The “Shadow Sign”: A Radiographic Differentiation of Stainless Steel vs Titanium Spinal Instrumentation in Spine Surgery

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**Spinal Instrumentation**
- For many years initially spinal instrumentation was made of stainless steel (SS)
- For the past 10 years the shift of material has been to titanium (Ti)

**Ti Instrumentation**
- Biocompatibility
- Corrosion resistance
- MRI compatibility
- More closely approximates the modulus of normal bone compared to stainless steel
Why should you know beforehand?

- As with anything in our profession, poor planning can lead to poor results
- Revision: material compatibility?
- Imaging: MRI vs CT
- Often can’t rely on patients to know the details
- Charts may not be accessible to identify instruments
Shadow Sign

- Describes the relative radiolucency of one metal superimposed on itself, specifically Titanium vs Stainless steel
- Titanium rods and/or the screws seen on lateral radiographs overshadow each other but still allow the contour of the rods and screws to be seen
- Stainless steel rods on the other hand eclipse completely the other rod and screws
Titanium – with shadow

Stainless steel – no shadow
Methods

- We performed the Shadow Sign Study to **determine if physicians can determine the material of the implant on plain x-rays.**
- To test the validity of this “Shadow Sign,” **19 residents, 1 spine fellow, and 2 board-certified spine surgeons** were chosen to participate in an inter- and intra-rater reliability study.
- Tutorial - Participants were shown representative cases of stainless steel instrumentation and titanium instrumentation and explained the meaning of the “Shadow Sign”
Methods (cont’d)

- **16 cases** were chosen randomly from an extensive radiographic database of all spinal surgery cases done in a University setting from 2005 to 2009.
  - 8 Ti, 8 SS
  - Using 5.5 mm rods from the same vendor
  - Indication for surgery: Scoliosis correction
Methods (cont’d)

- No consideration for the quality of the films
- Using an online survey, participants were asked to identify the type of metal and answer a questionnaire.
- Kappa values for inter- and intra-rater reliability analysis were computed using Minitab.
## Results

### Kappa values

<table>
<thead>
<tr>
<th></th>
<th>Kappa value</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement between raters and gold standard</td>
<td>0.83</td>
<td>0.053</td>
</tr>
<tr>
<td>Agreement between raters</td>
<td>0.71</td>
<td>0.016</td>
</tr>
<tr>
<td>Agreement within raters</td>
<td>0.70</td>
<td>0.016</td>
</tr>
</tbody>
</table>
Results
Kappa values

- Kappa coefficients showed that the “Shadow Sign” produced substantial to excellent agreement between and within raters.

- This study attempts to illustrate that **plain lateral x-rays can be viewed to discern the type of spinal instrumentation implanted** into a patient even in the absence of medical records.
Answer: C
Disclosure: None of the authors of this study has identified any possible conflicts of interest.

Thank you: For your attention!