

# Assessment of Surgical Treatment Strategies for Moderate to Severe Adult Cervical Deformity Reveals Marked Variation in Approaches, Osteotomies and Fusion Levels

Justin S. Smith MD, PhD; Eric Klineberg MD; Themistocles Protopsaltis MD; Munish Gupta MD; Douglas C. Burton MD; Vedat Deviren MD; Robert Eastlack MD; Marilyn Gates MD; Justin K Scheer BS; Malla Keefe; Peter G Passias MD; Gregory Mundis MD; D. Kojo Hamilton MD; Robert Hart MD; Shay Bess MD; Christopher P. Ames MD; International Spine Study

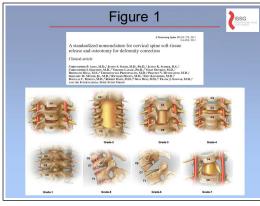
### Introduction

Although previous reports suggest that surgery can improve the pain and functional impact of adult cervical deformity (ACD), approaches and techniques are not standardized.

## Methods

18 ACD cases ranging from moderate to severe deformity were assembled, including a clinical vignette, cervical imaging (x-rays, CT/MRI), and fulllength standing x-rays. Cases were reviewed by a panel of deformity surgeons who were queried regarding recommended surgical plan. Plans were compared across surgeons and by deformity type. To help standardize response, surgeons were requested to specify any

recommended osteotomies based on a recently published nomenclature for soft tissue release and osteotomy (**Fig 1**).



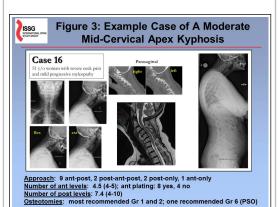
#### Results

The panel included 14 surgeons (10 orthopedic, 4 neurosurgery) that had a mean of 11 yrs in practice, performed an average of 80 instrumented cervical cases/yr,

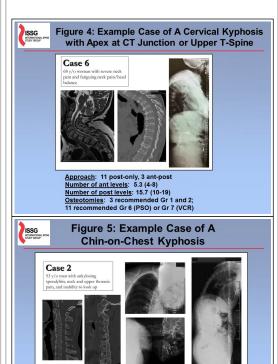
including a mean of 20 ACD cases/yr. There was marked variation in treatment plans across all deformity types (**Fig 2**). Even for the least

Figure 2				
Deformity Type	Approach	Ant Levels, mean (range)	Post Levels, mean (range)	Osteotomies
Moderate mid-cervical apex kyphosis (n=8)	•Ant 25%	4.0 (2-6)	8.2 (4-16)	<ul> <li>Most rec facet releases</li> </ul>
	•Post 25%			and SPOs
	•A-P 50%			•3 surgeons rec PSO in C/T spine
Cervical kyphosis with apex at CT-junction or upper T-spine	•Post 86%	4.7 (4-8)	13.9 (7-19)	•78% rec PSO or VCR in
	•A-P 14%			C/T spine
Chin-on-chest cervical kyphosis (n=2)	•Post 82%	4.5 (4-5)	13.2 (7-27)	•72% rec PSO or VCR in
	•A-P 15%			C/T spine
	•540° 3%			<ul> <li>2 surgeons rec PSO in L spine</li> </ul>
Mild cervical kyphosis with mid-thoracic kyphosis (n=2)	•Ant 11%	5.5 (2-8)	12.8 (4-22)	+43% rec PSO or VCR in
	•Post 64%			C/T spine
	•A-P 25%			
Cervical/CT scoliosis (n=2)	•Ant 2%	3.3 (2-5)	11.7 (6-19)	+41% rec PSO or VCR in
	•Post 48%			C/T spine
	•A-P 33%			
	•540° 17%			

complex deformities (moderate midcervical apex kyphosis), there was lack of agreement on approach (50% combined A-P, 25%, ant-only, 25% post-only), number of fusion levels: anterior (range: 2-6) and posterior (range: 4-16), and types of osteotomies (**Fig 3**). As the kyphosis apex moved caudally (CT junction/upper T-spine) and cases with chin-on-chest kyphosis, >80% of surgeons agreed on a post-only approach and >70% recommended a

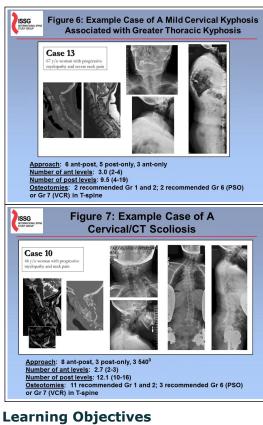


PSO or VCR, but the range in number of anterior (4-8) and posterior (4-27) fusion levels was exceptionally broad (**Fig 4 and 5**). For cases with mild



Approach: All 14 post-only Number of post levels: 14.1 (7-27) Osteotomies: 2 recommended Gr 1-4 only; 12 recommended Gr 6 (PSO) or Gr 7 (VCR); 2 also recommended additional lumbar PSO

cervical kyphosis associated with a greater degree of thoracic kyphosis, the majority of surgeons recommended a posterior-only approach (64%), but there was a considerable range in the number of anterior (range: 2-8) and posterior (range: 4-22) fusion levels (**Fig 6**). Cases of cervical/CT scoliosis had the least agreement in approach and had broad variation in number of anterior (range: 2-5) and posterior (range: 6-19) fusion levels, and recommended osteotomies (41% PSO/VCR) (**Fig 7**).



TERNATIONAL SPINE

 understand the wide variability of treatment recommendations for ACD
 recognize the importance of determining which surgical treatment approaches may be associated with better outcomes.

#### Conclusions

Among a panel of deformity surgeons, there is marked lack of consensus on recommended surgical approach, osteotomies and fusion levels for ACD. Further study is warranted to assess whether specific treatment approaches may be associated with better outcomes.