Investigating Mechanics of Long Bone Fixation
With Conformable Bone Plate System Using FEA

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Background
Like many other medical implants, bone plates are prone to failure. Failure of a plate and screw fixation system could occur at the plate, where the plate will be exposed to excessive bending stresses, and/or at the junction between the plate and the screws. Another form of failure is the one that occurs at the long bone fixation area. In this case, the bone is stressed at the point of contact between the plate and the bone and/or at the point of contact between the screws and the bone. The paper studies in detail the load distributions of the conformable bone plate system (CBPS) verses traditional dynamic compressive plate (DCP) fixation.

Purpose
The objective of this study is to prove that placing a low molecular weight Polyethylene (LMWPE) slip under bone fixation plates can facilitate better (tight) fit between the plate and the bone and therefore reduce the stress and strain on the bone caused by the plate surface. The plastic will be made out of a pre-heated LMWPE so that it can conform to the shape of the bone and plate once placed inside the body. The LMWPE absorbs the energy reducing the maximum stress and strain in the bone as well as the plates. In addition, the plastic slip allows better stability of the fractured bone, and therefore a faster healing process. It also minimizes micro movements of the screws and plates and therefore reduces the likelihood of screws slipping out.

Design/Method
SolidWorks is used to conduct finite element analysis on a transverse fracture using a femur model augmented with a bone plate and subjected to a moment of 10 Nm (the assumption is that half the body weight of a 50 kg person will act on the femur head and cause a moment about the center of the knee. The femur model was created in SolidWorks based on a compression bone plated design. The plastic slip is made to perfectly fit over the uneven surface of the bone on one side and the inner surface of the plate on the other side (mimic the LMWPE after heated and be compressed on bone from underneath the bone plate). The same method is applied to the traditional technique using DCP system.

Results
Maximum stress of the conformable bone plate system is reduced from approximately 1.2988 GPa to approximately 0.61985 GPa and maximum strain in reduced from 0.005378 to 0.002277 in by inserting the LMWPE slip between the bone plate and the femur.

Conclusions
Based on this study, the direct load applied on the bone plate via screws was absorbed via the LDMWPE slip. That reduces significantly the shielding stress onto long bone through internal fixation.