

## C13

### Electrical Stimulation Stiffens Ovine Mitral Leaflets *In Vivo*

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#### Objectives:

Mitral valve leaflets contain contractile elements, *e.g.* valvular interstitial and striated muscle cells. We tested the hypothesis that direct electrical stimulation stiffens the anterior leaflet in the beating ovine heart.

#### Method:

The mitral apparatus was delineated with 34 radiopaque markers in 5 hearts: 16 annular, 16 on the anterior leaflet, one at the tip of each papillary muscle. 4-D marker coordinates were obtained before (CTRL) and ~30 seconds after rapid electrical stimulation below the LV response threshold (STIM, 1-4mA, 320min<sup>-1</sup>) *via* an electrode at the junction of the anterior leaflet and middle of the anterior annulus ("saddlehorn"). Inverse finite element analysis was employed to derive leaflet belly rigidity modulus ( $G_{\text{circ-rad}}$ ) and elastic moduli in the radial ( $E_{\text{rad}}$ ) and circumferential ( $E_{\text{circ}}$ ) directions during isovolumic relaxation for 3 sequential beats in each heart.

#### Results:

All moduli were significantly stiffer with stimulation ( $E_{\text{circ}}$ : 27±12 vs. 54±17;  $E_{\text{rad}}$ : 9±3 vs. 20±4;  $G_{\text{circ-rad}}$ : 95±13 vs. 144±18 N/mm<sup>2</sup>, CNTL vs. STIM, 15-beat group mean±1SD, all  $P<0.003$  by 2-way RM ANOVA with Bonferroni post-hoc test).

#### Conclusions:

Direct electrical stimulation stiffened the anterior mitral valve leaflet in the beating ovine heart by factors from 1.4 to 2.9. The ability to rapidly change leaflet material properties by stimulation of native contractile elements is a novel observation linking *in vivo* mitral valve structure and function.