The Role of Screening and Brace Management for Adolescent Idiopathic Scoliosis: A Reflexive Account Regarding Conflicting Recommendations

ABSTRACT

Adolescent Idiopathic Scoliosis (AIS) is defined as curvature of spine in the coronal plane with a Cobb angle of more than 10°. AIS affects 1-3% of children younger than 16 years of age. Less than 20% of those children will progress to severe deformity requiring interventions. Screening with clinical examination and selective radiographic assessment seems to be a cost-effective approach to filter specialist referrals but current literature is controversial. Evidence supports brace management of AIS for skeletally immature patients with primary scoliosis measuring 25°–40. The risk reduction for progression to the surgical range (deformity greater than 50 degrees) is 56%. Timely diagnosis and evidence-based brace management of AIS seem likely to reduce the surgical burden. The implementation of screening guidelines at the primary care level is a critical step.

KEYWORDS: Scoliosis; Idiopathic; Brace treatment; Conservative treatment; Screening

CME Pre-test Quiz

Adolescent Idiopathic Scoliosis (AIS) is defined as a curvature of the spine in the coronal plane with a Cobb angle measurement of more than 10 degrees. AIS affects 1-3% of children younger than 16 years of age. Less than 20% of those children will develop severe deformity requiring interventions such as bracing

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or surgery.[1,2] Conventionally deformities larger than 50° are managed with operative intervention.[1,2]

The purpose of this manuscript is to review controversial themes related to screening and brace management of AIS, providing an approach based on our interpretation of the current evidence and its relevance to the Canadian health care setting.

The Controversy Around Screening for Scoliosis

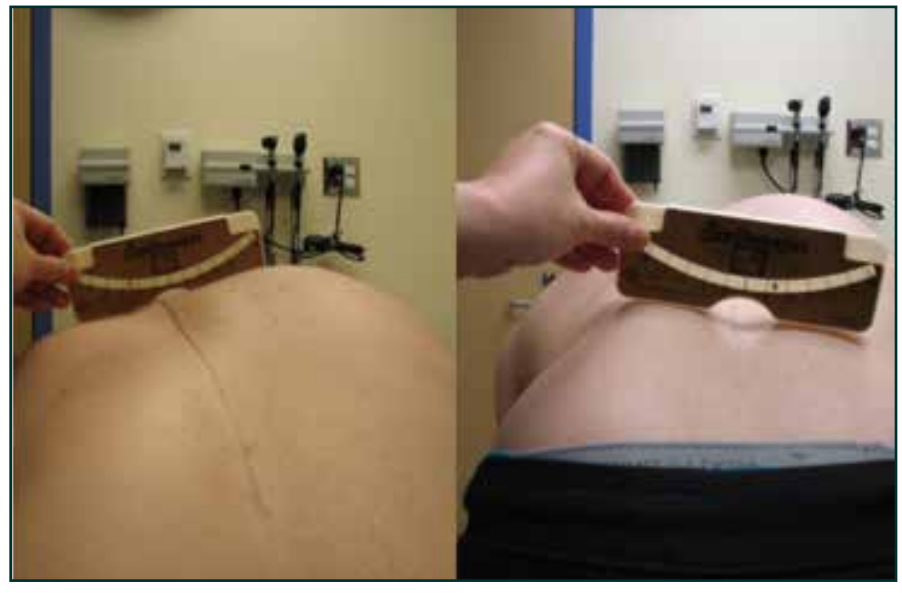
As with many other valuable screening tests in medicine, scoliosis screening meets multiple principles from Wilson and Jungner's screening criteria to identify asymptomatic patients suitable for further potential interventions.[3] However, there has been controversy regarding the value of screening to prevent long-term complications from AIS.[1] In 2007, the Pediatric Orthopaedic Society of North America (POSNA) and the American Academy of Pediatrics (AAP) emphasized the importance of timely detection of AIS.[4] Favorable outcomes with bracing for AIS, which were reported in a North American multicenter trial (BrAIST) make a strong case for investing in screening for timely diagnosis to facilitate large scale brace management of AIS.[5] This is particularly relevant in the publicly financed health care settings in Canada.

In 2015, the Scoliosis Research Society (SRS), POSNA, American Academy of Orthopaedic Surgeons (AAOS), and the AAP came together in a position statement calling for improved screening for AIS.[4,6] Screening is recommended twice for girls at ages 10 and 12 and once for boys at the age of 13 or 14.[6] They recommend physical examination with Adam's forward bending test. On screening, clinically significant scoliosis has a scoliometer reading more than 7 degrees (Figures 1 and 2).

Figure 1

Sagittal profile (left) showing rib and scapular prominence. Coronal view (right) showing right shoulder higher and trunk shift to the left. The blue line represents the planned incision for a posterior spinal instrumentation and fusion.

Figure 2



Adams forward bending test showing rib prominence and rotatory deformity of the thoracic region (left) and lumbar region (right) measured with the scoliometer.

Recommendations, building from the BrAIST[5] findings aim to reduce the burden of operative treatment by increasing access to brace management for eligible patients.

In 2018, the US Preventative Services Task Force (USPSTF) concluded that "the current evidence is insufficient to assess the balance of benefits and harms of screening for AIS in children and adolescents aged 10 to 18 years".[4] The recent systematic review conducted by USPSTF reviewed seven cohort studies of screening programs which included 447,243 adolescents.[1] According to this review, screening accuracy increases with the number of tests used. For example, when the Adam's forward bending test, scoliometer and Moiré topography were used altogether, the sensitivity, specificity and predictive values were the highest (93.8%, 99.2%, and 81.0%) and the false positive tests were the lowest (0.8%).

The SRS/POSNA/AAOS/AAP position statement emphasizes the value of well trained personnel to accurately use the scoliometer, to perform the forward bending test and to refer eligible patients appropriately to tertiary care.[6] A physical examination by a well-trained primary care physician, combined with selective radiographic assessment, can lead to timely detection of AIS (figure 1 and 2). Vernacchio *et al.*,[7] used physical exam and scoliometer assessment prior to radiographic imaging and referral to surgery. In their quality improvement study in 2013, the authors reported a successful reduction in the number of unnecessary specialist referrals by 20% over a two years period. Their clinical decision-making algorithm did not cause a delay in patient referral. Practical screening tools, including decision support algorithms, can facilitate timely detection of AIS requiring treatment without unnecessary referrals (Figure 3).

Bracing for AIS

The main therapeutic goal is to prevent deformity progression. Bracing includes the following:

- Full Time Rigid Bracing (18–23 h per day) (FTRB).
- Night Time Rigid Bracing (8–12 h per day) (NTRB).
- Soft Bracing (SB): it includes mainly the SpineCor brace.
- Part Time Rigid Bracing (12–20 h per day) (PTRB)

Nachemson *et al.*,[8] evaluated 240 patients with thoracic or thoracolumbar curves between 25and 35 degrees, aged between 10 and 15 years; 129 were observed only and 111 were treated with thoracolumbar braces. Progression of six or more degrees at any of two radiographic follow-ups was considered a failure of the selected treatment (observation versus brace treatment). At four years the success rate for brace treatment was 74% (range, 52—84%), whereas the rate for observation alone was 34% (range, 16—49%).

Figure 3: Referral Form for the Primary Care Physicians Prior to Referring the Patient to the Pediatric Spine Specialist

Alberta Health Services

Pediatric Spine Program Referral

Alberta Children's Hospital
2888 Shaganappi Trail NW | Calgary, AB T3B 6A8

Please fill out this form and send your referral back for review by the orthopedic surgeons

Date:

Patient Label

Referring Doctor's Name & Contact Information:

Neurological exam: Normal □ Abnormal □
Explanation: _____

Family History of Scoliosis: Yes □ No □

Male **Female**
Date of Menarche: _____

Date of Last X-ray: _____
(Please attach a copy of x-ray if it's not available on Impax/Netcare)

Cobb Angle: _____

Risser Grade: 0 □ **1** □ **2** □ **3** □ **4** □ **5** □

Other Observations: _____

Problem List / Symptoms:
Pain at rest □
Pain that disrupts sleep □
Pain that limits participation in activities □
Other: _____

Treatments tried to date / Results:

Physiotherapy	Effective: yes □	no □	n/a□
Massage	Effective: yes □	no □	n/a□
NSAIDs	Effective: yes □	no □	n/a□

Other Medications: Please list:
_____ Effective: yes □ no □ n/a□
_____ Effective: yes □ no □ n/a□

Other Therapies: Please List
_____ Effective: yes □ no □ n/a□
_____ Effective: yes □ no □ n/a□

Other diagnostics:

MRI CT Bone Scan
Other: _____
(Please attach copies if not available on Impax/Netcare)

Please Note: For patients who meet criteria for x-ray screening for scoliosis, please obtain a *3' standing PA spine x-ray* and request a cobb angle and risser sign on radiology report

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In a prospective trial by Lusini *et al.*,[9] success in the per-protocol analysis was 25/33 in the brace group and 0/10 in observation group. In the Intent-To-Treat analysis the success was 31/39 in the brace group and 8/18 in the observation group in. Their definition of success of brace treatment was curve progression less than 5 degrees and no consideration of surgery. The study included all idiopathic scoliosis patients with curves of 45 degrees or more and Risser stage 0 to 4 who either chose brace treatment over surgical treatment or no treatment in any form. They concluded that the brace plus exercises treatment (if correctly performed and managed) is a viable treatment alternative for patients with curves above 45 degrees.

A randomized controlled trial by Wong *et at.*,[10] compared a rigid plastic TLSO to a flexible elastic brace. They concluded that the rigid plastic TLSO brace is more effective. Their study showed that 68% of the subjects in the elastic brace group and 95% of the subjects in the rigid orthosis group did not show curve progression. All the subjects in their study were requested to wear the orthosis 23 hours/day with the rest hour for bathing and physical exercises.

The Bracing in Adolescent Idiopathic Scoliosis Trial (BrAIST) by Weinstein *et al.* consisted of a multicenter randomized controlled trial, which was stopped early owing to the superior efficacy of bracing. Full time rigid bracing (18–23 h per day) was the treatment arm. The rate of treatment success—skeletal maturity with a Cobb of less than 50 degrees—was 72% after bracing, as compared with 48% with observation. The relative risk reduction for scoliosis progression to the surgical range (deformity greater than 50 degrees) with appropriate brace treatment was 56%. For every three patients treated with a brace one less patient required surgery. The authors concluded that bracing significantly decreased the progression of high-risk curves to the threshold for surgery.[5]

Compliance and Issues Associated with Brace Wear

The effectiveness of bracing is dose dependent. Rowe *et al.*,[11] suggested that 23h/day regimens were significantly more successful than any other treatment, while the difference between the 8h and 16h regimens was not significant. Dolan *et al.* did not find differences in success rates among groups wearing the brace 16–18 h (19–34% surgery rate), 18–23 h (21–26%), and night time (17–25%).[2] Katz *et al.*[12] measured brace compliance (hours per day) using a heat sensor. A logistic regression analysis showed a "dose-response" curve in which longer hours of brace wear correlated with lower odds of deformity progression. Scoliosis did not progress in 82% of patients who wore the brace more than 12 h per day, compared with only 31% of those who wore the brace fewer than 7h per day.

SUMMARY OF KEY POINTS

Bracing is an effective but time sensitive intervention for managing AIS in skeletally immature patients with primary scoliosis measuring 25 to 40 degrees.

Clinical screening is required to identify AIS patients who eligible for bracing.

Improving access to bracing for eligible patients requires a collaborative approach involving primary care physicians and specialists.

Compliance to bracing has been correlated to quality of life and psychological issues.[13–18] In subsequent studies, using data from BrAIST, Schwieger et al showed that wearing a brace for managing AIS did not have a negative impact on body image or quality of life,[16] and that body image and quality of life did not have a significant impact on brace wear compliance.[17] This level 2 evidence[16,17] contradicts previous lower level evidence studies.[18-21]

The continuing education and training of primary care physicians for timely diagnosing of AIS and managing the larger number of patients who do not require bracing or surgical intervention is a critical step to ensure tertiary care access to those requiring treatment. In our practice, this is facilitated using a standardized referral form completed by the primary care physician and reviewed by the specialist on a weekly basis (Figure 3). The form consists of a check list of key clinical information, including "red flags" which could suggest a differential diagnosis requiring further investigation and specific radiographic information regarding the scoliosis (e.g. Cobb angle measurement and skeletal maturity). Brace eligible patients are offered timely appointments.

CLINICAL PEARLS

1. A systematic collaborative approach involving primary care physicians for screening patients and referring to tertiary care ensures timely assessment and management for eligible patients.

2. Evidence supports brace management of AIS for skeletally immature patients with primary scoliosisl measuring 25°–40°, with the goal of preventing deformity progression to the surgical threshold.

3. A full time (18-23h/day) rigid brace treatment may mitigate the surgical burden of AIS by approximately 30%.

CME

Post-test Quiz

Members of the College of Family Physicians of Canada may claim MAINPRO-M2 Credits for this unaccredited educational program.

For patients who are deemed not eligible for bracing or surgery, a phone consult is scheduled with the referring physician to discuss patient education and to provide further instructions on criteria for referral and follow-up plan. Although the performance of this approach has yet to be systematically assessed, we have observed improved specialist assessment wait times for patients requiring intervention.

Conclusion

Evidence supports brace management of AIS for skeletally immature patients with primary scoliotic curves measuring 25 to 40 degrees, with the goal of preventing deformity progression to the surgical threshold. Screening for AIS at the primary care level to with identify eligible patients for timely access to full time (18-23h/day) rigid brace treatment may reduce the surgical burden of AIS by approximately 30%.[5] In Calgary, a systematic collaborative approach between primary and tertiary care to manage the increased volume of referrals generated with primary care screening, has ensured timely access to selective tertiary care assessment and treatment for eligible patients.

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