

Justin S. Smith MD, PhD; Eric Klineberg MD; Christopher I. Shaffrey MD, FACS; Tamir T. Ailon MD, MPH; Virginie Lafage PhD; Frank Schwab MD, PhD; Shay Bess MD; Alan H Daniels MD; Malla Keefe; Justin K Scheer BS; Themistocles Protopsaltis MD; Jens Chapman MD; Michael G. Fehlings MD, PhD, FRCS(C), FACS; Christopher P. Ames MD; International

Introduction

A recent study demonstrated that long-cassette x-rays can have significant impact on surgical planning for lumbar pathology. It remains unclear whether long-cassette x-rays may be similarly impactful for cervical pathology, especially since some cervical pathologies may be directly related to the TL spine.

Methods

15 cases of cervical pathology were presented with a brief vignette and cervical imaging (x-rays and MRI/CT) (**Figures A-C**). Surgeons were asked to select a surgical plan, with 6 choices, ranging from least aggressive (cervical anterior-

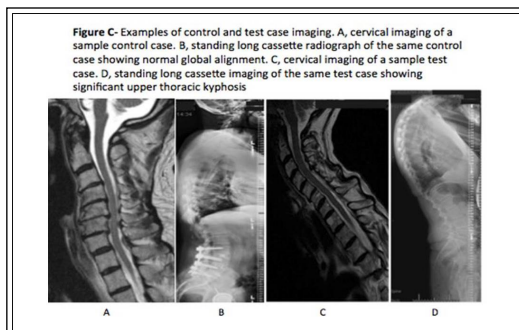
Figure A- Sample case with cervical imaging and a brief clinical vignette.



Figure B- Surgical options for the survey cases

Surgical Plan:

- Anterior cervical discectomy ± corpectomy and fusion at one or more levels
- Posterior cervical decompression and fusion ± extension to T1, T2 or T3 ± low-grade osteotomy
- Combined anterior and posterior cervical decompression and fusion ± extension to T1, T2 or T3 ± low-grade osteotomy
- Posterior cervical fusion with extension to mid or lower T-spine or posterior T-spine procedure only ± low-grade osteotomy
- Posterior three-column osteotomy (C7 or T1) with cervical fusion ± extension to T1, T2 or T3
- Posterior three-column osteotomy at or below mid-thoracic region ± thoracic fusion ± lumbar fusion



only with discectomy/corpectomy at one or more levels and fusion; 1 point) to the most aggressive (posterior 3- column osteotomy at or below mid-thoracic region with T/L fusion; 6 points). Cases were then reordered and presented with long-cassette standing x-rays and the same question. Results were compared based on cervical imaging only vs addition of long-cassette x-rays. 5 cases (controls) had normal global alignment and 10 cases (study group) had global malalignment.

Results

157 surgeons completed the survey, predominantly from North (28%) or South (36%) America and Asia (15.6%). Specialties included orthopedic surgery (62%) and neurosurgery (38%), 79% completed spine fellowship, and responders had a mean 14 yrs in practice that was a mean of 78% spine (32% cervical) and 21% deformity. For study cases, extent of recommended surgery increased significantly with addition of long-cassette x-rays vs cervical imaging only ($p=0.003$) (**Figure D, Table**). For control cases, no

Figure D- Change in the mean response score on addition of standing full cassette imaging. Increased slope indicates greater increase in the mean response scores. A-control cases, B- Test cases of which, case nos. 4,5,6,7,8 and 9 belong to Group A and case nos. 1,2,3 and 10 belong to Group B.

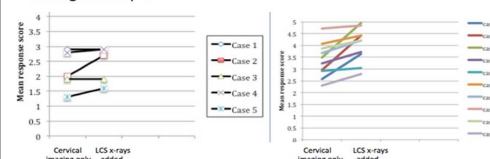


Table: Survey Analysis. A- Mean response score for cervical imaging only, B- Mean response score with addition of LCS x-rays, C- % of participants choosing options D, E and F with cervical imaging only, D- % of participants choosing options D, E and F after addition of LCS x-rays. Significant results are shown in bold characters.

| Survey Cases | n | A | B | Significance (P<. 05) | C (%) | D (%) | Significance (P<. 05) |
|--------------|----|------|------|-----------------------|-------|-------|-----------------------|
| Control | 5 | 2.21 | 2.48 | .106 | 6 | 12.4 | .122 |
| Test | 10 | 3.38 | 4.03 | .003 | 42.5 | 59.9 | .002 |
| Group A test | 6 | 3.75 | 4.08 | .005 | 51.6 | 61 | .015 |
| Group B test | 4 | 2.83 | 3.95 | .018 | 29 | 58.3 | .012 |

significant changes in surgery plans were identified with addition of long-cassette x-rays ($p=0.106$). For test cases, 42.5% of the participants opted for surgical options D, E or F when they were provided with the cervical imaging only. This increased to 59.9% ($p=0.002$) when the long-cassette radiographs were also included. For group A test cases with evidence of thoracic spine involvement as observed in the cervical imaging studies, this increased from 51.6% to 61% ($p=0.01$). For the group B test cases in which no evidence of thoracic spine involvement was noted in the cervical imaging, 29% of participants initially opted for options D, E and F; which significantly increased to 58.9% upon additional of long-cassette radiographs ($p=0.001$). Conversely, for control cases, the proportion of participants choosing options D, E or F changed only minimally with the addition of long-cassette radiographs from 6% to 12.4% ($p=0.12$).

Conclusions

Long-cassette x-rays can have significant impact on surgical planning for cervical pathology. Spine surgeons should maintain a relatively low threshold for obtaining long-cassette standing x-rays when planning surgical treatment for significant cervical spine pathology. In cases where global malalignment was present, addition of long-cassette radiographs appears to significantly influence surgical decision-making.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) recognize the importance of global alignment when examining cervical pathologies, and 2) understand the role of long-cassette standing x-rays in planning for surgical treatment of cervical deformity.

References

- Maggio D, Ailon T, Smith JS, et al. Assessment of impact of long-cassette radiographs on surgical planning for lumbar pathology: an international survey of spine surgeons. *J Neurosurg Spine* (in press).
- Scheer JH, Tang T, Smith JS, et al. Cervical spine alignment, sagittal deformity, and clinical implications: a review. *J Neurosurg Spine*. 2013;19(2):141-59.