

Fig. E-1

A: Scatterplot of physiological cross-sectional area versus fiber length. Since the physiological cross-sectional area is proportional to muscle force and fiber length is proportional to muscle excursion, this type of plot illustrates the functional design of a muscle. These data illustrate that the multifidus has the largest force-generating capacity in the lumbar spine and is designed for stability. The bars represent the standard deviation. **B:** Sarcomere length operating range of the multifidus plotted on the human skeletal muscle sarcomere length-tension curve (black line). These data demonstrate that the multifidus muscle operates on the ascending limb of the length-tension curve and becomes intrinsically stronger as the spine is flexed (lower arrow). Schematic sarcomeres are shown on the ascending and descending limbs to scale, on the basis of the quantification of actin and myosin filament lengths. (Reprinted from: Ward SR, Kim CW, Eng CM, Gottschalk LJ 4th, Tomiya A, Garfin SR, Lieber RL. Architectural analysis and intraoperative measurements demonstrate the unique design of the multifidus muscle for lumbar spine stability. *J Bone Joint Surg Am.* 2009;91:176-85.)

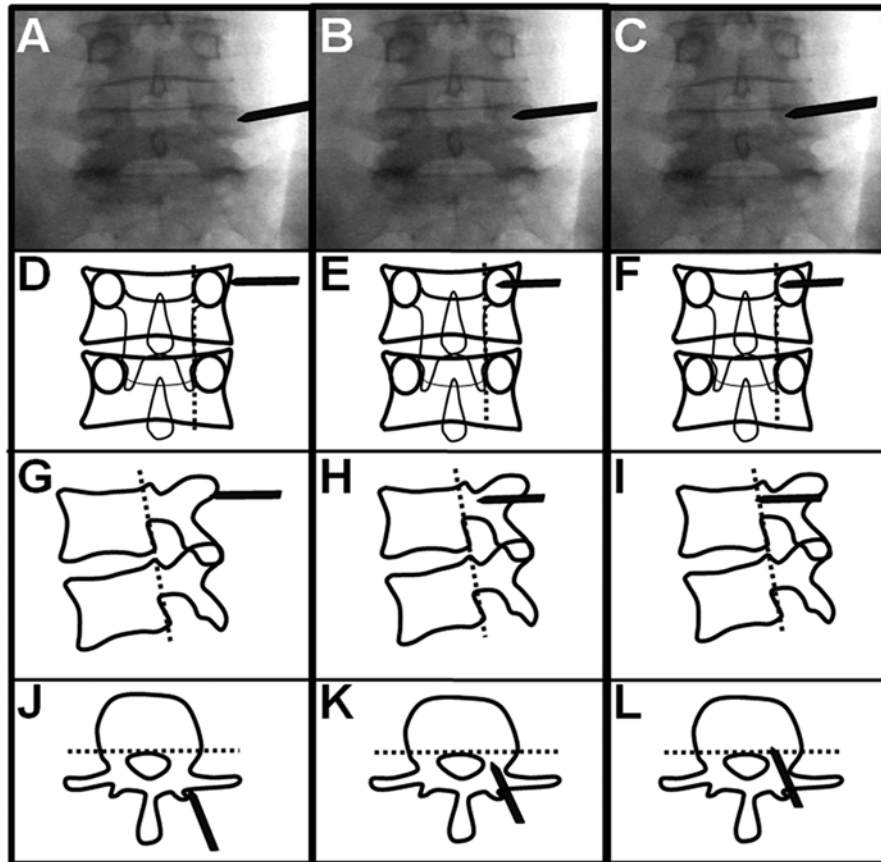


Fig. E-2

Percutaneous pedicle screw insertion requires scrupulous intraoperative imaging. *A*, *B*, and *C*: The trocar needle is inserted with use of a perfect en face anteroposterior image of the pedicle. *D*, *E*, and *F*: The needle is inserted from a lateral to medial direction until the tip reaches the medial border of the pedicle. *G*, *H*, and *I*: The c-arm is used for a lateral view. *J*, *K*, and *L*: If the needle is correctly inserted into the pedicle, the tip should be past the posterior vertebral body line. *D*, *G*, and *J* show the initial position of the needle in the anteroposterior, lateral, and axial planes, respectively. *E*, *H*, and *K* show the needle halfway across the pedicle. *F*, *I*, and *L* show the needle at the medial border of the pedicle. Once past the posterior vertebral body line, the needle can be inserted another 5 mm, in preparation for insertion of the guidewire.