**GEOMETRIC MORPHOMETRICS APPLIED TO THE STUDY OF SCOLIOSIS IN PATIENTS WITH IMPERFECT OSTEOGENESIS.**

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Osteogenesis Imperfecta (OI) is a rare condition characterized by a high prevalence of vertebral fractures. This invalidating disease causes deviation of thoracic spine, especially scoliosis, in these patients (Ishikawa et al., 1996). Scoliosis is a complex, three-dimensional (3D) deformity in response to gravity during static posture and motion (Hresko et al., 2016). It is also frequent the development of hiperkyphosis associated with scoliosis between OI patients. It is caused by vertebral collapse and fractures among vertebral bodies. It is well-known that scoliosis is a progressive condition that should be considered in all cases.

No Geometric Morphometrics (GM) study has yet addressed scoliosis in OI subjects. Thus, this work is the first studying the overall 3D thoracic spine structure of OI patients. Only Wekre et al. (2014) have found respiratory dysfunction in relation to spine deformity using spirometry variables. But so far, nobody has measured kinematic size and its relation to shape in OI using GM.

Three goals were set in this work: to describe thoracic scoliosis in OI patients, to describe allometric shape changes in the spine (size-shape relations) in these subjects and to analyse changes between maximal inspiration and expiration in terms of centroid size (CS, square root of the sum of the squared distances of all landmarks to its centroid) and shape (Procrustes distances (information about shape excluding size influence). We addressed the following hypotheses: collapse of vertebral bodies causes hyperkyphosis and greater size (CS) is linked with greater spine deformity.

We used GM to study shape variation of thoracic spine between 7 patients with OI and 9 healthy controls. We have also analysed changes between maximal inspiration and maximal expiration in terms of kinematic size and shape (Procrustes distances). Principal component analysis and univariate statistics have been carried out to investigate these problems.

The mean shape of OI patients shows thoracic scoliosis towards the left and hyperkyphosis compared to controls. Additionally, we found greater spine deformation significantly correlated with greater centroid size. Finally, Procrustes distances and kinematic size (difference in centroid size) between inspiration and expiration were twice as large in patients compared to controls.

We found greater hyperkyphosis in the caudal thoracic spine, where more body weight is supported. This result matches with collapse theory of vertebral bodies (Engelbert et al., 2003; Watanabe et al., 2007; Lee et al., 2006). Contrary to our findings, other papers that measured increment of deviation related to size using body height (Schlösser et al., 2014), have not found any relation between size and deformity. Our result in changes of kinematic size in these patients needs to be tested in a larger sample to test the hypothesis that OI subjects need more spinal implication than healthy subjects to achieve functional breathing such as proposed by LoMauro et al. (2012).

ACKNOWLEDGEMENTS

Funding was provided by Funación ERESA (BF14\_005), Care4Brittlebones Foundation, and CGL2015-63648-P (MINECO). AHUCE supported data acquisition of OI patients. Data of control group was contributed by Dr. Francisco García Río and Dr. Maribel Torres (La Paz Hospital, Madrid).

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