APPLICATION OF GEOMETRIC MEASUREMENTS AT THE HIP REGION (HSA) BY DEXA IN PATIENTS WITH OSTEOGENESIS IMPERFECTA (OI)

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Objectives:

Osteogenesis Imperfecta (OI) is an inherited disorder characterized by increased bone fragility with recurrent fractures that leads to skeletal deformities in severe cases. OI is also characterized by a low bone mass, a reduced trabecular thickness and number and a decreased bone formation in adults. 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. Since reliance on BMD alone does not provide the best predictive ability for peripheral fracture risk in patients with OI the aim of our study was to compare DXA BMD measurements and femoral geometric dimension measurements (Hip Structure Analysis) between Osteogenesis imperfecta, Osteoporosis and a Control-group.

Materials & Methods:

We performed DXA measurements (Lunar iDXA, software version 11.2, GE Healthcare) in 12 patients (9 female, 3 male) with OI (mean age 39,2 +/- 11,7 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. 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]. The same tools were applied to a age matched control group (CO) of 25 healthy females and a age matched female patient group with severe osteoporosis and multiple fractures (OPO).

- CSMI: cross sectional moment of inertia of the section of minimum CSMI within the neck region of interest (ROI) describes femur geometry and density and its resistance to bending from a biomechanical point of view.
- CSA: cross sectional area of the minimum CSMI within the neck region of interest (ROI)
- FSI: is the ratio of estimated compressive yield strength of the femoral neck to the expected compressive stress of a fall on the greater trochanter (figure 1). [5]

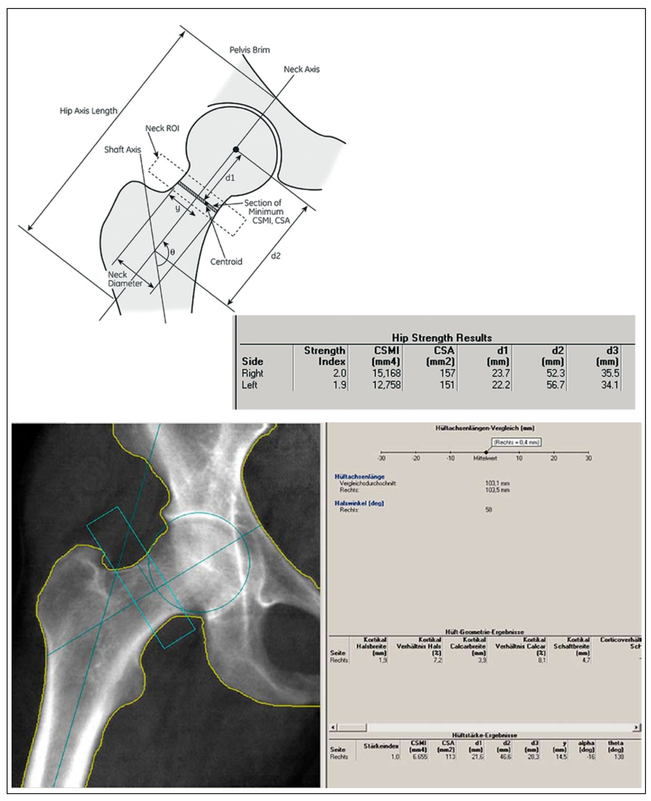

Fig. 1: Hip measurement, right femur

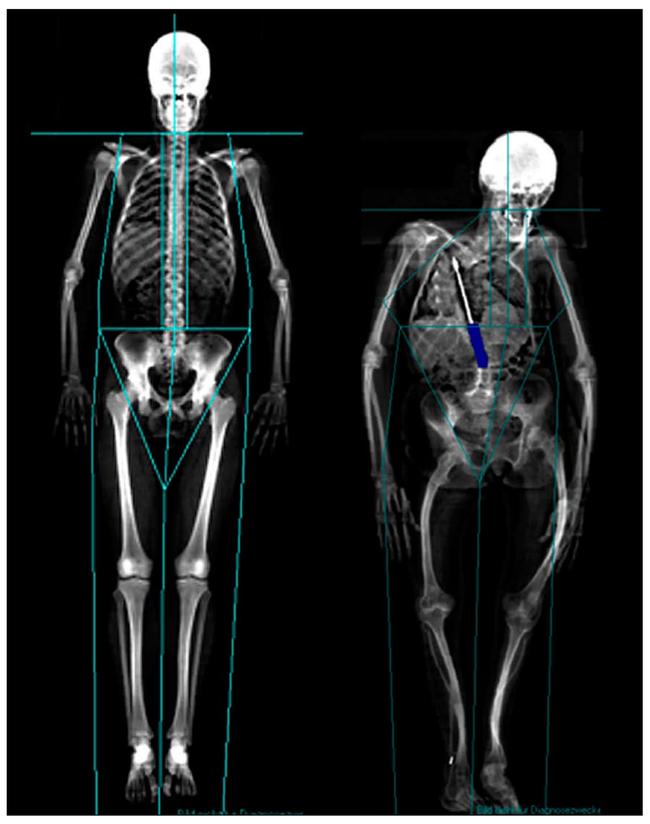

Fig 2. Densitometry, left: CO, right: OI.

These structural variables can be derived from cross-sectional absorption curves generated by DXA. 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.
The statistical analysis was performed using SPSS version 15. The Kolgomorov-Smirnov-test was carried out to verify the normal distribution. The comparison of the mean value was performed using t-test. A p-value of less than 0.05 was considered as statistically significant.

Results:

Both groups, the OI and the OPO showed statistically significant variations of BMD, CSA and CSMI in comparison to the control group.
The Pearson correlation test showed high-significant correlations between BMD and CSA in the OI group and between BMD, CSA and CSMI in the OPO and CO group.
In addition, in the OI group there were also high-significant correlations between FSI, CSA and CSMI.
There was also a remarkable difference of CSMI between the OI- and the OPO-group, however we found a statistically trend without significance.
All results of the different groups are shown in table 1 and figure 3.

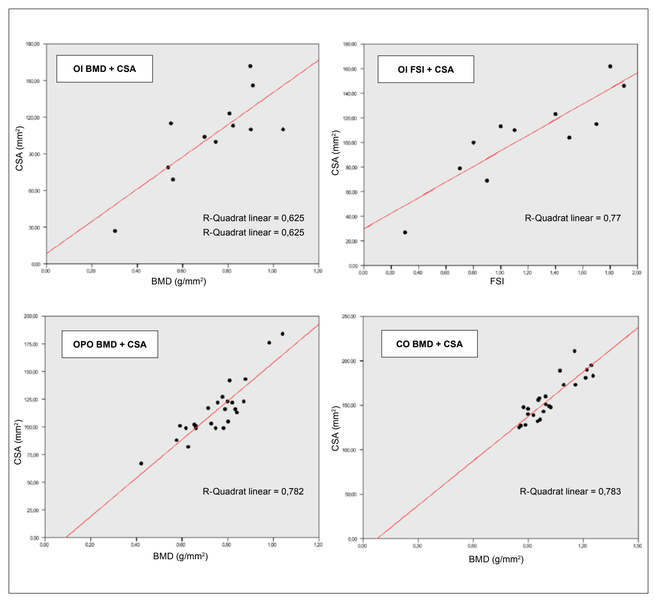

Fig. 3. Correlation between femoral geometric parameters and BMD within the groups.

Conclusion:

Apart from significant differences in BMD measurement between OI and CO, we found
significant differences in CSA and CSMI between those two groups.
Additionally strong correlations between BMD and CSA and between FSI, CSMI and CSA within the OI group were found. A correlation of BMD and CSA was proved by a high-significance of these values in the OPO- and CO-group.
Our results also showed a clear but not statistically significant difference of CSMI between OI and OPO indicating differences in the mechanical structure of the different bone disorders.
We conclude that geometric structural measurements made at the femoral neck by DXA are of more clinical relevance and may be more reliable for fracture prediction than BMD measurements in patients with Osteogenesis Imperfecta.

group	n	age	FSI	CSMI	CSA	BMD
OI	12	39,2 ± 11,7	1,2 ± 0,5	8,2 ± 3,9*	104 ± 35,1**	0,73 ± 0,21**
OPO	25	39,4 ± 3,5	1,3 ± 0,3	7,8 ± 2,4 **	115 ± 26,1**	0,75 ± 0,13**
CO	25	40,4 ± 6,4	1,4 ± 0,4	11,2 ± 3,2	156 ± 24,4	1,01 ± 0,13

Table 1: BMD and HSA results of OI, OPO and control group (CO).
(significant differences to control group, p<0.05, ** significant differences to control group, p<0,001)*

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