An International Consensus on the Appropriate Treatment of Adults with Spinal Deformity

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An AOSpine Knowledge Forum Deformity Study

Introduction

- The management of adult spinal deformity is characterized by significant variability
  - Indications for surgery/ Goals of Surgery
  - Preoperative preparations
  - Intraoperative strategies
  - Postoperative care

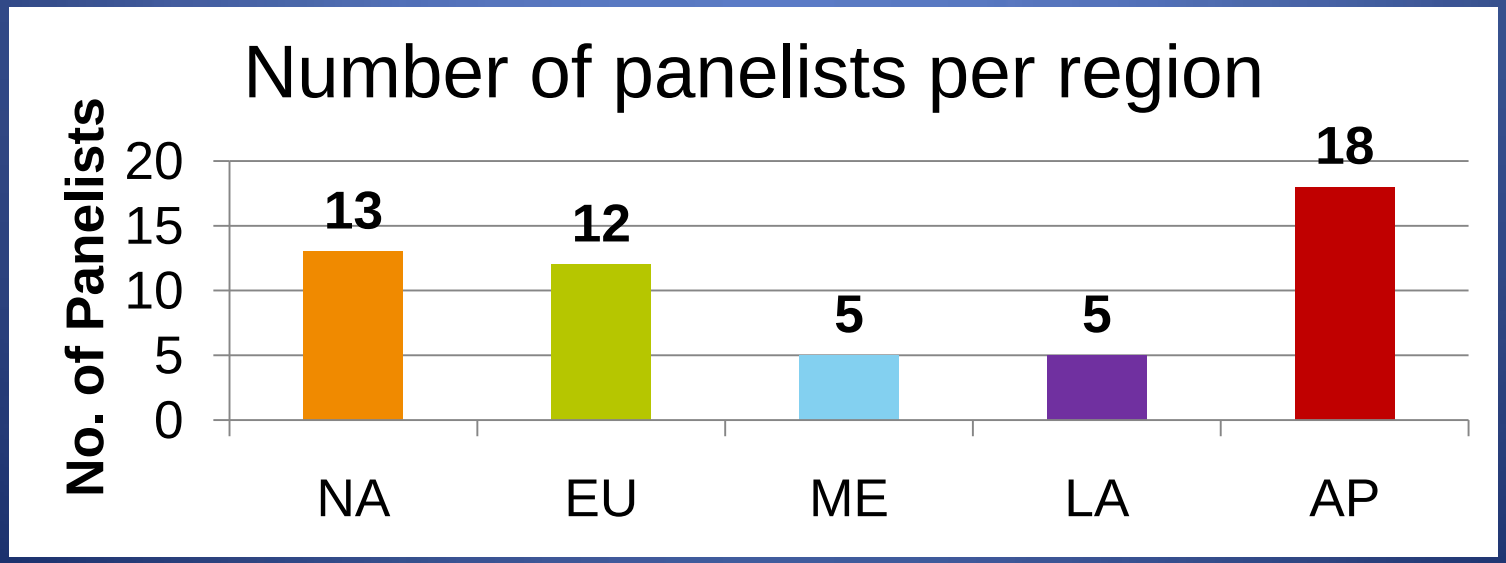
- Purpose
  - define appropriateness and inappropriateness
  - of specific approaches and management strategies
  - for the treatment of adults with spinal deformity

Material and Methods

Expert Opinion

based upon evaluation of specific case scenarios
by a panel of 53 surgeons
from 24 countries
representing global diversity

Received a 96-100% response rate



Material and Methods

Delphi Method

Purpose

- Technique used to collect information to establish consensus
- Expert group of individuals (panelists)
- Flexible, but should contain:
  - Anonymity
  - Iterative process
  - Summaries for participants

Appropriate Use Criteria

Instructions for Rating Management Procedures and Strategies (Fitch et al. 2001)

Consensus findings for preoperative assessment of risk factors for surgery and poor prognosis for ASD patients

Area	Item	Consensus
Patient History – Collecting and evaluating:	• Medication history • Surgical history (i.e., previous spine operation) • Duration of symptoms • Level of pain • Social support *for patients > 65 years of age*	Appropriate
	• Family history of degenerative adult deformity • Prior hospitalization	No Consensus
Patient Smoking History – Collecting and evaluating:	• Patient's smoking history through patient reporting • Patient's smoking cessation *in patients who smoke > 1 pack per day (for elective surgery)*	Appropriate
	Patient's smoking cessation (never)	Inappropriate
	Patient's smoking history through urine/ blood testing	No Consensus
Cardiovascular Condition – Performing a cardiac stress test (chemical or exercised-based) in patients with:	• *Significant co-morbidity (i.e., remote myocardial infarction, blood pressure, and cholesterol medications)* • *History of congestive heart failure*	Appropriate
	No pulmonary complaints (no shortness of breath, good tolerance to walking 3 flights of stairs), healthy, 40-65 years old	No Consensus
Pulmonary Condition – Performing a pulmonary function test with spirometry in patients with:	*History of pulmonary co-morbidity (i.e., chronic obstructive pulmonary disease, asthma), ≥ 40 years old*	Appropriate
	No pulmonary complaints (no shortness of breath, good tolerance to walking 3 flights of stairs), healthy, 40-65 years old	No Consensus
Body Mass Index (BMI) – Evaluating:	BMI in order to stratify risk or to guide treatment	No Consensus
Bone Quality – Evaluating:	• Bone mineral density with DEXA *in patients with history of insufficiency fracture (low energy fracture of extremity and spine)* • Bone quality/ presence of osteoporosis *in patients with known risk factors for osteoporosis*	Appropriate
	Bone quality/ presence of osteoporosis (never)	Inappropriate
	Bone mineral density with DEXA *in a > 65 year old female patient with no known history of osteoporosis (no history of fragility fractures)*	No Consensus
Patient Physical Exam – Evaluating:	• Gross motor function and knee and ankle reflexes by performing a neurological exam • Gait (ability to walk) • Pelvic tilt (physical assessment of pelvic version) • Hip flexion contracture • Skin (surgical site, legs for pigmentation and signs of venous stasis and arterial disease) • Peripheral pulses	Appropriate

Consensus findings for preoperative imaging for ASD patients

Imaging Modality	Item	Level of Consensus
X-ray	• Full standing anterior-posterior and lateral films • 3D full body standing image (e.g., EOS) (if available in your clinic/ country)	Appropriate
MRI of the Lumbar Spine	Planned lumbar fusion, with or without no neural symptoms	Appropriate
MRI of the Thoracic Spine	Planned lumbar or thoracic and lumbar fusion, with myelopathy	Appropriate
	Planned lumbar or thoracolumbar fusion, without neural symptoms	No Consensus
MRI of the Cervical Spine	Planned lumbar or thoracic and lumbar fusion, with myelopathy	Appropriate
	Planned lumbar or thoracolumbar fusion, without neural symptoms	No Consensus
CT	Previous laminectomy	Appropriate
	No history of previous surgery	No Consensus
CT Myelogram of the Lumbar Spine	No history of previous surgery, when preoperative MRI is available	Inappropriate
	No history of previous surgery	No Consensus

Consensus findings for surgical procedures for ASD patients

Area	Item or patient scenario	Consensus
Decompression alone	Symptomatic stenosis within a 30° lumbar scoliosis: • progressive curve, sagittally balanced • stable curve, sagittal imbalance	Inappropriate
	Symptomatic stenosis on the CONVEX or CONCAVE apex of 30° lumbar scoliosis: • stable curve, sagittally balanced	No Consensus
Decompression with limited fusion	Symptomatic stenosis within a 60° lumbar scoliosis: • stable curve, sagittal imbalance	Inappropriate
	• Symptomatic stenosis within a 60° lumbar scoliosis and: - stable curve, with trunk shift of 4 cm to the left, sagittally balanced - stable curve, sagittally balanced Symptomatic stenosis within a 30° lumbar scoliosis and: - stable curve, sagittal imbalance - stable curve, sagittally balanced	No Consensus
Decompression with long fusion	• Sagittal imbalance, no comorbidities • Coronal deformity > 60°, with trunk shift > 4 cm to the left, no comorbidities	Appropriate
	• Sagittal imbalance, osteoporotic, coronary artery disease • Coronal deformity > 60°, with trunk shift > 4 cm to the left, osteoporotic, coronary artery disease	No Consensus
Lumbosacral fusion (LIV) –Interbody support at L5-S1	With intermediate posterior fusion (lower thoracic spine to L5), sagittally balanced, non-osteoporotic, no disc degeneration at L5-S1	Appropriate
	L5 in patients with long fusion (> 7 segments) and symptomatic pathology at L5-S1	Inappropriate
	Anterior column support with ALIF or posterior interbody approach to the L5-S1 segment for a long fusion from T12 to S1	Appropriate
Lumbosacral fusion (LIV) –Pelvic fixation (T10-S1)	• Osteoporotic and: sagittal plane deformity (> 5 cm) severe deformity (trunk shift > 4 cm, sagittal deformity > 5 cm) sagittally balanced • Non-osteoporotic and severe deformity (trunk shift > 4 cm, sagittal deformity > 5 cm)	Appropriate
	• Non-osteoporotic and: - sagittal plane deformity (> 5 cm) - sagittally balanced	No Consensus
Lumbosacral fusion (LIV) –Pelvic fixation (L2-S1)	Osteoporotic, sagittal imbalance	Appropriate
	• Osteoporotic, sagittally balanced • Non-osteoporotic, sagittally balanced • Non-osteoporotic, sagittal imbalance	No Consensus
Lumbosacral fusion (UIV) Thoracolumbar junction (T9-L1)	• Thoracic kyphosis (< 30°), sagittally balanced, non-osteoporotic	Appropriate
	• Thoracic kyphosis (> 50°), sagittally balanced, non-osteoporotic	No Consensus

Consensus findings for novel intraoperative techniques for ASD patients

Area	Item or patient scenario	Consensus
Cement Augmentation	UIV and UIV +1 in T10-S1, non-osteoporotic	Inappropriate
	UIV and UIV +1 in T10-S1, osteoporotic	No Consensus
Percutaneous Fixation	Coronal deformity (> 60°), bends to 30°, severe sagittal imbalance (SVA > 100 mm)	Inappropriate
	• Coronal deformity (> 60°), bends to 30°, moderate sagittal imbalance (SVA 50-100 mm) • Coronal deformity (> 60°), bends to 30°, sagittally balanced • Rigid coronal deformity >30°	No Consensus
Ponte Osteotomy	Rigid lumbar hypolordosis, sagittal imbalance, immobile discs in the anterior column with rigidly fused anterior interbody/ ankyloses	Inappropriate
	Mobile anterior column and: - coronal deformity (> 60°), severe sagittal imbalance (SVA > 100 mm) - coronal deformity (> 60°), moderate sagittal imbalance (SVA 50-100 mm) - trunk shift 6 cm with level shoulders, sagittally balanced	No Consensus
Pedicle Subtraction Osteotomy	Rigid lumbar hypolordosis, age 40-65 years, no comorbidities, and: - sagittal imbalance - 4 cm trunk shift and level shoulders	Appropriate
	Rigid lumbar hypolordosis, age > 65 years, osteoporotic, coronary artery disease, and: - sagittal imbalance - 4 cm trunk shift and level shoulders	No Consensus
Vertebral Column Resection	Rigid thoracic deformity with 4 cm trunk shift to the left and: - level shoulders, age 40-65 years, no comorbidities - level shoulders, age > 65 years, osteoporotic, coronary artery disease - right shoulder elevated with a convex right thoracic deformity, age 40-65 years, no-comorbidities - right shoulder elevated with a convex right thoracic deformity, age > 65 years, osteoporotic, coronary artery disease	No Consensus

Conesnsus findings for postoperative management strategies for ASD patients

Area	Item or patient scenario	Level of Consensus
DVT prophylaxis –Early mobilization	Low risk of DVT	No Consensus
DVT prophylaxis –Mechanical	Low risk of DVT	Appropriate
DVT prophylaxis –Chemical	High risk of DVT	Appropriate
	Low risk of DVT	No Consensus
DVT prophylaxis –Coumadin	• High risk of DVT • Low risk of DVT	No Consensus
Return to activity	• Sedentary work by 3 months postoperative • Cycling at 1-year postop	Appropriate
	• Manual labor at 1 month postoperative • Contact sports after a long fusion (> 7 segments) when the patient is fully healed and there is good bony fusion	Inappropriate
	• Manual labor, hiking, dance, yoga, golf, tennis by 1 year postoperative • Sedentary work by 6 months after long fusion • Contact sports after a short fusion (< 5 segments) when the patient is fully healed and there is good bony fusion	No Consensus

The goals of care in adult spinal deformity ranked by the panelists in the order of importance on a 10-point scale where 1 is most important and 10 is least important.

Goals of care in adult spinal deformity	Mean Rank
Functional improvement (improvement in the ability to perform activities of daily living)	2.1
Pain improvement	2.6
Neural improvement (improvement of weakness or sensory function)	3.5
Safety	4.4
Prevention of deformity progression	6.0
Radiographic improvement of spinal alignment (SAGITTAL)	6.1
Achieving a solid arthrodesis	6.5
Avoidance of short term complications (i.e. urinary tract infection, pneumonia)	7.5
Avoidance of long term complications (i.e. pseudarthrosis, adjacent segment disease)	7.7
Optimizing value (benefit measured as health related quality of life versus unit cost)	8.5

Conclusions

- An evidence-based approach
  - for the management of adult spinal deformity
  - based upon expert consensus
  - regarding appropriateness
  - provides guidance for informed decision-making for
    - patients
    - and health care providers
  - serves to reduce variability in care
  - improves quality of care

- Variability will remain due to considerations including patient values and preference, physician preferences and skills, and cost and value considerations.

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