DESIGN, REALISATION AND VALIDATION OF A NON-DESTRUCTIVE CYCLICAL UNIAXIAL MECHANICAL COMPRESSION TEST

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INTRODUCTION:
We have designed and commissioned a non-destructive cyclical uniaxial mechanical compression test with the aim to validate a method permetting the evaluation of the mechanical properties of fragile biomaterials.
Presently very few mechanical tests exist permitting one to establish the properties of fragile biomaterials.

METHODS:
The equipment used an horizontal test bed , the calibration of the force and linear movement sensor, the realisation of the digital conversion tactor,the generation of a PC control test. The validation of the test bed, are realised by using samples of cylindrical trabecular bone and composites taken from human femoral head.They were subjected to cyclic uniaxial compression somewhere between 0,6% - 0,8% of their maximal deformation.

RESULTS:
The mean modulus of elasticity of samples of trabecular bone is of the order 49 + /- 14 Mpa and of composite samples is of the order 153 (+ /- 46) Mpa. Some test series measurements performed seven days later on the same samples differed by 10%.We obtain for each, the hysteresis curve.

DISCUSSION:
This study confirms the heterogeneous mechanical properties of the trabecular bone of the human femoral head. The mechanical test being specifically adapted and the fact that the tests can be faithfully reproduced it is therefore possible to now do non-destructive testing.The P/Ca ceramics used as bone replacement require physico chemical, structural and mechanical matching studies.However, few test exist permitting to establish the macroporous P/Ca ceramics resistance without causing their destruction.

CONCLUSION:
The test designed is non-destructive.It allows one to obtain the elastic properties and to appreciate the visco-elasticity of fragile materials. It should thus allow one to evaluate the mechanical properties of many fragile materials, to appreciate the evolution of these properties after implantation to be able to reuse these materials after testing,andto appreciate the standardisation work on the visco-elasticity of biomaterials presently in progress.

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A NEW METHOD FOR 3D EVALUATION OF CTM CORRECTION BRACE FOR SCOLIOSIS USING MRI.

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INTRODUCTION
The aim of this study was to analyse the immediate effect of the CTM brace using a new MRI method. Stereoradiography technique[1, 2] has been used to evaluate Boston brace effect for correction of scoliosis.

METHODS
Two MRI examinations had been performed, with and without brace, on 5 girls (12.5±1.5 years old having treatment for idiopathic scoliosis) wearing the CTM brace for the first time, only at night. The protocol consisted in two acquisitions of the entire spine in the sagittal and coronal planes. An in house processing software (SIP 305) allowed the transfer and the reconstruction of the images. The geometrical information (grids, lines) of the vertebral bodies were imported into the pre and post processor Patran allowing the visualisation. A matching method of both views was developed. A spline interpolating each body centre and geometrical axes for each vertebral body and intervertebral disc had been calculated. Results obtained with and without brace, were compared.

RESULTS
The superimposition of both spline curves of the vertebrae allowed to quantify the global effect of the CTM brace (Figure 1).

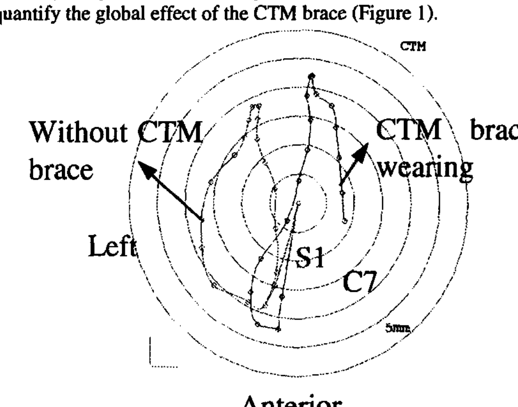

Figure 1 : Top view of the CTM brace effect

For the five patients, the effect of the brace was respectively : 1) to move the lumbar scoliosis from L3 to D12, to transform the left curvature into right curvature, and to decrease the dorsal cyphosis, 2) to decrease the lumbar scoliosis, to give a S curvature in the top view and to decrease the dorsal cyphosis, 3) to decrease the lumbar scoliosis and to increase the dorsal cyphosis, 4)- to decrease the scoliosis and to increase the dorsal cyphosis, and to remove the lumbar lordosis and 5) not correcting the lumbar scoliosis and to decrease the dorsal cyphosis. The Euler's angles defined between the body without brace and the body with brace show the local effect of the brace. Axial rotation had been modified on L1, D12, D11 and D9 of the 1st patient, on L4, L3, and D9 of the 2nd patient, on L5 and L4 of the 3rd patient, on L1, D12, D8 and D7 of the 4th patient, on L1, D12 and D11 of the 5th patient. One significant axial rotation correction (1st) about 20° was found. Finally, the results showed one negative effect (5th), three partial positive effect (1st, 2nd, 4th) and one global positive effect (3rd) of the CTM brace. Similar results were obtained on the intervertebral disc.

DISCUSSION
Our method gave objective and quantitative data for the comprehension of the effect of the CTM brace. Results were similar on the vertebrae and intervertebral discs due to the low curvature studied. Compared to conventional techniques, the method presented no irradiation and provided more accurate geometrical informations. Furthermore, analysis of the intervertebral disc was possible.

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