

# Intraoperative Surgeon Assessment of Bone Correlates with CT Hounsfield Units and Vertebral Bone Quality

James T Bernatz, Jon David Skjaerlund, Brian Goh, Jeremy Lee Fogelson, Benjamin D Elder<sup>1</sup>, Syed Mohammed Karim<sup>1</sup>, Ahmad Nassr, Arjun Sebastian, Brett Freedman<sup>1</sup>

<sup>1</sup>Mayo Clinic

**INTRODUCTION:** Evaluation of bone health is important in spine surgery patients because osteoporosis has been shown to portend worse postoperative outcomes. Preoperative radiologic assessment of bone can include modalities such as CT Hounsfield Units (HUs), dual-energy x-ray absorptiometry bone mineral density (DXA BMD) with trabecular bone score (TBS), and MRI vertebral bone quality (VBQ). Quantitative analysis of bone with screw insertional torque and pull-out strength measurement has been performed in cadaveric models and has been correlated to these radiologic parameters. However, these quantitative measurements are not routinely available for use in surgery. Surgeons anecdotally judge bone strength, but the fidelity of the intraoperative judgement has not been investigated. The purpose of the study is to determine if a surgeon's qualitative assessment of bone intraoperatively correlates with radiologic parameters of bone strength.

**METHODS:** All adult patients undergoing instrumented spine fusion by one of seven surgeons at a single center over a 3-month period were included. Surgeons evaluated the strength of bone based on intraoperative feedback and graded each patient's bone on a 5-point Likert scale. Two independent reviewers measured preoperative CT HUs and MRI VBQ. BMD, lowest T-score, and TBS were extracted from DXA within 2 years of surgery. An a priori power analysis showed sample size of 85 (pairs) will have 80% power to detect a ratio sum for discordant proportions of 0.2.

**RESULTS:** Eighty-five patients were enrolled and 15, 29, 26, 14, and 1 patients had Likert grade 1 (strongest bone), 2, 3, 4, and 5 (weakest bone), respectively. The surgeon assessment of bone correlated with VBQ ( $\tau = 0.14$ ,  $p = 0.09$ ), CT HU ( $\tau = -0.26$ ,  $p < 0.01$ ), lowest DXA T-score ( $\tau = -0.52$ ,  $p < 0.01$ ), and TBS ( $\tau = -0.33$ ,  $p < 0.01$ ). These results were consistent both in the cervical spine and the thoracolumbar spine.

**DISCUSSION AND CONCLUSION:** Spine surgeons' qualitative intraoperative assessment of bone correlates with preoperative radiologic parameters. This information is valuable to surgeons as this supports the idea that decisions based on feel in surgery have statistical foundation.

ISAB Grade	A (N=15)	B (N=29)	C (N=26)	D (N=14)	E (N=1)	Total (N=85)	p value
<b>VBQ Score</b>							0.06
Mean (SD)	2.32 (1.10)	2.85 (0.80)	2.82 (0.71)	3.15 (1.31)	4.62 (-)	2.82 (0.97)	
Range	0.56 - 4.20	1.26 - 4.21	1.40 - 4.60	1.12 - 5.63	4.62 - 4.62	0.56 - 5.63	
<b>CT Hounsfield Units</b>							0.01
Mean (SD)	263.50 (138.51)	273.45 (132.00)	194.35 (100.56)	173.45 (66.24)	31.60 (-)	225.13 (120.92)	
Range	142.28 - 640.09	92.52 - 497.82	86.35 - 442.54	69.08 - 280.90	31.60 - 31.60	31.60 - 640.09	
<b>Lowest T-Score</b>							< 0.01
Mean (SD)	0.87 (2.32)	-0.41 (1.42)	-1.52 (0.75)	-1.97 (0.74)	-2.40 (-)	-0.90 (1.60)	
Range	-0.60 - 7.20	-3.00 - 3.40	-2.50 - -0.20	-3.20 - -0.90	-2.40 - -2.40	-3.20 - 7.20	
<b>TBS</b>							0.03
Mean (SD)	1.429 (0.135)	1.434 (0.102)	1.353 (0.130)	1.247 (0.117)	-	1.381 (0.134)	
Range	1.223 - 1.606	1.270 - 1.619	1.193 - 1.622	1.117 - 1.430	-	1.117 - 1.622	