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Redesigning a K-Wire limits inadvertent advancement: A biomechanical study

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Introduction

The migration of K-Wires is a well-known complication that can occur with potentially catastrophic consequences. This study investigates a guidewire technology designed to increase the force it takes to advance a K-Wire after it is deployed.

Methods

A biomechanical study was designed to test the force required to displace the guidewire through both cancellous and cortical bone. Guidewires were placed at every vertebral level between Ll to L5 in human cadaveric specimens. The design was internally randomized between a standard guidewire and a Y-Wire, allowing each vertebra to serve as its own control. Displacement and axial load were measured. The regions of interest were the mid vertebral cancellous bone and the anterior cortical wall.

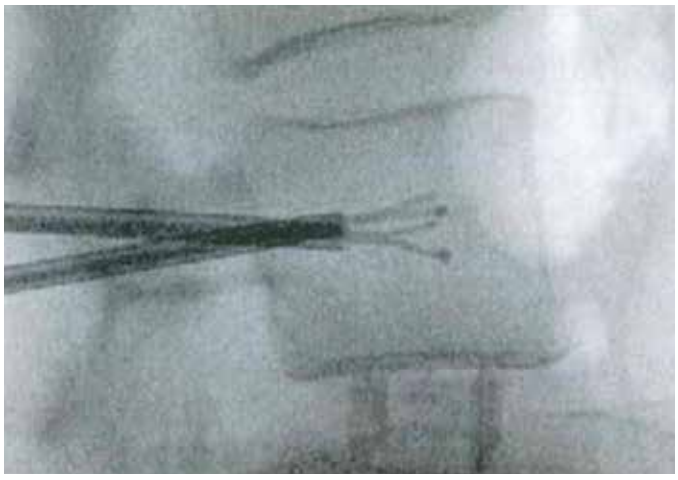

Figure 1. Radiographic image of splayed Y-Wire in mid-vertebral cancellous bone

Results

The force for a standard wire stayed roughly the same throughout the cancellous bone tested (p=0.83). In contrast, the force to advance a Y-Wire increased in a linear fashion. The median cancellous force values exceeded 400% of the values obtained from a standard guidewire (435%, range 272% - 2136%). The force to displace a Y-Wire exceeded the cortical values obtained in the same vertebra after it was deployed 5.0mm (range 1.0-8.4mm). Additionally, the force required to breach the anterior cortex with a Y-Wire was 219% greater than a standard guidewire (p<0.001, range 184%-7129%).

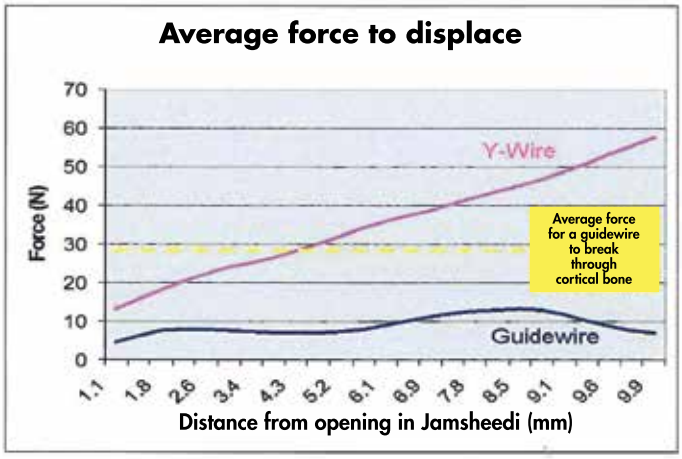

Figure 2. Average force for a guidewire to break through cortical Bone

Conclusions

Y-Wire offers the ability to increase the push-in force to advance a guidewire placed into cancellous bone to values that exceed the force which cause standard guidewires to break through the anterior cortex. By altering the distal tip design of a guidewire, Y-Wire substantially decreases the chances of inadvertently advancing a guidewire away from its desired location.

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