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## Surgical Strategies to Improve Fixation in the Osteoporotic Spine: The Effects of Tapping, Cement Augmentation, and Screw Trajectory

**Study Design** Biomechanical study of pedicle screw fixation in osteoporotic bone.

**Objective** To investigate whether it is better to tap or not tap osteoporotic bone prior to placing a cement-augmented pedicle screw.

**Methods** Initially, we evaluated load to failure of screws placed in cancellous bone blocks with or without prior tapping as well as after varying the depths of tapping prior to screw insertion. Then we evaluated load to failure of screws placed in bone block models with a straight-ahead screw trajectory as well as with screws having a 23-degree cephalad trajectory (toward the end plate). These techniques were tested with nonaugmented (NA) screws as well as with bioactive cement (BioC) augmentation prior to screw insertion.

**Results** In the NA group, pretapping decreased fixation strength in a dose-dependent fashion. In the BioC group, the tapped screws had significantly greater loads to failure ( $p < 0.01$ ). Comparing only the screw orientation, the screws oriented at 23 degrees cephalad had a significantly higher failure force than their respective counterparts at 0 degrees ( $p < 0.01$ ).

**Conclusions** Standard pedicle screw fixation is often inadequate in the osteoporotic spine, but this study suggests tapping prior to cement augmentation will substantially improve fixation when compared with not tapping. Angulating screws more cephalad also seems to enhance aging spine fixation.

在骨質疏鬆性脊柱以手術策略改善固定：刺穿，水泥增強，與螺釘軌跡的影響

**研究設計** 椎弓根螺釘內固定在骨質疏鬆性骨的生物力學研究

**目的** 研究在放置水泥增強椎弓根螺釘之前刺穿或不刺穿骨質疏鬆性骨會更好。

**方法** 起初，我們評估在放置螺釘前有或沒有預先刺穿和改變刺穿深度後，放置在松質骨塊螺釘的破壞荷載。然後，我們評估以直行螺絲軌跡及 23 度的頭側軌跡（向端板），放置在骨塊模型螺絲的破壞荷載。這些技術均在放置螺釘前以沒想到添加（NA）的螺絲，以及與生物活性水泥（BioC）螺絲進行測試。

**結果** 在 NA 組，沒刺穿的會以劑量依賴的方式降低固定強度。在 BioC 組，有刺穿的螺絲有顯著更大的破壞荷載（ $p < 0.01$ ）。只比較螺釘定向，螺釘定向於 23 度頭側比在 0 度有明顯較高的破壞荷載（ $P < 0.01$ ）。

結論 在骨質疏鬆性脊柱，標準的椎弓根螺釘內固定往往是不足的，但這項研究表明，在水泥鞏固前進行刺穿比沒有刺穿更能大幅度改善固定。螺釘的調角更頭側也似乎提升老年脊椎內固定。