**Reviewer's report**

**Title:** Biomechanical optimization of different fixation modes for a proximal femoral L-osteotomy

**Version:** 2  **Date:** 8 June 2009

**Reviewer:** kent bachus

**Reviewer's report:**

This study evaluates the biomechanical characteristics of a femur from a dysplastic patient who underwent an L-osteotomy surgical correction. This surgery aims to correct residual deformities by lengthening the femur and repositioning the greater trochanter. It is performed by sectioning the femur in two down from the trochanteric fossa and then re-securing in the desired position with a plate and bone screws. Two main variables are present in these surgeries: the number of fixations screws and osteotomy lengths.

This study evaluated the impact of these two variables separately using finite element models (FEM). Using 3d reconstructions of CT data, simulated surgeries were performed. Finite element meshes of the bone and fixations were created and loaded with boundary conditions approximating single-legged stance, to obtain the von Mises stress distribution and femoral head displacement. No specific hypothesis was tested in terms of how variations of the L-osteotomy affect the biomechanics of the femur. Instead, a general hypothesis, that FEM can be used to understand the mechanical characteristics is proposed. The results provided meet this general goal.

Overall, the methods were sufficiently described, but more could be included regarding the verification and validation of the models. Without this, the legitimacy of the FEM predictions is questionable, but it is most likely sufficient to evaluate trends between osteotomy variations.

With N=1, no statistical analysis was performed on the results. Little was done to interpret the clinical significance of the obtained stresses and differences between screw placement and osteotomy length.

The limitations of the work are clearly stated, and all previous work is appropriately acknowledged.

The title and abstract accurately describe the findings of the study and overall, the writing is acceptable throughout the paper.

The following specific suggested revisions are labeled as follows:
(1) - Discretionary Revisions (which are recommendations for improvement but which the author can choose to ignore)
(2) - Minor Essential Revisions (such as missing labels on figures, or the wrong
use of a term, which the author can be trusted to correct)

(3) - Major Compulsory Revisions (which the author must respond to before a decision on publication can be reached)

Title Page: The title of the paper clearly describe the subject and purpose of the paper.

Abstract: No significant comments.

Background:
(1) The authors mention that 'the residual deformities compromise joint biomechanics and cause abnormal loading.' Could strengthen paragraph by explaining why abnormal loading and biomechanics is clinically relevant, i.e. What does it lead to, why should it be prevented long term through surgical correction?

(1) In paragraph 2, explaining the differences between Papavasiliou's surgical approach versus the less successful previous methods.

(2) In the final paragraph, it is mention that the 'aim of this study [...] in subjects...'. Only one subject was evaluated in this study, so 'subject' should be used.

(1) Finally, the final paragraph could be strengthen by including why the finding of this study will increase postoperative longevity prior to mentioning it in the final sentence.

Materials and Methods:
(2) Include CT scan information, like slice thickness, radiation parameters, etc.

(3) How was the femoral head center determined when the femoral head was not spherical?

(2) Why was the plate dimensions 'assumed' when they were obtained from the measurement of the actual plates? (Paragraph two of 'Generation of finite element model' section).

(3) How might the simplification of modeling the fixation screws with no threads have affected model results? This simplification should at least be addressed in the discussion.

(1) Why was single-legged stance chosen over all other loading scenarios?

(3) A description of the location and angle of the applied forces should accompany the load values

(2) How was the strength of the glue contact elements chosen?

Results:
(3) A more detailed description of the verification and validation of the FEM
should be described in the Methods section.

(2) For the verification of the model, it is unclear that a substantially refined mesh was achieved. While it is mentioned that the total strain energy predicted by four models were within 5% of each other, this does not blatantly state that enough elements were used for convergence, which could be done by including the percent difference between the most refined and second most refined meshes. What is the significance of 5% difference, clinically? Would this difference impact the results and how they may be interpreted?

(3) Was the interface behavior between the screws and bone validated? It seems that only the bony portions of these models were validated, but a validation of both the metal pieces and how they interact as a system was not been performed.

(1) The varied results of Figure 6 could be presented in more detail here, and explained in the Discussion.

Discussion:

(2) The two paragraphs starting 'As computer technology...' and 'Finite element analysis...' seem better suited for the introduction.

(3) Why was the highest value of the von Mises stress in the screws important to evaluate? How close was the peak stress to failure of the material? Is it beneficial or detrimental to load the screws to the peak values seen? i.e. Is the concern of failure or uneven loading over the screws?

(1) What is meant by 'the algorithm clearly indicates that no general rules can be applied to preoperative planning'? If 'the algorithm' refers to the FEM, it is the first time this terminology is used in the paper. Which results 'clearly indicate' the suggested observation? Better to briefly point the reader to specific results than make blanket statements.

(1) Ending the paper with the limitations of the study is weak. Reorganization of the discussion or ending with the future uses of this FE model after addressing the limitations would make the paper stronger.

Level of interest: An article of importance in its field

Quality of written English: Acceptable

Statistical review: Yes, and I have assessed the statistics in my report.

Declaration of competing interests:

I declare that I have no competing interests