MEASUREMENTS OF BMD AND FEMORAL GEOMETRIC DIMENSION BY DXA IN ADULT PATIENTS WITH OSTEOGENESIS IMPERFECTA

R. Kocijan[1], C. Muschitz[1], J. Patsch[2], EM Fischer[1], A. Trubrich[1], C. Bittighofer[1], H. Resch[1]

[1] The VINFORCE Study Group - St. Vincent Hospital – Medical Department II, Academic Teaching Hospital of Medical University of Vienna, Stumpergasse 13, 1060 Vienna, Austria
[2] Department of Diagnostic Radiology, Medical University of Vienna, Währinger Gürtel 18-20, 1090 Vienna, Austria

KRANKENHAUS BARMHERZIGE SCHWESTERN Wien
EIN UNTERNEHMEN DER VINZENZ GRUPPE WIEN

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Objectives:

Osteogenesis Imperfecta (OI) is characterized by increased bone fragility with recurrent fractures that leads to skeletal deformities in severe cases (see figure 1). Animal and human studies suggest that skeletal fragility in OI is due to the defect in collagen synthesis [1-3], whereas the abnormalities in bone turnover and mineral are inconsistent. In almost all of the cases the hip is the only reliable measuring site and therefore relevant for estimating the future risk of peripheral fractures. Since reliance on BMD alone does not provide the best predictive ability for bone strength and peripheral fracture risk in those patients we evaluated additional measurements of femoral geometric dimension (Hip Structure Analysis - HSA, see figure 2) in patients with osteogenesis imperfecta and healthy controls.

Methods:

We performed DXA measurements (Lunar iDXA, software version 11.2, GE Healthcare) in 27 patients (20 female, 7 male) with OI (mean age 47.2 +/- 15.8 yrs) and a multiple fracture history and consequently abnormality of the stature and analyzed the different features of DXA like BMD at different measuring sites and also geometric measurements (patients characteristic see table 1). Hip structure analysis (HSA), including cross-sectional moment of inertia (CSMI), cross-sectional area (CSA) and femoral strength index (FSI) is known to correlate to bone mass distribution and fracture [4,5]. The same tools were applied to an age and gender matched control group (CO).

BMD accounts for only about half of the variation in strength estimated by CSMI, indicating that CSMI, CSA and FSI contribute additional information regarding femoral strength not contained in BMD.

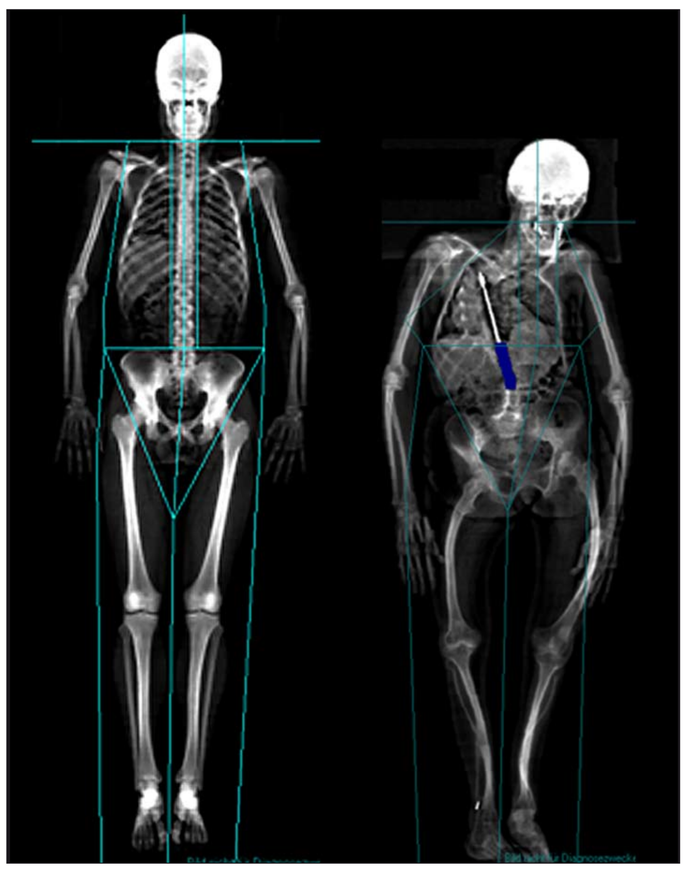

Figure 1: Densitometry, left: CO, right: OI.

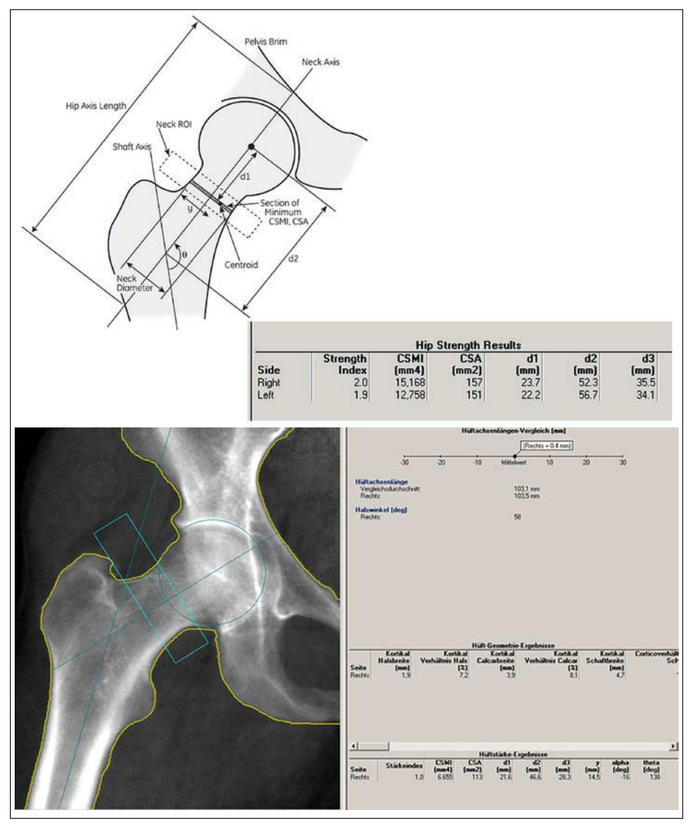

Figure 2: Hip measurement, right femur.

Groups	OI I	OI III/IV	OI total	CO
Number of patients	17	10	27	30
Age (years)	49.1 ± 15.2	44.0 ± 17.1	47.2 ± 15.8	42.0 ± 7.6
Height (cm)	154.1 ± 9.8	141.9 ± 18.7	149.6 ± 14.7	169.9 ± 8.8
Weight (kg)	60.9 ± 13.9	54.1 ± 19.2	58.4 ± 16.0	74.2 ± 17.7
Body mass index	25.6 ± 4.9	26.2 ± 3.7	25.8 ± 4.4	25.5 ± 5.1
Number of fractures	5 – 10	5 - > 40	5 - > 40	0

Table 1: Patients characteristic

Groups	OI I	OI III/IV	OI total	CO
No. patients	17	10	27	30
FSI	1.29 ± 0.39	1.10 ± 0.44 *	1.22 ± 0.42 *	1.48 ± 0.39
CSA	114.7 ± 28.6 **	87.6 ± 31.3 **, ***	104.7 ± 31.9 **	162 ± 27.3
CSMI	7.85 ± 2.80 **	7.48 ± 4.54 *	7.73 ± 4.54 **	12.36 ± 4.18
BMD neck	0.819 ± 0.23 **	0.563 ± 0.12 **, ***	0.721 ± 0.23 **	1.023 ± 0.13
BMD trochanter	0.661 ± 0.17 **	0.530 ± 0.18 **	0.618 ± 0.18 **	0.848 ± 0.14
BMD total	0.849 ± 0.19 **	0.632 ± 0.18 **, ***	0.769 ± 0.22 **	1.05 ± 0.14

* significant differences to CO group, p<0.05, ** significant differences to CO group, p<0.001,
*** significant differences to OI I, p<0,05

Table 2: Results

Results:

The mean BMD neck, BMD trochanter and BMD total of OI I and OI III/IV group were significantly lower than in the CO group (p<0,001). The CSA (p<0,001) and the CSMI (p<0,001) value were significantly lower for OI total in comparison to CO. Similar results were found for the subtypes OI I and OI III/IV in comparison to control. In addition CSA, BMD neck, BMD trochanter and BMD total were significantly decreased in OI III/IV in comparison to OI I. FSI was significantly decreased in the OI total (p<0,05) and the severe forms OI III/IV (p<0,05) in comparison to the CO (see table 2). In addition high-significant correlations between BMD and HSA were found.

Conclusion:

Apart from significant differences in BMD between OI and CO, we found also significant differences in geometrical parameters of the hip between those two groups. Since the application of BMD measurements is very critical in patients with OI due to the complex deformations of the spine and hip regions we conclude that geometric structural measurements made at the femoral neck by DXA are a additional helpful tool and of important clinical relevance.

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ACADEMIC TEACHING HOSPITAL MEDICAL UNIVERSITY VIENNA

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