



Evaluation of Intraoperative tEMG Testing of Tap and Screw

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ABSTRACT

Background/Introduction:

Triggered electromyography (tEMG) is an established, adjunctive method for detecting pedicle wall breach. A breach in the pedicle wall reduces impedance relative to an intact pedicle resulting in an evoked electromyographic response. Generally, a positive response at screw thresholds less than 5-8mA warrants further evaluation of the pedicle screw tract. Comparison between screw and tap stimulation thresholds has not been well documented in the published literature. In this study, we compared tEMG thresholds between stimulation of both the tap and the pedicle screw at the same pedicle to assess the value of using the tap as the stimulated instrument for tEMG.

Methods:

A retrospective analysis was performed of a subset of patients who underwent procedures at NYU Langone Orthopedic Hospital from 12/2014 to 7/2019. Patients included were those who had tEMG performed during their procedure utilizing both tap and screw stimulation at the same nerve root level. Paired t-test was used for statistical analysis.

Results:

10 patients were included with a total of 24 data points. Each data point included one stimulation value via tap and one via screw for the same nerve root level performed during the procedure. The set included patients who had undergone a variety of spinal surgeries between levels L3-S1. The average stimulation value was 29.09mA (SD=11.68) for the tap and 30.79mA (SD=7.96) for the screw (p=0.242). The mean value of tap minus screw recording was -1.693 (SE=1.41). Out of the 24 data points, 8 showed higher tap values compared to screw, with a higher value suggestive of a further distance from the stimulated instrument to the nerve root. Of the remainder, 6 showed higher screw values compared to tap, and 10 had equal values for both.

Conclusion:

The tEMG values obtained via stimulation of the tap were lower on average than those obtained via stimulation of the screw, suggesting stimulating the tap may underestimate the distance from the pedicle screw to the nerve root. Taking this into account, tap tEMG values may then serve as a cautious predictor of pedicle breach and consideration for thresholds greater than 5-8mA used for screws should be made.

INTRODUCTION

Intraoperative monitoring was initially developed as an alternative to the wake-up test (Loftus et. al). During the procedure, a pedicle screw serves as a stimulating electrode while a grounding needle measures the myogenic response to the stimulation. Stimulation intensity is increased until an tEMG response is received, which is then compared to a "warning threshold" (Loftus et. al). The intensity at which a response is received serves as an indicator of the distance from the stimulated instrument to the spinal nerve root. Bone has a high resistance which requires a larger stimulation value to show nerve root activity, allowing for an increased stimulation intensity to be indicative of a further distance to the nerve root.

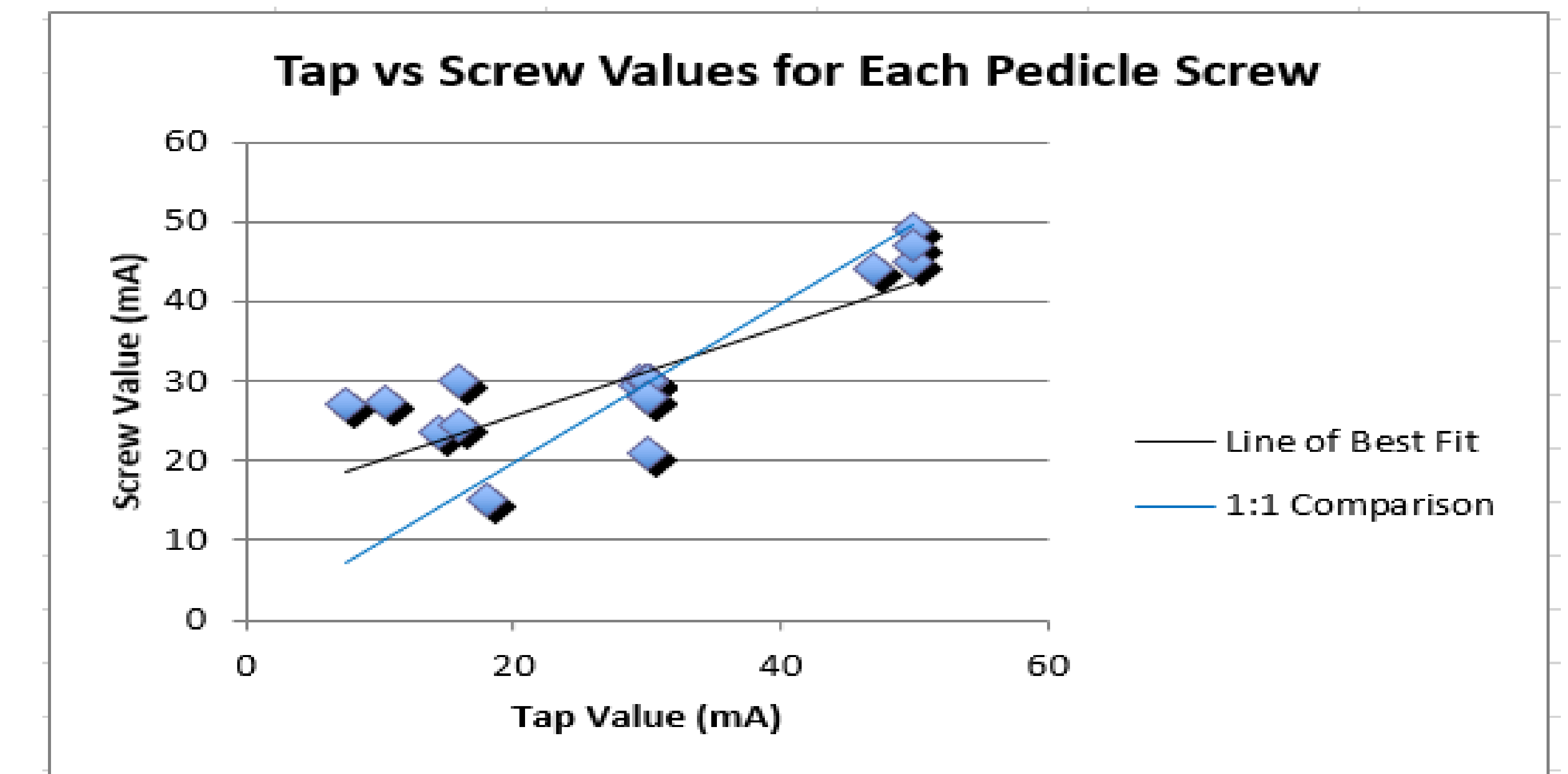
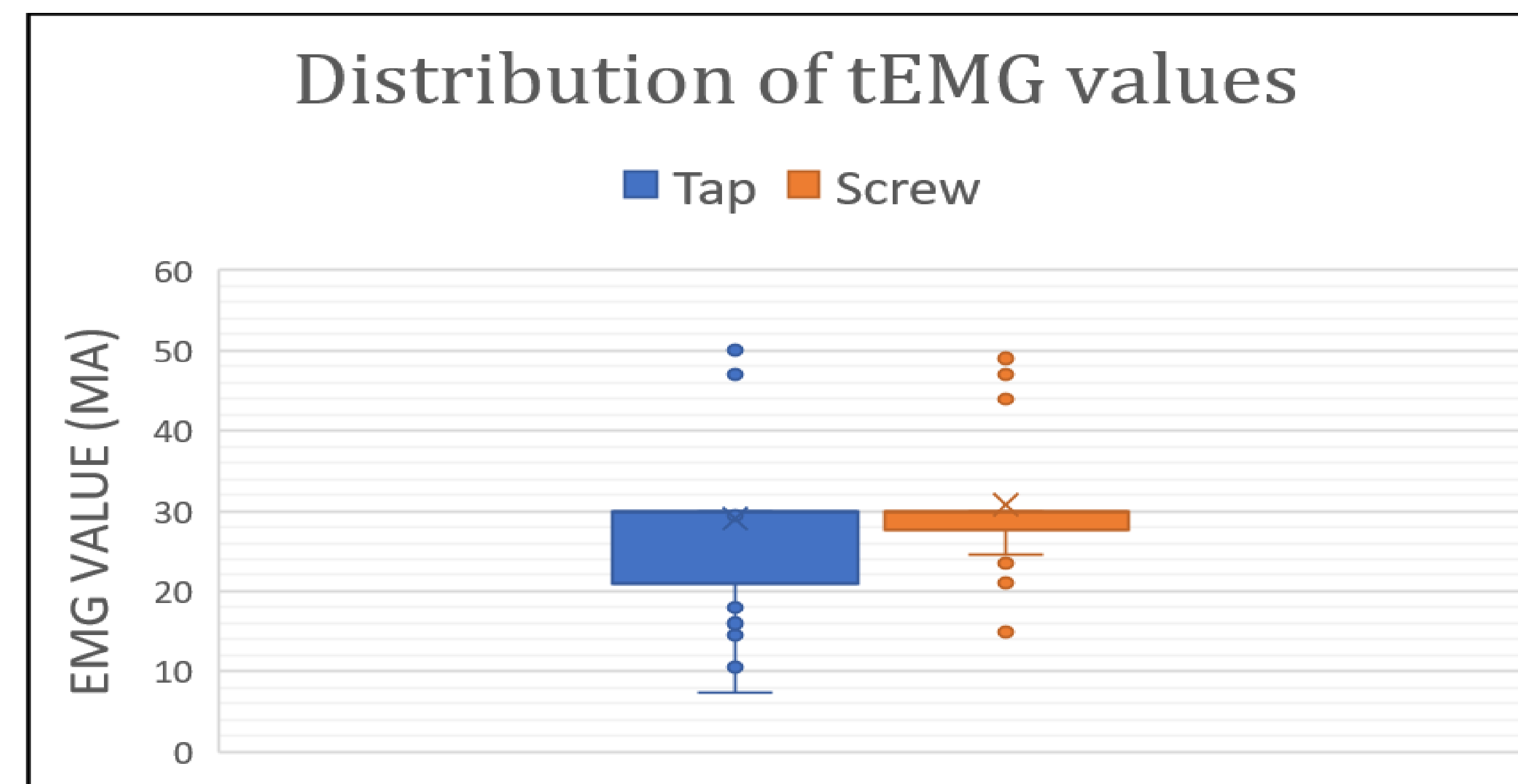
Proper placement of pedicle screws prevents both pedicle breach and nerve root irritation (Bindal et. al). There is a 5.5-40% incidence of pedicle breach with associated neurologic impairment in 1-11% (Loftus et. al). Historically, the pedicle screw has been used as the stimulating instrument. In this study, we investigated the utility of the tap as the stimulated instrument by comparing tEMG values obtained using both methods.

METHODS

- A retrospective analysis was performed at NYU Langone Medical Center including 10 patients who underwent spinal procedures between 12/2014 and 7/2019. Each patient had intraoperative neuromonitoring performed which utilized both the tap and the screw as the stimulated device.
 - Spinal levels L3-S1 were included
- For each patient, grounding was performed in the muscle near the incision at the same spinal cord level using both the tap and the screw. All measurements were included from the same procedure.
- If multiple values were taken for the same spinal root level, values were averaged.
- Upper limits were included at 30 or 50 depending on when the study values were taken.

RESULTS

Value	Tap	Screw	Tap - Screw
Mean (N=24)	29.09	30.79	-1.69
SD	11.68	7.96	1.41
Range	7.37 - 50	15 - 49	-19.62 - 9
			P=0.24



CONCLUSIONS

- On average, stimulation values obtained via the tap are lower than those obtained by the screw at the same nerve root level.
- Tap values underestimate that of screw – allowing it to serve as a cautious indicator of distance from nerve root to pedicle screw.
 - This may prove useful in the placement of pedicle screws, allowing surgeons to estimate risk of pedicle breach prior to placing the screw, minimizing rate of replacement.
- Stimulation of the tap serves as a possible alternative to typical stimulation of the screw during intraoperative neuromonitoring.

LIMITATIONS/FUTURE DIRECTIONS

Limitations:

- Values limited by upper range of 30 or 50
- Retrospective analysis
- Factors influencing results: Muscle relaxers, current shunting via blood, pre-existing conditions

Future Directions:

- Increase sample size
- Determine adequate cut-off for values
- Investigate accuracy of values

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