Adolescent Idiopathic Scoliosis Spinal Fusion Pathway

July 1, 2019

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**Definition**

**Scoliosis**

Scoliosis is defined as curvature of the spine in the coronal plane greater than 10 degrees (as measured by the Cobb angle). Idiopathic scoliosis is scoliosis with no definite etiology. Adolescent idiopathic scoliosis (AIS) is scoliosis that presents in a patient at age 10 or older and accounts for 80-85 percent of scoliosis cases (Workman J.K, Wilkes J., Presson A.P, et al., 2018).

**Scoliosis surgical correction**

Treatment modalities for scoliosis include observation, bracing, and surgery. Surgical correction is indicated for skeletally immature and mature patients with curves with a Cobb angle greater than or equal to 50 degrees. Skeletally mature patients with curves between 40 and 50 degrees are managed by a provider on an individual basis (Workman J.K, Wilkes J., Presson A.P, et al., 2018).

Surgical treatment of AIS is done by a spinal fusion procedure. Spinal fusions can be done posteriorly or anteriorly; posterior spinal fusion with instrumentation and bone grafting is the most common surgical procedure for AIS correction. The primary surgical treatment goal for AIS is prevention of curve progression and the secondary goal is improved quality of life, including enhanced patient reported self-image, function, and level of activity (Workman J.K, Wilkes J., Presson A.P, et al., 2018).

Common barriers in the immediate postoperative period for spinal fusion patients include delayed mobilization, delayed return of bowel function, pain management, opioid use side effects, and prolonged hospitalization. Literature supports the use of a rapid recovery pathway for AIS spinal fusion patients that focuses on early mobilization, early initiation of a bowel regimen, early transition from intravenous opioid pain management to oral opioid and non-opioid analgesic pain management, and multimodal pain regimens to mitigate common postoperative barriers to full functional recovery (Muhly WT, Sankar WN, Ryan K, et al., 2016).

**Epidemiology**

AIS is the most common spinal condition that requires surgery in children (Fletcher N., Lazarus D., Bruce R., et al., 2018). The prevalence of AIS is approximately 1 to 3 percent; only 0.3 percent of the AIS population require treatment (Shan L.Q, Skaggs D.L, Lee C., et al, 2013). Males and females are affected equally, but the risk of curve progression is 10 times higher in females. Overweight or obese patients seem to have increased severity of AIS on initial presentation, possibly due to delayed detection.
From 2001 to 2011, an average of 5,000 AIS spinal fusions were performed annually in North America (Muhly WT, Sankar WN, Ryan K, et al., 2016).

**Etiology**

There is no clear etiology of AIS. Literature supports a potential genetic component. There is also research that proposes abnormalities in growth hormone secretion, connective tissue structure, paraspinal musculature, vestibular function, melatonin secretion, and platelet microstructure may contribute to the pathogenesis of AIS (UpToDate, 2019).

**Guideline Eligibility Criteria**

Patients with a diagnosis of AIS undergoing a spinal fusion procedure, aged 10-18.

**Guideline Exclusion Criteria**

Patients with a scoliosis diagnosis undergoing a spinal fusion procedure secondary to trauma or cerebral palsy, muscular dystrophy, spina bifida, or other similar birth defect or syndrome

### Evidence Found with Searches

<table>
<thead>
<tr>
<th>Check Type of Evidence Found</th>
<th>Summary of Evidence – All Questions</th>
<th>Number of Articles Obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒</td>
<td>Systematic Reviews</td>
<td>2</td>
</tr>
<tr>
<td>☐</td>
<td>Meta-analysis articles</td>
<td></td>
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<tr>
<td>☒</td>
<td>Randomized Controlled Trials</td>
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</tr>
<tr>
<td>☒</td>
<td>Non-randomized studies</td>
<td>7</td>
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<tr>
<td>☒</td>
<td>Review articles</td>
<td>1</td>
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<tr>
<td>☐</td>
<td>Government/State agency regulations</td>
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<tr>
<td>☒</td>
<td>Professional organization guidelines, white papers, ect.</td>
<td>2</td>
</tr>
<tr>
<td>☐</td>
<td>Other:</td>
<td></td>
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</tbody>
</table>
The GRADE criteria were used to evaluate the quality of evidence presented in research articles reviewed during the development of this guideline. The table below defines how the quality of evidence is rated and how a strong versus a weak recommendation is established.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Strong</th>
<th>Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Desirable effects clearly outweigh undesirable effects or vice versa</td>
<td>Desirable effects closely balanced with undesirable effects</td>
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</table>

<table>
<thead>
<tr>
<th>Type of Evidence</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
<th>Very Low</th>
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<tbody>
<tr>
<td></td>
<td>Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies</td>
<td>Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies</td>
<td>Evidence for at least 1 critical outcome from observational studies, from RCTs with serious flaws or indirect evidence</td>
<td>Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence</td>
</tr>
</tbody>
</table>

**Recommendations**

<table>
<thead>
<tr>
<th>Evidence Supports</th>
<th>Evidence Lacking/Inconclusive</th>
<th>Evidence Against</th>
</tr>
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<tbody>
<tr>
<td>Use of a standardized rapid recovery pathway for the healthy, AIS spinal fusion patients developed by a group of multidisciplinary stakeholders using evidenced based research and expert opinion.</td>
<td>Pre-operative carbohydrate loading facilitates an early return of bowel function in pediatric spinal fusion patients.</td>
<td>Use of a traditional post-operative spinal fusion pathway that does not emphasize early mobilization, early initiation of bowel regimen and regular diet, and early transition to oral analgesic from IV narcotics and antispasmodics.</td>
</tr>
<tr>
<td>Early mobilization, early initiation of a bowel regimen, and an early transition to oral analgesic from IV narcotics and antispasmodics.</td>
<td></td>
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</tr>
<tr>
<td>The healthy, AIS post-operative spinal fusion patient can be managed on the surgical floor without compromising patient safety or patient outcomes.</td>
<td></td>
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<tr>
<td>A multi-modal pain approach is effective for post-operative spinal fusion patients.</td>
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<tr>
<td>Preoperative carbohydrate loading may help with the post-operative surgical stress response, thirst, hunger, anxiety, &amp; malaise in surgical patients.</td>
<td></td>
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<tr>
<td>Post-operative gum chewing may facilitate a quicker return to normal bowel function in pediatric spinal fusion patients.</td>
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<td></td>
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<tr>
<td>Managing patient expectations and education before surgery may enhance patient satisfaction post-operatively.</td>
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</table>
EXCLUSION CRITERIA
Scoliosis secondary to:
- Cerebral palsy
- Muscular dystrophy
- Spina Bifida
- Similar birth defect or syndrome
- Spinal Injury

Inclusion Criteria
Patients undergoing a spinal fusion with a diagnosis of adolescent idiopathic scoliosis age 10-18

Anesthesia Pre Op

Post Op Day 0
- Disposition- IMC/PICU or 3N
- Management
- Goals

Post Op Day 1
- Disposition- Transfer to 3N if not already there
- Management
- Goals

Post Op Day 2
- Management
- Goals

Post Op Day 3
- Management
- Goals

Discharge Criteria
- Tolerating Oral Analgesia and pain controlled
- PT/OT Clearance
- Tolerating Diet
- Urinating without difficulty, passing gas/
- abdomen soft and non-distended

Meets Discharge Criteria? 1

Discharge
Anesthesia consult checklist preoperative appointment:

1. **Education given to family at pre-admission testing appointment:**
   a. Discuss plan and associated risks including: Endotracheal tube (ETT), Total intravenous anesthesia (TIVA), IVs, possible central line, arterial line, pain management, wake up test, risk of vision loss, potential need for blood transfusion, post-op facial swelling, and pressure points.
   b. Give time of arrival for surgery and where to check in
   c. NPO instructions
   d. Instruct patient to drink 10-12 oz of clear carbohydrate drink 2 hours prior to arrival (Gatorade, apple juice, etc.), if possible
   e. Bring chewing gum to use post-operatively if patient able to chew gum
   f. Bathing protocol- Per Physician Preference

2. **Pre-operative Anesthesia Labs:**
   - CBC
   - PT, PTT, INR
   - TEG & fibrinogen
   - Pregnancy Test
   - Type & Screen

3. **Anesthesia to order appropriate medications at pre-admission testing appointment, including:**
   a. Premeds for anxiety or nausea as indicated
   b. Order Acetaminophen and Gabapentin per spine guidelines:
      i. Gabapentin 600 mg for patients weighing > 50 kg or 10 mg/kg/dose for patients <50 kg. Take one dose in the morning on DOS
      ii. Acetaminophen 15 mg/kg/dose. Take one dose in the morning on DOS

4. **Preadmissions Nursing**
   a. Obtain weight and height and record in Compass
   b. Draw ordered lab work. Send for diagnostic testing if indicated.
   c. Arrange for EKG if ordered
   d. Sign and witness surgical and anesthesia consent
<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Nursing Assessment</td>
<td>VS q2, Neurovascular assessment of UE and LE q2. Braden Q q12, notify MD if change is NV status</td>
<td>VS q4, neurovascular q4, Braden Q q12, notify MD if change is NV status</td>
<td>VS q4, neurovascular q4, Braden Q q12, notify MD if change is NV status</td>
<td>VS q4, neurovascular q4, Braden Q q12, notify MD if change is NV status</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Cont pulse ox &amp; O2 per protocol (greater than 92%). IS q2 while awake.</td>
<td>Cont pulse ox &amp; O2 per protocol (greater than 92%). IS q2 while awake.</td>
<td>Cont pulse ox as needed once PCA removed and O2 per protocol (greater than 92%), IS q2 while awake.</td>
<td>Cont pulse ox as needed once PCA removed and O2 per protocol (greater than 92%), IS q2 while awake.</td>
</tr>
<tr>
<td>Thromboprophylaxis</td>
<td>SCDs while in bed</td>
<td>SCDs while in bed</td>
<td>SCDs while in bed. Discontinue if OOB bid.</td>
<td>SCDs while in bed. Discontinue if OOB bid.</td>
</tr>
<tr>
<td>GU</td>
<td>Foley to gravity, Foley care qshift, strict I&amp;Os q4</td>
<td>DC Foley 6 am per orders unless otherwise noted by provider. I&amp;Os q4</td>
<td>I&amp;Os q4</td>
<td>I&amp;Os q4</td>
</tr>
<tr>
<td>Antibiotic Therapy</td>
<td>Per MD order</td>
<td>DC ANTBX 24 hours post-op. If drain present continue antibiotic per provider order.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet, Bowel</td>
<td>Maintenance IV fluids ordered, advance to clear as tolerated, begin bowel regimen, encourage gum chewing, fluids, ambulation.</td>
<td>Advance to regular diet as tolerated Continue bowel regimen Gum chewing Fluids, Ambulation</td>
<td>Regular diet Continue bowel regimen Gum chewing Fluids, Ambulation</td>
<td>Regular diet Continue bowel regimen Gum chewing Fluids, Ambulation</td>
</tr>
<tr>
<td>Skin</td>
<td>Full skin assessment qshift, monitor drain sites</td>
<td>Full skin assessment qshift, monitor drain sites</td>
<td>Full skin assessment qshift, monitor drain sites</td>
<td>Full skin assessment qshift, monitor drain sites</td>
</tr>
<tr>
<td>Dressing/Drains</td>
<td>Monitor surgical dressing q4 for saturation. Reinforce as needed, dressing change by MD only. Record hemovac output q4 if present.</td>
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<td>Monitor surgical dressing q4 for saturation. Reinforce as needed, dressing change by MD only. Record hemovac output q4 if present. Hemovac dc’ed by provider</td>
<td>Monitor surgical dressing q4 for saturation. Reinforce as needed, dressing change by MD only. Record hemovac output q4 if present. Hemovac dc’ed by provider</td>
</tr>
<tr>
<td>Activity</td>
<td>OOB to chair with nurse or PT night of surgery. No bending, lifting or twisting.</td>
<td>OOB to chair, Ambulate bid as tolerated. No bending, lifting or twisting.</td>
<td>OOB to chair, Ambulate bid. No bending, lifting or twisting.</td>
<td>OOB to chair. Ambulate bid. No bending, lifting or twisting.</td>
</tr>
<tr>
<td>Labs</td>
<td>Drawn in OR</td>
<td>CBC &amp; BMP</td>
<td>H&amp;H</td>
<td>H&amp;H</td>
</tr>
<tr>
<td>Discharge Planning</td>
<td>Reinforce education-pain management, transfers/precautions after spinal fusion, follow up appts</td>
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</tbody>
</table>

*See Pain Management Addendum for pain control*
<table>
<thead>
<tr>
<th>Pre-op</th>
<th>DOS</th>
<th>POD1</th>
<th>POD2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acetaminophen:</strong> 15mg/kg/dose PO x1 (Max dose 1,000mg)</td>
<td>IV PCA Morphine: Basal Rate: 0.01-0.15mg/kg/hr Bolus Dose: 0.015-0.02 mg/kg/dose every 15 min.</td>
<td>Discontinue IV PCA Morphine @0630 (30 minutes after 1st scheduled oxycodone)</td>
<td><strong>Scheduled Medications:</strong> Acetaminophen: PO per protocol q 6 hrs. Ketorolac: 0.25mg/kg/dose IV q 6 hrs. x 48 hrs. (max dose 30mg) Gabapentin: 5mg/kg/dose PO q 8 hrs. (Max dose 300mg). Total 5 doses. Last dose 0400 POD#2</td>
</tr>
<tr>
<td>Gabapentin: 10 mg/kg/dose PO x1 for &lt; 50kgs 600mg PO x1 for &gt; 50kg</td>
<td><strong>Scheduled Medications:</strong> Acetaminophen: PO per protocol q 6 hrs. Ketorolac: 0.25mg/kg/dose IV q 6 hrs. x 48 hrs. (max dose 30mg) (1st Ketorolac dose in PACU: 0.5mg/kg x 1) <em>per surgeon preference/medical hx</em></td>
<td>Gabapentin: 5mg/kg/dose PO q 8 hrs. (Total of 5 doses; Give 1st dose at 8pm) Diazepam: *0.1 mg/kg/dose 2-5mg PO q 6 hrs. x 24-48 hrs</td>
<td><strong>Diazepam:</strong> <em>0.1 mg/kg/dose 2-5mg PO q 6 hrs. x 24-48 hrs <strong>Oxycodone:</strong> Patients &lt; 44kg:0.1mg/kg/dose PO q 4 hrs. Patients &gt; 44kg order 5mg PO q 4 hours <strong>Step 2:</strong> Oxycodone prn breakthrough pain Patients &lt; 44kg: 0.05mg/kg/dose Patients &gt; 44kg: 5mg tablet x 1 PO prn <strong>ANESTHESIA SIGNS OFF TO ORTHO</strong> <strong>Based on assessment of the patient, medications dosages &amp;/or intervals may be changed. They may also be changed from scheduled to prn.</strong></em></td>
</tr>
<tr>
<td><strong>Gabapentin:</strong> 5mg/kg/dose PO q 8 hrs. (Total of 5 doses; Give 1st dose at 8pm)</td>
<td><strong>Diazepam:</strong> *0.1 mg/kg/dose 2-5mg PO q 6 hrs. x 24-48 hrs</td>
<td><strong>Diazepam:</strong> Change to q 6 hrs prn</td>
<td><strong>Diazepam:</strong> OR Discontinue Acetaminophen and Oxycodone Start Hydrocodone/Acetaminophen or Tramadol per home RX</td>
</tr>
<tr>
<td><strong>Diazepam:</strong> 0.1-0.2mg/kg/dose (5-10mg PO x 1)</td>
<td></td>
<td><strong>Oxycodone:</strong> Patients &lt; 44kg:0.1mg/kg/dose PO q 4 hrs. Patients &gt; 44kg order 5mg PO q 4 hours <strong>Step 2:</strong> Oxycodone prn breakthrough pain Patients &lt; 44kg: 0.05mg/kg/dose Patients &gt; 44kg: 5mg tablet x 1 PO prn</td>
<td><strong>Discontinue Acetaminophen and Oxycodone</strong> Start Hydrocodone/Acetaminophen or Tramadol per home RX</td>
</tr>
<tr>
<td><strong>Note:</strong> Order low dose Valium 2mg PO q 6 hours(not per kg dose) with back up IV Valium dose prn if not tolerating PO</td>
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## Management of Side Effects:

### Antiemetics:

<table>
<thead>
<tr>
<th>DOS</th>
<th>POD1</th>
<th>POD2</th>
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</table>
| **Zofran IV q 6 hours prn N/V**  
(dose: 0.1mg/kg/dose; max dose 4mg)  
Phenergan x 1 IV prn  
(dose per P&T protocol)  
Scopolamine Patch  
dose: 1mg patch/72 hours  
(for persistent/unrelieved N/V) | **Zofran IV q 6 hours prn N/V**  
(dose: 0.1mg/kg/dose; max dose 4mg)  
Phenergan x 1 IV prn  
(dose per P&T protocol)  
Scopolamine Patch  
dose: 1mg patch/72 hours  
(for persistent/unrelieved N/V) | **Zofran IV q 6 hours prn N/V**  
(dose: 0.1mg/kg/dose; max dose 4mg)  
Phenergan x 1 IV prn  
(dose per P&T protocol)  
Scopolamine Patch  
dose: 1mg patch/72 hours  
(for persistent/unrelieved N/V) |
| **Benadryl PO/IV q 6 hours prn itching**  
(dose: 0.5mg/kg/dose PO; max dose 25mg)  
(dose: 0.5mg/kg/dose IV; max dose 12.5mg)  
**Atarax** (if unrelieved by Benadryl)  
(dose: 0.5mg/kg/dose PO; max dose 25mg)  
**Nubain** (if unrelieved by Benadryl)  
(dose: 0.05mg/kg/dose IV; max dose 3mg) | **Benadryl PO/IV q 6 hours prn itching**  
(dose: 0.5mg/kg/dose PO; max dose 25mg)  
(dose: 0.5mg/kg/dose IV; max dose 12.5mg)  
**Atarax** (if unrelieved by Benadryl)  
(dose: 0.5mg/kg/dose PO; max dose 25mg)  
**Nubain** (if unrelieved by Benadryl)  
(dose: 0.05mg/kg/dose IV; max dose 3mg) | **Benadryl PO/IV q 6 hours prn itching**  
(dose: 0.5mg/kg/dose PO; max dose 25mg)  
(dose: 0.5mg/kg/dose IV; max dose 12.5mg)  
**Atarax** (if unrelieved by Benadryl)  
(dose: 0.5mg/kg/dose PO; max dose 25mg)  
**Nubain** (if unrelieved by Benadryl)  
(dose: 0.05mg/kg/dose IV; max dose 3mg) |

### Constipation:

**Scheduled Medications:**

<table>
<thead>
<tr>
<th>DOS</th>
<th>POD1</th>
<th>POD2</th>
</tr>
</thead>
</table>
| **Docusate**  
(dose: q 12 hours per P&T protocol)  
**Senna**  
(dose: q HS per P&T protocol) | **Docusate**  
(dose: q 12 hours per P&T protocol)  
**Senna**  
(dose: q HS per P&T protocol)  
**Miralax (max dose 17gm)**  
(dose: 17g PO q day; 17grams=1 packet) | **Docusate**  
(dose: q 12 hours per P&T protocol)  
**Senna**  
(dose: q HS per P&T protocol)  
**Miralax (max dose 17gm)**  
(dose: 17g PO q day; 17grams=1 packet) |
Executive Summary

Approved by the Pediatric Evidence-Based Outcomes Center Team

Revision History
Original Date Approved: July 1, 2019
Revision Dates:
Next Review Date: July 2022

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Recommendations
Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible.

Approval Process
EBOC guidelines are reviewed by DCMC content experts, the EBOC committee, and are subject to a hospital wide review prior to implementation. Recommendations are reviewed and adjusted based on local expertise.

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Evidence supporting the use of a standardized rapid recovery pathway including early mobilization and bowel regimen.


Evidence supporting the importance of preoperative patient education and managing preoperative expectations for the spinal fusion patient


Evidence supporting the benefits of sending non-complicated spinal fusion cases to the surgical acute care floor instead of the ICU/IMC.


**Evidence supporting the use of a multimodal pain approach for the postoperative spinal fusion patient.**


**Evidence highlighting the benefits of postoperative gum chewing and pre-operative carbohydrate loading for return of bowel function in postoperative spinal fusion patient.**
