Modelling of an electrohydraulic shock wave device - implications for optimal device operation

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Device and producing company:
OssaTron (HMT, SanuWave)

Introduction:
Mathematical modelling is commonly used in science and engineering to gain insights into complex systems. Finite element analysis is used to model an electrohydaulic shock wave (SW) device to learn characteristics of this type of device.

Methods:
COMSOL-Multiphysics is used to model an electrohydraulic SW device (OssaTron). Properties of de-gas water are used for modelling. Gaussian explosion shocks at F1 with various frequency contents are studied.

Results:
Electrohydraulic SW device with semi-ellipsoid reflectors produced about 50% of the reflected shock wave intensity at F2 compare with the source (F1). Depending on the device and frequency contents of the SW, the primary divergent SW, which arrives at the F2 earlier than the reflected one, may have some therapeutic implications. SWs with higher frequency contents (shorter rise time) tend to have more focused F2 (-6dB). The F2 volumes tend to be oval in shape with the axial length longer than the lateral length. There's asymmetry in the axial length with the proximal portion longer than the distal one.

Discussion:
Reflected SW rises gradually along the axial axis but declines quickly laterally. Higher frequency contents within the shock wave produce more focused F2 volume.

Conclusion:
Intensity of the reflected SW at F2 amounts to about 50% of the source for an electrohydraulic device using a semi-ellipsoid reflector. Higher frequency contents within the shock wave produce more focused F2. Because of the narrower lateral axis of the F2 volume, aiming system is thus recommended. Moving the target tissue closer to F1 by deflating the coupling membrane is generally acceptable.