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# 29. Osteoporose Forum – Young Investigators

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Österreichische Gesellschaft für Knochen und Mineralstoffwechsel
Austrian Society for Bone and Mineral Research

### 1
### Nutritional habits of patients with rare bone diseases & osteoporosis

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**Background:** Osteogenesis imperfecta, Hypophosphatasia, X-linked Hypophosphatemia and Ehlers Danlos syndrome are rare genetic bone diseases. As there is currently no cure, patients are advised to have a health-conscious lifestyle.
**Patients/Methods:** This project aims to collect data on complementary and alternative medicine, nutritional habits and quality of life in rare bone disease patients (RARE), comparing them to an osteoporosis group (OPO) and healthy controls (CTRL). In our first analysis we used a standardized nutritional questionnaire, targeting bone influencing foods and nutrients.
**Results:** A total of 114 people were included in the study (RARE $n=40$, 49.3 years; OPO $n=46$, 66.9 years; CTRL $n=28$, 48.6 years). The body mass index (BMI) averages at 25.1 in RARE, 24.4 in OPO and 27.1 in CTRL. In the RARE group 23.7 % stated, that they completely refrain from dairy products, compared to 8.7 % OPO and 10.7 % CTRL. More than two daily portions of vegetables were stated only by 13.6 % of RARE, 15.6 % of OPO and 14.3 % of CTRL patients, but fruit consume once to twice per day by 59.5 %, 73.3 % and 71.4 %, respectively. Meat consume more than 3 portions per week was stated in 35.7 % of CTRLs versus only 13.1 % in RARE and 13.0 % in OPO. Recommended fish consumption was declared by more than 50 % of subjects. Light beverage consumption was generally low (5.3 %, 6.7 % and 3.6 %).
**Conclusion:** The current trend suggests, that most patients with rare bone diseases or osteoporosis have not implemented the recommended bone protective nutrition.
**Keywords:** rare bone diseases, osteoporosis, nutrition, osteogenesis imperfecta, x-linked hypophosphatemia

Bei den mit * gekennzeichneten Autoren handelt es sich um die präsentierenden Autoren.

### 2
### Analysis of bone architecture using fractal-based TX-Analyzer™ in adult patients with osteogenesis imperfecta

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**Background:** Osteogenesis imperfecta is a rare genetic disorder characterized by impaired bone quality and quantity. TX-Analyzer™ is a new fractal-based technique assessing bone microstructure based on conventional radiographs. We explored whether TX-Analyzer™ can discriminate osteogenesis imperfecta patients from controls and investigated the correlation between TX-Analyzer™ and crucial imaging techniques.
**Patients/Methods:** 29 osteogenesis imperfecta patients and 58 age- and gender-matched controls were analyzed. The parameters bone structure value, bone variance value and bone entropy value were measured at the vertebral bodies of T7 to L4. Furthermore, bone mineral density by dual energy x-ray absorptiometry, trabecular bone score and trabecular bone microstructure by high-resolution peripheral quantitative computed tomography were correlated to them. The accuracy of TX-Analyzer™ in detecting osteogenesis imperfecta was assessed with area under curve analysis of receiver operating characteristic.
**Results:** Bone entropy value of thoracic and lumbar spine were significantly lower in osteogenesis imperfecta patients compared to controls (both $p<0.001$). Bone entropy value of the thoracic spine correlated significantly to trabecular bone score ($\rho=0.427$, $p=0.042$) as well as trabecular number ($\rho=0.603$, $p=0.029$) and inhomogeneity of the trabecular network ($\rho=-0.610$, $p=0.027$) at the radius. No correlations were found between bone entropy value and bone mineral density. Bone entropy value of thoracic and lumbar spine had an area under the curve of 0.81 ($p<0.001$) and 0.73 ($p=0.008$), respectively.
**Conclusion:** The TX-Analyzer™ can discriminate patients with osteogenesis imperfecta from controls. Low to no correlations with conventional meth-

ods suggest, that the TX-Analyzer™ may indicate a new and independent examination tool in osteogenesis imperfecta.
**Keywords:** Osteogenesis imperfecta, TX-Analyzer™, Fractal-based analysis Bone microstructure, Conventional radiography

### 3
### High risk for skeletal related events in osteolytic bone metastasis treated with denosumab

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**Background:** Clinical consequences of bone metastatic breast cancer are associated with skeletal related events like instability, pathologic fractures, chronic pain and decreased rates of survival. With the advent of the human monoclonal antibody denosumab, a significant decrease in skeletal related events has been registered. However, whether this result can be reached in all types of bone metastasis, is still under debate. The primary goal of our study was the evaluation of bone metastasis response to denosumab according to lesion type (osteoblastic, osteolytic, mixed).
**Patients/Methods:** This retrospective study was based on data retrieved from all patients suffering from breast cancer who attended the Department of gynecology and oncology, Medical University of Vienna, between 1994 and 2018. A total of 60 patients with advanced breast cancer, bone metastasis and current denosumab therapy, was included. CT diagnosed bone metastasis were classified as osteolytic, osteoblastic or mixed. Metastases response to denosumab, as well as bone instability and pathologic fractures were evaluated. A p value ≤ 0,05 was classified as statistically significant.
**Results:** Out of the 60-bone metastasis, 20 (33.3 %) were classified as osteoblastic, 25 (41.6 %) as osteolytic and 15 (25 %) as mixed. Participants showed similar age at cancer first diagnosis (46.42 vs 59.41 vs 56.5 $p = 0.55$), BMI (25.45 vs 27.56 vs 23.43 $p = 0.13$), menopausal status ($p = 0{,}68$) and median overall survival after bone diagnosis (31 vs 60 vs 112 $p = 0.29$).
However, in patients with osteolytic metastasis, significant higher skeletal related events like bone instability ($p = 0.01$) and bone pathologic fractures ($p = 0.03$) were reported.
Interestingly, the extension of bone disease at first exam did not correlate with median overall survival ($p = 0.48$). A strong negative correlation between breast tumor MIB-1 proliferative activity and overall survival.
**Conclusions:** Patients affected by osteolytic metastasis treated with denosumab developed more skeletal related events as compared to osteoblastic and mixed metastasis, thus, with no significative impact on overall survival. Hence, further research in order to develop targeted therapies for osteolytic metastasis is needed.
**Keywords:** Advanced breast cancer, Bone metastasis, Denosumab, Skeletal related events, Pathological fractures

### 4
### Retrospective observational study: anemia in hypoparathyroidism–a common companion

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**Background:** Hypoparathyroidism is a rare endocrine disorder characterized by hypocalcemia and inadequately low parathyroid hormone levels (PTH). Anemia is a common comorbidity in many chronic diseases. We investigated a possible link between hypoparathyroidism and anemia.
**Methods:** In a retrospective observational study, we identified 226 patients with hypoparathyroidism in 19 Styrian hospitals and analyzed their laboratory data from 2013 to 2021. We excluded 27 patients because of missing data. Anemia was defined as hemoglobin <12 mg/dl for women and <13 mg/dl for men.
**Results:** Overall, 56.3 % of all patients were anemic during the observed time period. The investigated cohort had a mean age of 62.419.5 years and consisted of 144 women (72.4 %) and 55 men (27.6 %). 51.4 % of all women and 69.1 % of all men presented with anemia since 2013. On average, 85 patients had their blood works done per year and we had access to 4 ± 2.5 years of laboratory data per patient. We identified 51 women <55 years ("premenopausal") of which 41.2 % had anemia. In anemic premenopausal women 29.3 % had a ferritin below 30 ng/ml and 44.8 % had a transferrin saturation below 20 %. The hemoglobin content of all anemic patients correlated significantly with the estimated glomerular filtration rate (eGFR) ($p < 0.001$). The mean eGFR of patients with and without anemia was 52.8 and 72.7 ml/min/1.7 m$^2$, respectively. The cause of anemia was not determinable in most patients because of missing data, but where available, iron deficiency and renal anemia appeared to be the most common cause.
**Conclusion:** In patients with hypoparathyroidism, anemia appears to be a very common comorbidity. This is a novel and highly relevant finding, as some complaints such as fatigue may be explained rather by anemia than by hypoparathyroidism and should prompt individual assessment and treatment. Further research is necessary to fully understand the underlying mechanisms.

### 5
### Hypoparathyreoidismus und Fertilität, Schwangerschaft und Stillzeit

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**Fragestellung:** Von der seltenen Erkrankung Hypoparathyreoidismus (HypoPT) sind Frauen überproportional häufig betroffen (70–80 %). Da bei prämenopausalen Patientinnen ein Kinderwunsch bestehen kann und Schwangerschaft und Stillzeit eine besondere Belastung für den Mineralhaushalt darstellen, ist der Einfluss eines *chronischen HypoPT* auf Schwangerschaft, Stillzeit und Fertilität höchst relevant.
**Material und Methode:** Aus der prospektiven „HypAus-Studie" wurden 23 Patientinnen identifiziert *(Einschlusskriterien: weiblich, Diagnose: chronischer HypoPT)*, wovon sich 21 bereit erklärten, an einer Befragung teilzunehmen. Mittels Fragebogen wurden Informationen zu Fertilität, Verlauf der Schwangerschaft/en und Geburt/en sowie dem Stillverhalten erhoben. Zusätzlich wurde im Rahmen einer Literaturrecherche die Thematik bearbeitet.
**Ergebnisse:** Elf Frauen waren kinderlos, neun bekamen ein oder mehrere Kinder *vor* Manifestation des HypoPT, es gab keine erfolgreichen spontanen Schwangerschaften. Eine einzige Frau hatte unter bestehendem HypoPT eine erfolgreiche Schwangerschaft durch in-vitro Fertilisation. 16 der 21 Frauen waren zum Diagnosezeitpunkt prämenopausal. Davon hatten neun keine Kinder, bei drei Frauen lag ein unerfüllter Kinderwunsch vor. Weiters äußerten einige prämenopausale Frauen aufgrund ihrer Vorerkrankung starke Bedenken bezüglich einer möglichen Schwangerschaft.
Eine starke Hypocalcämie der Mutter während der fetalen Skelettentwicklung kann die Nebenschilddrüsen stimulieren (reaktiver Hyperparathyreoidismus) und zu einem Phänotyp ähnlich einer schweren Rachitis mit Demineralisierung des fetalen Skeletts, Krümmung der Röhrenknochen, Osteitis fibrosa cysica, intrauterinen Frakturen, Abort und einem niedrigen Geburtsgewicht führen. Bei maternaler Hypercalcämie können die fetalen Nebenschilddrüsen unterdrückt werden (fetaler HypoPT) und dadurch Wachstumsstörungen, Tetanie und Abort oder schwere peripartale

Komplikationen auslösen. Bei der Mutter kann ein erhöhter Calciumspiegel Nierensteine, Pankreatitis und Präeklampsie begünstigen.
**Schlussfolgerung:** Die Stabilisierung des $Ca^{2+}$-Spiegels im unteren Normbereich während der Schwangerschaft kann sehr herausfordernd sein. Da der Substitutionsbedarf stark variieren kann, wird eine individuelle Dosisanpassung und Kontrolle in 2–3-wöchigen Abständen empfohlen. Neugeborene sollten auf Folgen einer Hyper- und Hypokalzämie untersucht werden. Bei gut eingestelltem HypoPT zeigen sich keine Auswirkungen auf den Schwangerschaftsverlauf und geringer Einfluss auf das Gesamtrisiko einer Schwangerschaft. Der Zusammenhang zwischen unerfülltem Kinderwunsch und Hypoparathyroidismus sollte weiter erforscht werden.

## 6
## Identifying adult hypophosphatasia in the rheumatology unit

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**Objectives:** The most frequent manifestation in adult Hypophosphatasia is musculoskeletal pain. The unspecific nature of its clinical presentation may prevent correct diagnosis.
**Methods:** Over a period of 10 years 9522 patients were screened in a rheumatological outpatient unit. Serum alkaline phosphatase levels ≤40 U/l were found in 524 patients. After screening for secondary causes, 73 patients were invited for clinical evaluation. Genetic testing was performed in 23 patients with suspected hypophosphatasia. Logistic regression models were used to estimate the association of each clinical factor with hypophosphatasia.
**Results:** Mutations in the *ALPL* gene were observed in 57 % of genetically screened patients. Arthralgia, fractures and pain were the leading symptoms in hypophosphatasia patients. Chondrocalcinosis (OR 29.12; 95 % CI 02.02–1593.52) and dental disease (OR 8.33; 95 % CI 0.93–143.40) were associated with hypophosphatasia independent of body mass index. Onset of symptoms in hypophosphatasia was at 35.1 (14.3) years, with a mean duration from symptoms to diagnosis of 14.4 (8.1) years. Bone mineral density and trabecular bone score as well as bone turnover markers were not indicative for hypophosphatasia.
**Conclusion:** Hypophosphatasia can mimic joint diseases. Thus, in patients with uncertain rheumatologic complaints and low alkaline phosphatase, hypophosphatasia should be considered as potential diagnosis.
**Key words:** hypophosphatasia, HPP, arthralgia, alkaline phosphatase, chondrocalcinosis

## 7
## Thirty years of hip fracture incidence in Austria; is the worst over?

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**Purpose:** In the Austrian population ≥50 years, nationwide hip fracture incidences over a period of 20 years (1989–2008) have shown an initial steep increase, followed by a levelling-off during the last few years of observation. The purpose of the present study was to follow up on hip fracture incidences for another 10 years (2009–2018), and to analyze trends over the entire period of 30 years.
**Methods:** ICD-10 code classes S72.0, S72.1, and S72.2 were applied. All data were retrieved from the Statistics Austria database and its hospital discharge register. Annual absolute numbers, crude and age-standardized incidences as well as incidence rate ratios (IRR) were stratified by sex and 5-year age intervals, and calculated by using a correction factor for multiple registrations.
**Results:** Total number of hip fracture cases increased from 13,984 (2009) to 14,640 (2015), and decreased thereafter to 14,457 (2018), despite a persistent increase in men. Age-standardized incidences peaked at 476/100,000 (2010), followed by a decrease to 408/100,000 (2018). The observed overall decrease was mainly driven by the female population. Incidence rate ratios (IRRs) yielded a statistically significant average annual decrease of age-standardized incidences in both women and men (ΔIRR 0.984; 0.981–0.987).
**Conclusion:** While absolute numbers of hip fracture in women showed a slight decrease during the last 10 years of observation, numbers in men continued to increase. Age-standardized incidences nevertheless decreased in both men and women, which may be interpreted as a trend in the right direction. However, due to the rapid ageing of the population it cannot be precluded that this trend will be compromised during the next few decades.
**Keywords:** Epidemiology, hip fracture, Austria, incidence trend

## 8
## Impact on quality of life by osteoporosis treatment after fragility fracture

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**Introduction:** Osteoporotic fractures cause complex disability, morbidity, functional limitations and higher risk for re-fractures. Beside secondary prevention of fractures, osteoporosis treatment also has been proposed to be effective in improving health-related quality of life. This paper aims to assess the impact of osteoporosis treatment on quality of life (QoL) after a fragility fracture.
**Methods:** Based on data of the International Costs and Utilities Related to Osteoporotic fractures Study (ICUROS), a multinational study assessing the consequences after fragility fractures. Recruitment was performed in 8 different trauma centers throughout Austria. Osteoporosis treatment and QoL using the European Quality of Life-5 Dimensions-3 Levels (EQ5D) were assessed in individuals having sustained a fragility fracture and 4, 12 and 18 months thereafter. For analysis, patients were divided into two groups whether osteoporosis treatment was initiated or not, and differences in QoL was assessed with the chi-squared test using the statistical software package IBM® SPSS® Statistics Version 23.
**Results:** A total of 922 patients were eligible for analysis. However, at the end of study, there was a loss of follow-up in 396 patients (43.0 %). At baseline (time of fracture), the two subgroups were comparable except of differences regarding usual activities. At all follow-up analyses, osteoporosis treatment did not result in a significant difference in all assessed dimensions of QoL.
**Conclusions:** Despite multiple studies demonstrating osteoporosis treatment to be effective in improving QoL, the Austrian data of ICUROS does not support a significant difference in QoL after a fragility fracture whether receiving osteoporosis treatment or not.

**Keywords:** Quality of life, osteoporosis, fracture, treatment

## 9

## The impact of lockdown during COVID-19 pandemic on hip fracture cases in Austria

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**Introduction:** Social lockdown has been repeatedly imposed worldwide due to the coronavirus disease 2019 (COVID-19). Resultant isolation with less physical activity and restricted health care access may have an impact on fracture incidences. The aim of this analysis was to assess the effect of a social lockdown on hip fracture cases in Austria.
**Methods:** Based on the data of the Austrian Workers' Compensation Board (AUVA), which is the social insurance for the majority in Austria, hip fracture cases in the time period March 16th to May 31st, 2020 (first lockdown period in Austria) were compared with those in the same period of previous years (2016–2019). Further analysis included stratification by gender, age and weekly intervals using repeated measures analysis of variance (ANOVA), while a p-value of less than 0.05 was considered statistically significant.
**Results:** In the time period March 16th to May 31st 2020 the fracture cases of 445 lied within the standard deviation (SD) of years before (438 ± 20.1). The mean cases of weekly separated intervals in 2016–2019 did not differ significantly from those in 2020. In patients aged 50 to 69 years, the fracture cases in 2020 was below the SD of those in years before (64 vs. 77 ± 10). Stratified by weekly intervals and age group, mean fracture cases of years before were comparable with those of 2020, except 2018, which had significant lower rates in patients aged 50–69 years ($p < 0.05$). Separated by gender, this difference was only seen in women.
**Conclusion:** Hip fracture cases did not significantly change during first social lockdown (March 16th to May 31st 2020) in Austria, except a decreased fracture rate in female patients aged 50–69 years.
**Keywords:** COVID-19, lockdown, epidemiology, hip fracture, Austria

## 10

## Incidence and mortality risk after pelvic fracture in Austria, 2010–2018

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**Objectives:** Pelvic fractures (PF) are related to osteoporosis and represent a serious individual and socioeconomic burden.
**Patients/Methods:** We examined age and sex standardized incidence rates of PF, rates of all-cause overall and one-year mortality among patients with PF, and comparison of mortality between PF patients and a matched fracture-free cohort. Patients ≥50 years old in Austria hospitalised with PF in 2010–2018 and their dates of death were recorded.
**Results:** A total of 59,085 patients aged ≥ 50 years sustained 59,150 pelvic fractures between 2010 and 2018. Out of these patients 17,569 (29.7 %) were men with an average age of 72.1 years (SD 12.0) and 41,516 (70.3 %) were women with an average age of 78.7 years (SD 10.6). Between 2010 and 2018 the standardized incidence rates of PF increased in both sexes. For men it increased by 31.4 %, from 128.3 to 168.6 per 100,000 and for women by 14.6 % from 223.1 to 255.6 per 100,000. The men-women annual incidence ratio decreased over time from 1.7 to 1.5. One-year post-PF mortality rate was higher in men than in women (13.2 % and 11.3 % respectively, $p < 0.001$). Pelvic fractured patients had elevated mortality hazard (HR 1.27, 95 % CI 1.25–1.29, $p < 0.001$) compared to controls. Adjustment for comorbidities decreased the mortality risk (HR = 0.87, 95 % CI = 0.85–0.88, $p < 0.001$).
**Conclusions:** There is a clear increase in incidence of PF in the aged population, with a higher increase in men over time. Men revealed higher excess mortality after PF than women.
**Key words:** pelvic fracture, epidemiology, osteoporosis, mortality, Austria

## 11

## Biomechanische Eigenschaften eines Fadenankersystems aus humaner allogener mineralisierter Knochenmatrix

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**Hintergrund:** Fadenanker aus humaner allogener mineralisierter kortikaler Knochenmatrix (biologische Fadenanker) gehören zu den neuesten Entwicklungen in der Orthopädie und Traumatologie. Ziel dieser Studie war die Beschreibung der biomechanischen Eigenschaften des biologischen Fadenankers und sie mit einem herkömmlichen metallischen Fadenanker (MFA) und einem bioresorbierbaren Fadenanker (BFA) zu vergleichen.
**Methodik:** Zunächst wurde die Knochenmikroarchitektur von insgesamt 12 frisch gefrorenen menschlichen Humeri von sechs Spendern mittels highresolution peripheral quantitative computed tomography (HR-pQCT) untersucht. Insgesamt wurden 18 biologische Fadenanker, 9 MFA und 9 BFA alternierend an drei Positionen innerhalb des Tuberculum majus implantiert (Position 1: anterior, Position 2: zentral, Position 3: posterior). Das maximale Versagen der Fadenankersysteme wurde in uniaxialer Richtung bei 135° gemessen.
**Resultate:** Die maximale Belastung war für biologische Fadenanker höher als für MFA und BFA, ohne statistische Signifikanz zu erreichen. Die Verteilung der Versagensarten (maximale Belastung bis zum Versagen, Fadenriss, Ankerbruch) war signifikant unterschiedlich zwischen den drei Fadenankersystemen ($p < 0{,}001$). Die maximale Belastung bis zum Versagen wurde bei biologischen Fadenankern in allen Fällen erreicht, bei MFA in 44,4 % und bei BFA in 55,6 %. Ein Fadenriss wurde in 55,6 % für MFA und in 22,2 % für BFA beobachtet. Ein Ankerbruch wurde ausschließlich bei BFA (22,2 %) beobachtet. Es wurde keine Korrelation zwischen Knochenmikroarchitektur und Versagensraten der drei Fadenankersysteme gefunden.
**Schlussfolgerungen:** Der biologische Fadenanker zeigte vergleichbare biomechanische Eigenschaften wie der MFA und der BFA. Darüber hinaus stellt der biologische Fadenanker aufgrund seiner Eigenschaften eine vielversprechende Alternative zu konventionellen Fadenankern dar, die das Einwachsen in den Knochen und die Heilung der Enthese verbessern könnte.
**Schlagwörter:** Rotatorenmanschettenruptur, Rekonstruktion, biologische Fadenanker, Knochenmikroarchitektur, Biomechanik

## 12

## Teriparatide after 38 months of treatment still effective and safe: a case report

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**Background:** Treatment with teriparatide (TPTD) is limited to 24 months according to current guidelines. So far, no data exists on safety and efficacy for extended treatment duration. The current case report shows the effect of a 38-month TPTD treatment in a now 73-year-old woman with post-menopausal osteoporosis, following radial fracture, symphysis fracture and two vertebral fractures, despite antiresorptive therapy. Due to less administrative barriers for head physician authorization on her TPTD prescription during the COVID-19 pandemic the patient received the treatment for more than 3 years.
**Methods:** Case report.
**Results:** The patient's laboratory findings showed immaculate results (see Table 1) with still high bone turnover and no additional fractures occurred. Bone mineral density changes are remarkable (see **Fig. 1**), the therapy was well-tolerated and the patient had clinically improved. The bone scan was normal. These findings suggest that TPTD is safe and effective even after an exceeded treatment duration of 38 months.
**Conclusio:** We report the effect of the first known case of long-term treatment with TPTD on bone mineral density, fractures and bone metabolism in a patient with postmenopausal osteoporosis. Due to safety issues, the limitation to 24 months of treatment is still out of the question but according to our results, respondence to therapy was still excellent despite exceeding treatment duration, as shown in laboratory results and bone densitometry. Even in a patient with multiple fractures, the 38-month-treatment with TPTD was able to prevent from further fractures, the patient improved clinically and did not want to stop her anabolic treatment. Unintentional prolonged therapy with TPTD for 14 months proved to still have anabolic effects and most importantly, is safe. Therefore, in some cases, patients may benefit from exceeded treatment or from being given a second cycle of TPTD throughout their osteoporosis therapy.

## 13
## Longitudinale Evaluation des Serum-Phosphatspiegels nach intravenöser Eisenapplikation

*Alexandra Struppe[1*], Jakob E. Schanda[2,3,4], Andreas Baierl[5], Heinrich Resch[1], Christian Muschitz[1]*

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**Hintergrund:** Bei Eisenmangelanämie besteht ein Zusammenhang zwischen intravenöser Eisensubstitutionstherapie und Hypophosphatämie. Es wird angenommen, dass das Ausmaß der Hypophosphatämie von dem verabreichten Präparat abhängt. Wir stellten die Hypothese auf, dass die intravenöse Verabreichung von Eisen(III)-Carboxymaltose und Eisen(-III)-Sucrose-Komplex zu einer unterschiedlichen Anpassung des Serumphosphatspiegels nach 2, 4 und 12 Wochen führt.
**Patienten/Methodik:** Zwanzig Patientinnen und Patienten wurden in zwei Studiengruppen randomisiert (Gruppe 1: Eisen(III)-Carboxymaltose, $n=10$; Gruppe 2: Eisen(III)-Sucrose-Komplex, $n=10$). Die Serumwerte aller Patientinnen und Patienten wurden vor intravenöser Eisensubstitutionstherapie sowie 2, 4 und 12 Wochen nach Medikamentengabe erhoben. Primäres Studienziel war die longitudinale Auswertung der Serumphosphatwerte nach Eisensubstitutionstherapie mit Eisen(III)-Carboxymaltose sowie Eisen(III)-Sucrose-Komplex. Sekundäres Studienziel war die Untersuchung von Kalzium, 25-Hydroxyvitamin D, intaktem Parathormon, Prokollagen Typ 1 aminoterminales Propeptid (P1NP), beta-CrossLaps (CTX), Hämoglobin (Hb), Eisen, Ferritin und der Transferrinsättigung.
**Ergebnisse:** Zwei Wochen nach Medikamentenverabreichung wurden zwischen beiden Studiengruppe signifikante Unterschiede des Phosphat ($p<0{,}001$) und des Ferritin ($p=0{,}011$) beobachtet. In Gruppe 1 war der mediane Serum Phosphatspiegel unterhalb des therapeutischen Referenzwertes. Vier Wochen nach Medikamentengabe wurden nach wie vor signifikante Unterschiede zwischen beiden Studiengruppen für Phosphat ($p=0{,}043$) und Ferritin ($p=0{,}032$) festgestellt. Zwölf Wochen nach Medikamentengabe wurden keine Unterschiede sämtlicher Serumwerte zwi-

**Table 1 | 12** Laboratory results and bone measurements at the time of 0, 2, 12 and 38 months

| | 0 | 2 | 12 | 38 | Δ% to baseline |
|---|---|---|---|---|---|
| iPTH (pg/mL) | 40 | 20 | 21 | 14 | –65 |
| Osteocalcin (ng/mL) | 17 | 94 | 114 | 80 | +471 |
| P1NP (ng/mL) | 37 | 231 | 253 | 156.3 | +422 |
| β-CTX (ng/mL) | 0.36 | 0.97 | 1.67 | 1.6 | +444 |
| TBS | 1185 | – | – | 1247 | +5 |
| 25(OH)D (ng/mL) | 46 | 36 | 41 | 37 | –20 |
| T-score hip left | –3.0 | – | –2.7 | –2.2 | +27 |
| T-score lumbar spine | –4.0 | – | –3.1 | –3.1 | +22.5 |
| T-score radius left | –2.7 | – | –4.2 | –4.9 | –181 |

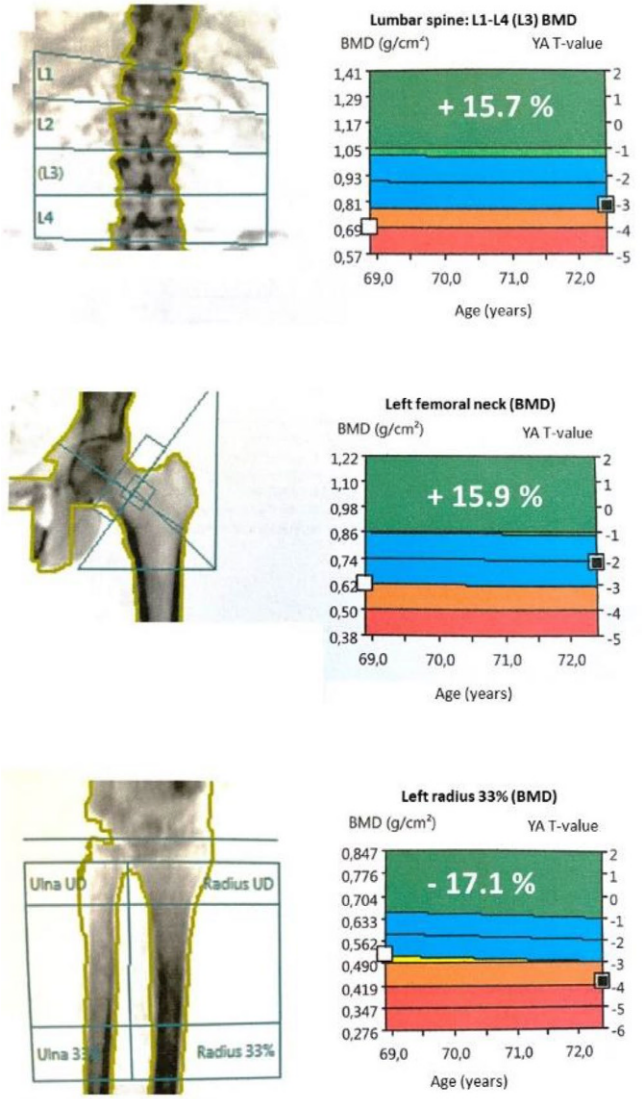


**Fig. 1 | 12** ▲ BMD changes over 38 months

schen beiden Studiengruppen festgestellt. Der Hb-Wert lag zwölf Wochen nach Eisensubstitutionstherapie in beiden Studiengruppen innerhalb des therapeutischen Bereichs.
**Schlussfolgerungen:** Die intravenöse Eisensubstitutionstherapie führte bereits zwei Wochen nach Medikamentengabe zu signifikanten Veränderungen der Serum-Phosphat- und Ferritinspiegel mit vorübergehender Hypophosphatämie. Auch vier Wochen nach der Behandlung waren diese Veränderungen des Serum Phosphat- und Ferritinspiegels noch zu beobachten. Zwölf Wochen nach Medikamentengabe wurden keine Unterschiede zwischen beiden Studiengruppen beobachtet.
**Schlagworte:** Hypophosphatämie, Eisensubstitution, Phosphat, Prokollagen Typ 1 aminoterminales Propeptid (P1NP), beta-CrossLaps (CTX)

## 14
## Adherence to anti-osteoporotic drugs during COVID-19-pandemic in Austria

*Theresa Stockinger[1*,2,3], Martina Behanova[1], Berthold Reichardt[4], Judith Haschka[1,2], Heinrich Resch[3,5], Jochen Zwerina[1,2], Roland Kocijan[1,2,3]*

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**Objectives:** The aim of the study was to assess the adherence of patients to oral and parenteral anti-osteoporotic agents during the Covid-19-pandemic 2020.
**Patients/Methods:** This study was a nationwide retrospective register-based observational study which included all patients in Austria aged ≥50 who received at least one prescription for anti-osteoporotic drugs between January 2018 and November 2020. Pseudonymized individual-level patients' data were obtained from social insurance authorities and the Federal Ministry of Labour, Social Affairs, Health and Consumer Protection in Austria.
Anti-osteoporotic agents were divided into: (i) oral bisphosphonates, (ii) intravenous bisphosphonates, (iii) selective estrogen receptor modulators (SERMs), (iv) teriparatide (TPTD) and (v) Denosumab (DMAB).
We compared the mean number of prescriptions per months from March to November 2020 to the two years prior the COVID-19-pandemic.
**Results:** There were 1,772,944 dispensing of anti-osteoporotic drugs by 319,155 patients between 2018–2020 (252,403 women (79.1 %, mean age 75.6, SD 10.8) and 66,752 men (20.9 %, mean age 73.4, SD 11.7)). The mean monthly prescriptions for oral bisphosphonates (–16.9 %), intravenous bisphosphonates (–7.1 %) and SERMs (–9.9 %) decreased during COVID-19-pandemic. The dispensing for teriparatide (–2.8 %) during COVID-19, was comparable to 2018 and 2019. The prescriptions for DMAB decreased during the first lock-down in March and April 2020 (24 %), however increased by 8.8 % for the total observation time.
**Conclusions:** Especially the prescription of oral anti-osteoporotic agents decreased during the COVID-19 pandemic. The observed decrease of DMAB during the first lockdown, was compensated in the following months. Further examinations will include the fracture incidence during COVID-19 in Austria.
**Key words:** COVID-19, anti-osteoporosis therapy, lockdown, osteoporosis, Austria

## 15
## Circulating miRNAs respond to treatment with Denosumab after two years in women with postmenopausal osteoporosis–the MiDeTe-study

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**Objectives:** Bone specific microRNAs (miRNAs) play a pivotal role in bone metabolism. The aim of the project was to investigate circulating miRNAs as biomarkers for treatment monitoring.
**Patients/Methods:** Postmenopausal women ($n = 21$) with the indication for denosumab (DMAB) treatment were included in the study. Bone specific circulating miRNAs in the serum were measured at baseline and months 3, 6, 12, 18 and 24. In the discovery phase, next-generation sequencing (NGS) was carried out to screen miRNA levels at three time points. 24 miRNA candidates with significant regulation ($p < 0.05$) were selected and measured by reverse transcription quantitative polymerase (RT-qPCR) chain reaction to confirm the findings in the entire cohort.:
**Results:** After 12 and/or 24 months of DMAB, 7 out of 24 miRNAs by RT-qPCR showed significant up- or downregulations compared to baseline. The top candidates were miR-454-3p ($p < 0.001$) and miR-26b-5p ($p < 0.01$). Bone mineral density (BMD) at the hip (+5.5 %, $p = 0.0006$) and lumbar spine significantly increased (+11.4 %, $p = 0.017$), C-terminal cross-linking telopeptide of type I collagen (CTX; –64.1 %, $p < 0.0001$) and procollagen type I N propeptide (P1NP; –69.3 %, $p < 0.0001$) significantly decreased after 24 months of treatment. The Delta changes of miR-454-3p and miR-26b-5p were positively correlated to BMD gain at the lumbar spine ($R = 0.39$; $p = 0.023$ and $R = 0.18$; $p = 0.3$ respectively) and hip ($R = 0.5$; $p = 0.002$ and $R = 0.31$; $p = 0.064$ respectively) and negatively to CTX ($R = –0.66$, $p < 0.0001$ and $R = –0.61$, $p < 0.0001$respectively) and P1NP levels ($R = –0.43$, $p = 0.00072$ and $R = –0.46$, $p = 0.00.018$ respectively).
**Conclusion:** DMAB-treatment leads to up-regulations of bone specific miRNAs. These changes are associated to BMD gain and could therefore be predictive for treatment response.
**Keywords:** postmenopausal osteoporosis, microRNAs, denosumab, bone metabolism, bone turnover

## 16
## Fractal-based analysis of bone microstructure in Crohn's Disease: a pilot study

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**Background:** Crohn's disease is associated with bone loss and increased fracture risk. The TX-Analyzer™ is a new fractal-based technique assessing bone microstructure based on conventional radiographs. We evaluated bone microstructure of the thoracic and lumbar spine by TX-Analyzer™ in

Crohn's disease patients and controls and correlated outcome parameters to standard imaging techniques.
**Patients/Methods:** 39 Crohn's disease patients and 39 age- and gender-matched controls were analyzed. The parameters bone structure value, bone variance value and bone entropy value were measured at the vertebral bodies of T7 to L4 out of lateral radiographs. Furthermore, bone mineral density and trabecular bone score by dual energy X-ray absorptiometry were correlated to them. Crohn's disease patients were further divided into subgroups according to history of glucocorticoid treatment >3 months, disease duration >15 years and history of bowel resection.
**Results:** Bone structure value and bone variance value of the thoracic spine of Crohn's disease patients were higher compared to controls ($p = 0.016$, $p = 0.012$). Bone entropy value was significantly lower in Crohn's disease patients with glucocorticoid treatment >3 months ($p = 0{,}015$) and disease duration >15 years ($p = 0.001$) at the thoracic spine and with history of bowel resection at the lumbar spine ($p = 0.011$), with no differences in bone mineral density between both subgroups. Additionally, trabecular bone score was reduced in patients with glucocorticoid treatment >3 months ($p = 0.014$).
**Conclusion:** Despite a not severely pronounced bone loss in this population, impaired bone quality in Crohn's disease patients with well-known risk factors for systemic bone loss was assessed by TX-Analyzer™.
**Keywords:** Crohn's disease, TX-Analyzer™, fractal-based analysis, bone microstructure, bone loss

**Hinweis des Verlags.** Der Verlag bleibt in Hinblick auf geografische Zuordnungen und Gebietsbezeichnungen in veröffentlichten Karten und Institutsadressen neutral.

# Young Investigators - Preisträger

Auch heuer konnten wieder unsere jungen Forscher auf dem Gebiet der Osteologie ihre wissenschaftliche Arbeit in Posterform und Kurzbeiträgen präsentieren. Sehr engagiert wurde präsentiert und auch nicht unkritischen Fragen Rede und Antwort gestanden.

Aus den Einsendungen wurden von einer Jury die drei besten Arbeiten prämiert.

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für das Abstract: *Biomechanische Eigenschaften eines Fadenankersystems aus humaner allogener mineralisierter Knochenmatrix*
Autor*innen: Jakob E. Schanda, Philipp R. Heuberer, Christian Muschitz, Christian Fialka, Johannes Grillari

DANIEL ARIAN KRAUS – 2. Preis
für das Abstract: *Analysis of bone architecture using fractal-based TX-Analyzer™ in adult patients with osteogenesis imperfecta*
Autor*innen: Daniel A. Kraus, Judith Haschka, Stephanie Huber, Jakob E. Schanda, Martina Behanova, Philip Meier, Arian Bahrami, Shahin Zandieh, Christian Muschitz, Heinrich Resch, Matthias Mähr, Katharina Rötzer, Göykan Uyanik, Jochen Zwerina, Roland Kocijan

ALEXANDRA STRUPPE – 3. Preis
für das Abstract: *Longitudinale Evaluation des Serum-Phosphatspiegels nach intravenöser Eisenapplikation*
Autor*Innen: Alexandra Struppe, Jakob E. Schanda, Dr. Andreas Baierl, Heinrich Resch, Christian Muschitz

***Wir gratulieren herzlichst!***

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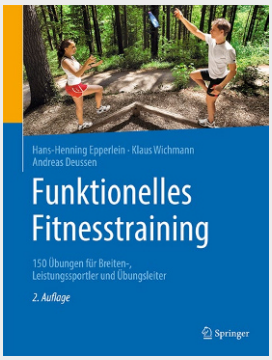
## Buchbesprechung

**Hans-Henning Epperlein, Klaus Wichmann, Andreas Deussen**

### Funktionelles Fitnesstraining

150 Übungen für Breiten-, Leistungssportler und Übungsleiter

**Springer 2021, 2. Auflage, 419 S., 930 Abb., 49,99 (Softcover 39,99) EUR**




Das ‚Projekt der aktiven Lebensführung', dem das außerordentliche Engagement der Autoren gilt, ist gerade heute durch die zunehmende Technisierung und Digitalisierung der Umwelt von besonderer Bedeutung. Die Autoren beginnen mit einer geschichtlichen Reflexion zum Thema Bewegung und Gymnastik bei ‚den alten Griechen', was zunächst befremdlich wirkt, doch durch die konsequente Fortsetzung und die differenzierte Darstellung der geschichtlichen Entwicklung des Begriffs ‚Gymnastik' bis in die heutige Zeit werden interessante Chancen aufgezeigt, wie das funktionelle Fitnesstraining heute in den Kontext des Wirkungsverständnisses eines selbstbestimmten Lebens eingebracht werden kann. Nachdem eine prägnante und fokussierte Darstellung der anatomischen und physiologischen Grundlagen für das Verständnis der Hintergründe des funktionellen Fitnesstrainings erfolgt ist, werden diagnostische Verfahren zur Erfassung der körperlichen Fitness (Kraft, Beweglichkeit, Ausdauer) erläutert. Hierbei wird der Hintergrund des jeweiligen Testansatzes durch ansprechende Bilder und entsprechende Dokumentationsbögen verständlich, plausibel und nachvollziehbar dargestellt. Sollten bei der Durchführung der Übungen Defizite erkannt werden, verweisen die Autoren direkt auf mögliche Übungen im nachfolgenden Text. Dadurch ist es möglich, zwischendurch auch einmal zielgerichtet ‚querzulesen', um dann aber wieder an der Stelle weiterzulesen, bei der man aufgehört hatte.

Den Hauptteil des Buches bilden die Darlegungen zu verschiedenen Übungen des funktionellen Fitnesstrainings. Im Unterschied zu sonstigen Ansätzen werden hierbei verschiedene Trainingsorte in den Fokus genommen, neben dem klassischen Hallentraining auch Übungen im Wald oder am Strand. Dieser Wechsel der Umgebungsperspektive gibt sehr viele motivierende Impulse für ein abwechslungsreiches Gestalten der Übungen, was für das Aufrechterhalten der Motivation der Teilnehmer*innen einen wichtigen Punkt darstellt. Die Darstellung der Übungen ist klar gegliedert und differenziert nach Schwierigkeitsgrad, Ort und beanspruchter Muskulatur. Der Fließtext des Buches wird durch alltagstaugliche ‚Praxistipps' aufgelockert, die nicht nur für Einsteiger*innen in den Bereich des funktionellen Fitnesstrainings hilfreich sind. Wie bereits erwähnt, begleiten und ergänzen die Bilder den Text hervorragend und vor allem ist in den Fotos auch der Spaß und die Freude der Personen an den Übungen festgehalten worden.

Durch die evidenzbasierte Vorgehensweise im Aufbau der Übungen und der Trainingsgestaltung leisten die Autoren mit ihrem Buch einen wichtigen Transfer von interdisziplinären sport-, bewegungs- und gesundheitswissenschaftlichen Ansätzen in den Breiten- und Leistungssport. Die Betrachtung und der Vermittlungsansatz sind in sich konsistent und zeichnen sich durch einen hohen Praxisbezug und die durch viele Bilder sehr anschauliche Darstellungsweise aus. Das Besondere an dem vorliegenden Buch ist die stete Verknüpfung und Bezugnahme von Inhalten der verschiedenen Kapitel. Die Gliederung und die Verweise auf vorherige oder folgende Buchkapitel sind so eingebunden, dass man beim Lesen nicht den Faden verliert, sondern immer gezielt bei verschiedenen Fragestellungen (z.B. Verlust der Kraft in der Bauchmuskulatur) durch das Buch geleitet wird. So ist es ohne viele Umstände möglich, hier innerhalb von kurzer Zeit ein entsprechendes Trainingsprogramm aufzustellen. Das Buch wird erfolgreich dazu beitragen, das ‚Projekt der aktiven Lebensweise' mit Spaß und Freude an der Bewegung umzusetzen.

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