) as a function of age as a 2D-surrogate parameter characterizing the osteocytes.

Transiliac biopsy samples from healthy individuals under 30 and over 30 years (u30: n=59, o30: n=50) were imaged by qBEI (field emission SEM SUPRA 40, Zeiss) with 0.9 μm spatial resolution. OLS (size between 5 and 200 μm²) were obtained from binary images (threshold at 5.2 wt% calcium). We measured OLS-density, OLS-porosity, OLS-area, OLS-perimeter, OLS-aspect ratio of the long and short axes of the lacunae, and the nearest neighbour OLS-distance (OLS-NND). The research was approved by the Institutional Ethics Committee.

Cortical OLS-density and OLS-porosity significantly decreased with age in u30 and increased slightly in o30 while, the opposite was true for OLS-NND. OLS-area, OLS-perimeter and OLS-aspect ratio did not change with age. Trabecular OLS-density was negatively correlated with age in u30 and remained stable in o30, the opposite being true for OLS-NND. OLS-area, OLS-perimeter and OLS-aspect ratio increased significantly with age in u30. In o30, there were no correlations with age for OLS size, while OLS-aspect ratio increased with age. In both u30 and o30, the cortex had a significantly higher OLS-density (+22%, $p<0.0001$; +10%, $p<0.05$ respectively), lower OLS-NND (-9.5%, $p<0.0001$,-9.2%, $p<0.001$ respectively) and a lower OLS-aspect ratio (-2.3%, $p<0.05$,-11%, $p<0.0001$ respectively) than spongiosa. In u30, cortex and spongiosa had similar OLS area while in o30, cortical OLS-area and OLS-perimeter were smaller than in trabeculae (-9.6%, $p<0.0001$ and -6.6%, $p<0.0001$ respectively).

In conclusion, qBEI revealed different cortical and trabecular osteocyte lacunae characteristics in healthy individuals before and after the age of peak bone mass. These data may be further used as references for bone disease assessment.

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P040

Spatial correlations between the local architecture of the lacunocanalicular network and the surrounding mineralized matrix in mouse tibiae

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