The accurate placement of epidural injections via either single injection or continuous catheter insertion techniques continue to have what we believe to be a suboptimal but accepted success rate.[Ref 1] The purpose of this work is to develop a significantly more reliable technique for establishing epidural anesthesia. The cornerstone of this effort is the ability to reliably and reproducibly identify the tissue layers encountered in the performance of the procedure. To this end we have employed an optics method and a pressure method. In both methods both a porcine and a synthetic tissue model were used.

The optics method involves the use of a borescope with an outer diameter of 1.5 mm that would fit through a scaled up epidural needle (inner diameter 1.68 mm) with an adjustable illumination system which allowed for live videoscopy to be obtained from the scope. Screen shots were taken from the video feed. These were processed later and analyzed for needle position. A two-tailed ANOVA was performed to test whether or not the cartridge (synthetic tissue model) prototype tissue layers and corresponding colors had statistical differences from one another. The confidence interval for this analysis was set at 0.05 and the resultant p-values were all below $\alpha$, proving their statistical significance.

For the porcine model, following the establishment of ideal settings for image quality (illumination level and distance of scope to needle tip) pictures were taken of the respective needle layers and pixel regions of interest were sent through an optical algorithm and a set of calibration trials was performed. Response for the red, green, and blue (R, G, And B) color model was acquired for the ligamentum flavum and the epidural space. Summary of fit; ANOVA; ad parameter estimates developed in JMP software were determined. Summary of fit data revealed a high degree of variability among responses and statistically significant differences within the two-tailed ANOVA values were noted. We found that of the testing parameters illumination was the most important factor.

The pressure method based on the loss of resistance technique proved unreliable in a non-living model except when artificially generated negative pressure was generated in the synthetic tissue model which demonstrably showed a pressure drop when the ligamentum flavum equivalent was traversed. We have accomplished reliable mechanical coupling for examining correlation between the pressure and optic methods. These studies need to be completed and agreement between the two techniques requires statistical description in order to direct further study and development.