Abstract

In the present work, the possibility of using an implant device based on NiTi pseudoelatic alloy for the correction of inferior member's deformities via growth modulation during childhood and adolescence was investigated. This is a natural continuation of two previous works, in which the material was characterized and the stress distribution on the bone was analyzed, during a conceptual design stage.

For obtaining a better approximation to the properties necessary in such a device, we introduce a mechanobiological model, capable of predicting the evolution of growth in a given treatment period. We validated the model by reproducing the development of a bony structure under different treatments, for which well documented experiments exist. The information obtained this way was used to propose a damage criterion that allowed the estimation of the maximal applicable force and to adjust the involved parameters. This way we were able to calculate the velocities involved in growth under different conditions. The last being a critical point, in a previous-clinical-test stage, that would be the most relevant contribution of our work.

Different configurations were proposed for the designs studied in the previous works, estimating their dimensions to prove the feasibility of the concept. A correction velocity of $0,59°/\text{month}$ in the angular deviation was estimated for the mean case, without a significant variation in the longitudinal growth velocity, trough the application of a 90 N distractive force. This velocity represents a slower correction, by 14 %, than the obtained with the treatments currently in use. Nevertheless, there is not a significant change in the linear-growth velocity, which is usually reduced with the conventional treatments. For this reason, the device here proposed could be a significant addition to the state of the art of child and adolescent's bone defects orthopaedic treatments.

Keywords: BONE DEFECTS, SHAPE MEMORY, NUMERICAL MODELLING