

A Systematic Literature Review of Nonsurgical Treatment in Adult Scoliosis

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**Study Design.** A formal systematic review of the literature for conservative treatment of adult deformity was performed.

**Objective.** To evaluate evidence for the efficacy and effectiveness of proposed conservative treatment options in adult deformity.

**Summary of Background Data.** Adult deformity is a major demographic health issue in the geriatric population in both the United States and the world communities. Surgeons are often very conservative in the treatment of adult scoliosis because of the complication rates associated with the surgeries and the marginal bone quality endemic to this population. A prerequisite to surgical intervention is usually failure of all appropriate conservative care. There is currently a lack of consensus on the most efficacious conservative treatments for adult deformity.

**Methods.** A systematic review of clinical studies; using the key terms of adult or degenerative and scoliosis combined with any of the following: bracing, casting, physical therapy, chiropractic, and injections for treatment. The database inclusions were PubMed, OVID, and CINAHL. Articles were excluded if the primary patient populations were adolescents or the treatment options performed were primarily surgical. The methodology of the studies was graded and the evidence was classified into 1 of 5 levels based on study types. Based on this, a treatment recommendation was determined.

**Results.** There is indeterminate, Level III/IV evidence on the effectiveness of any conservative care option. Specifically, there is Level IV evidence on the role of physical therapy, chiropractic care, and bracing. There is Level III evidence for injections in the conservative treatment of adult deformity. There is insufficient research for a treatment recommendation beyond Level 2c very weak evidence, but the available literature is supportive of further clinical research in conservative care as a treatment in adult deformity.

**Conclusion.** Conservative care in general may be a helpful option in the care of adult deformity, but evidence for this is lacking. Unfortunately, no treatment option within conservative care has support within the literature as a preferred solution. Basic clinical research at any level would be helpful to further clarify the options.

**Key words:** physical therapy, injections, scoliosis, adult, degenerative, chiropractic, bracing, review. *Spine* 2007;32:S130–S134

Adult deformity is a significant health issue within the aging population in both the United States and the world communities. This special issue of *Spine* explores the problem and the current evidence for the treatment options. This article specifically addresses the evidence base for the nonoperative options typically suggested. Surgeons are generally conservative in the treatment of adult deformity because of the complication rates associated with the surgeries and the marginal bone quality endemic to this population. A commonly described prerequisite to surgical intervention is a failure of all appropriate conservative care. What exactly constitutes conservative care and the evidence for the choice is questionable. Whether the symptoms a patient is complaining about are related to the common complaints with degeneration and age or to changes related to the curve itself make treatment selection difficult. Historically, the adolescent and adult treatment options were considered together within the nonoperative options despite a clear delineation within the surgical literature.

The objective is to evaluate the evidence of effectiveness of potential conservative treatment options in adult deformity. A formal systematic review of the literature for conservative treatment of adult deformity was selected as it provides a current benchmark of literature concerning this area of treatment. A common misconception about this type of study is that it includes all available articles in an exhaustive manner through all available information sources such as a narrative review. That is not the case as a systematic review uses a presearch experimental design that specifies the search strategy. This produces a set of references that is reproducible and repeatable allowing one to revisit the area of interest in the future to see if the level of support has changed.

**Methods**

**Inclusion Criteria**

**Population of Interest.** Adult patients with degenerative scoliosis, deformity.

**Types of Studies Included.** Clinical studies or expert opinion in the absence of objective research.

**Types of Interventions.** The treatment options selected for review were encapsulated within the key search terms of brac-
ing and casting, physical therapy and exercise therapy, chiropractic, injections, and epidurals.

**Types of Outcomes Measures.** The outcome measures are a function of the reason that patients seek treatment for adult degenerative scoliosis. These typically include pain, progression of the curve, complications associated with neural compression, or cosmesis. Specific outcomes for each of these areas can be difficult to objectify. The outcomes for the treatment options selected are reported directly as described within the selected articles.

**Exclusion Criteria.** Articles were excluded if the primary patient populations were adolescents, or if the treatment performed was surgical. Additionally review articles were excluded if they did not add significantly within an “expert opinion” level of evidence.

**Search Strategy**

Relevant clinical studies meeting the inclusion criteria for this study were identified in the following manner.

1. A computerized database search of MEDLINE (1966 to January 2007), Cumulative Index to Nursing & Allied Health Literature (CINAHL), and PubMed was performed. Specific search terms of adult or degenerative scoliosis were used to capture the greatest number of potentially applicable studies.

2. These studies were then cross referenced with the treatment options of bracing or casting, physical therapy, exercise therapy or physical therapy methods, chiropractic or manipulation, and injections or epidural. Limits were also selected for studies to be in English and involve humans. For the articles selected, the reference list was also reviewed for potential articles to review.

**Method of Review**

The database search results including the abstract were then reviewed for exclusion criteria. The authors reviewed this list independently with any disagreements included within the article review. If no clear exclusion criteria were identified within the abstract, the full journal article was obtained for review. The articles were then placed into the appropriate treatment section for discussion. The methodology of the studies was reviewed and the evidence was classified into 1 of 5 levels based on the study design (Table 1) as described in the introduction to evidence medicine article at the start of this journal.10,11

**Results**

**Literature Search**

The database search was performed as described above for the key terms Degenerative or Adult and Scoliosis within MEDline, which produced 4731 articles; CINAHL, 244 articles; and within PubMed, 244 articles. The above sets of articles were then cross referenced by the treatment options of interest and are reported below.

**Bracing or Casting**

Within MEDline, 183 articles were found after the “Boolean” search with bracing and casting. Excluding Surgical, Adolescent, and nonclinical articles based on abstract review: 9 articles remained. No additional studies were identified within CINAHL or PubMed. After reviewing the 9 complete articles, only 2 articles fit the criteria of the review as the others dealt with adolescent idiopathic scoliosis.

The remaining article was a case report a custom LSO was used in a patient with neurogenic claudication and adult scoliosis.12 In the short term, her ambulation distance improved, but her pain was minimally changed. The results are equivocal as a treatment option, but it did present a potential treatment option for function. In a follow-up study, the same institution and primary author looked at a group of 29 women with an average Cobb angle of 37°, average age of 41 years, and for an average of 7.5 months.13 The patients were again treated with a custom LSO that attempted to restore “sagittal realignment.” The patients noted an immediate, but only short-term relief of pain with the brace, and 22 had stopped wearing the brace at the time of follow-up.

Based on these limited studies and lack of support, there is Level IV, very weak evidence (Table 2) for bracing or casting in adult scoliosis.

**Physical Therapy, Exercise Therapy, or Physical Therapy Methods**

The Medline search for physical therapy, exercise therapy, or physical therapy methods produced 60 references. After excluding surgical, adolescent, and nonclinical articles based on abstract review, only 6 articles remain. An additional 4 studies were identified within CINAHL. No additional studies were found within PubMed.

After a careful review of these 10 articles, 7 articles were excluded as they did not meet the criteria. This left only 3 articles for review.

In a clinical study of 30 patients with degenerative scoliosis, a combination of physiotherapy options was tried for curve correction and pain control.14 The patients were initially treated with heat, lumbar traction, followed by the use of a traction device with pressure

### Table 1. Types of Study Design, Their Advantages and Disadvantages

<table>
<thead>
<tr>
<th>Type of Study</th>
<th>Type of Design</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observational</td>
<td>Case report</td>
<td>Used for rare clinical events</td>
<td>No comparison group</td>
</tr>
<tr>
<td></td>
<td>Case series</td>
<td>Experiences with new or complex treatments</td>
<td>No comparison group</td>
</tr>
<tr>
<td></td>
<td>Cohort studies</td>
<td>Compare two treatments</td>
<td>Prone to confounding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resemble “real life” clinical situations</td>
<td>Prone to confounding</td>
</tr>
<tr>
<td></td>
<td>Case-control studies</td>
<td>Small sample size</td>
<td>Limited generalization</td>
</tr>
<tr>
<td></td>
<td>Randomized controlled</td>
<td>Avoidance of confounding</td>
<td>Difficulties in study recruitment</td>
</tr>
<tr>
<td></td>
<td>studies</td>
<td></td>
<td>and conduct</td>
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applied through padding to the apex of the curve. The patients were treated for 60 sessions over an unknown time period. The patients were treated with nonsteroidal anti-inflammatory drugs as needed for pain. The results were compared with a control group of patients with scoliosis not fully described within the article except for the use of “physiotherapy.” The authors found a statistically significant improvement in pain relief and degree of curve improvement of 38.75% compared with the control group improvement of 18.75%. Unfortunately, the therapy and traction protocol, independence of the radiograph reviewers, and number of patients by degree of curve are all not described, making the study conclusions difficult to corroborate.

A case series of 2 patients treated with myofascial release after failing to improve with a standard exercise program also reported positive results. The combination of the myofascial release with exercise produced significant functional improvement by multiple measures, but carry over to a moderate or long-term improvement was not described.

A study of a specific exercise was also reported in 69 skeletally mature patients. Specifically, the use of a side shift exercise toward the concavity was reported after 4-year follow-up. The patients within this study stayed essentially the same or improved slightly in relation to degree of curve. Whether the patients performed the exercise as prescribed is not known. The population was skeletally mature patients, but it is unclear from the article description if they should be categorized within the adult degenerative scoliosis patients. They are reported within this section nonetheless as it supports an active approach to treatment.

The articles reported are the extent of the literature support for physical therapy and exercise within this population. There is Level IV, very weak evidence for the use of physical therapy, exercise therapy, or physical therapy methods in adult deformity.

**Chiropractic or Manipulation**

The “Boolean and” search within Medline for studies concerning chiropractic and manipulation produced 16 references. Excluding articles that focused on Surgical, Adolescent, or were nonclinical articles based on abstract review left 3 articles.

An additional 2 studies were found within CINAHL. No additional studies were from PubMed. After reviewing the 5 studies available, only 2 were selected for this review. The studies that were excluded had either an

### Table 2. Levels of Evidence

<table>
<thead>
<tr>
<th>Level</th>
<th>Therapeutic Studies: Investigating the Results of Treatment</th>
<th>Prognostic Studies: Investigating the Outcome of Disease</th>
<th>Diagnostic Studies: Investigating a Diagnostic Test</th>
<th>Economic and Decision Analyses: Developing an Economic or Decision Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1. Randomized controlled trial a. Significant difference b. No significant difference but confidence intervals</td>
<td>1. Prospective study*</td>
<td>1. Testing of previously developed diagnostic criteria in series of consecutive patients (with universally applied reference “gold standard”)</td>
<td>1. Clinically sensible costs and alternatives; values obtained from many studies; multivariate sensitivity analyses</td>
</tr>
<tr>
<td>II</td>
<td>2. Systematic review of Level I randomized controlled trials (studies were homogenous)</td>
<td>2. Systematic review† of Level I studies</td>
<td>2. Systematic review† of Level I studies</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>2. Retrospective cohort study§</td>
<td>2. Study of untreated controls from a previous randomized control trial</td>
<td>2. Systematic review‡ of Level II studies</td>
<td></td>
</tr>
</tbody>
</table>

*All patients were enrolled at the same point in their disease course (inception cohort) with ≥80% follow-up of enrolled patients.

†A study of results from two or more previous studies.

‡Patients were compared with a control group of patients treated at the same time and institution.

§The study was initiated after treatment was performed.

¶Patients with a particular outcome (“cases” with, for example, a failed arthroplasty) were compared with those who did not have the outcome (“controls” with, for example, a total hip arthroplasty) that did not fail.
inadequate description of the intervention or were treating an adolescent idiopathic scoliosis population.

An interesting case study of chiropractic care combined with Pilates was described for a 39-year-old woman with scoliosis and prior T9 to L4 fusion 20 years before this intervention. She underwent chiropractic care with temporary relief of pain that improved with the addition of Pilates. Despite the inflammatory tone of the article, the active exercise component matched with manual medicine is an interesting proof of concept. It is unclear within the article what degree of curve the patient had post surgery and what the pain generator may have been specifically post fusion. Additionally, one must question if it was the manipulation, Pilates, or both that produced the improvement.

A small case series of 2 patients that focused specifically on chiropractic manipulation therapy reported a reduction in pain but continued slow progression of the curve. The Cobb angle reported for these 2 patients at the time of initiation of treatment was 40° and 63°. It is suggested that routine chiropractic care in the patient with the larger curve reduced the progression below what would be expected by natural history.

Based on the available literature, there is Level IV, very weak evidence for the use of chiropractic manipulation in adult deformity.

**Injections or Epidural**
The Medline database search within the preselected studies for articles concerning injections or Epidural produced 22 potential articles. These were all excluded after removing studies concerning Surgical, Adolescent, or nonclinical articles. No articles were found in CINAHL, but 1 article was found in PubMed. This article did meet the criteria for this study and is included in the review.

This study was a retrospective study of 61 patients with degenerative scoliosis >10° and radicular complaints. It explored the role of transforaminal fluoroscopy-guided epidural steroid injections in the treatment of this radicular pain. The study protocol and procedure are well described within the article. The patients were satisfied with the treatment, and the study does suggest that this may be a promising intervention in those patients with true radicular pain. At issue is the use of historical recall for pain before the injection and the week before the phone interview as this limits the conclusions that can be made about the study. The patients having curves of at least 10° do meet the definition of scoliosis but raise the question of whether or not this is a clinically significant curve for radicular pain due to compression.

There is Level III, weak evidence on the use of transforaminal epidural steroid injections in the treatment of radiculopathy associated with adult deformity. Based on the Level III and IV evidence, the current grade of recommendation (Table 3) is Level 2C, very weak evidence on the effectiveness of any conservative care option using the McMaster grading scale.

Specifically, there is Level IV evidence on the role of physical therapy, chiropractic care, and bracing. There is Level III evidence for injections in the conservative treatment of adult deformity. There is insufficient research for a treatment recommendation beyond Level 2c very weak evidence, but the available literature is supportive of further clinical research in conservative care as a treatment in adult deformity.

## Conclusion
Conservative care may be a helpful option in the care of adult deformity, but evidence is lacking in this area. No specific treatment option within conservative care has support within the literature as a solution. The current level of support is limited to extremely small case reports and expert opinion. Clearly, for an area of such significance, this area of conservative care may be the least studied in spine care. Current recommendations within the area include activity modification and anti-inflammatory medications. Beyond this option, the physician should use the best clinical

### Table 3. Recommendation Grades

<table>
<thead>
<tr>
<th>Grade of Recommendation</th>
<th>Clarity of Risk/Benefit</th>
<th>Methodologic Strength of Supporting Evidence</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Clear</td>
<td>Randomized trials without important limitations</td>
<td>Strong recommendation; can apply to most patients in most circumstances without reservation</td>
</tr>
<tr>
<td>1B</td>
<td>Clear</td>
<td>Randomized trials with important limitations (inconsistent results, methodologic flaws)</td>
<td>Strong recommendations; likely to apply to most patients</td>
</tr>
<tr>
<td>1C+</td>
<td>Clear</td>
<td>No RCTs but RCT results can be unequivocally extrapolated, or overwhelming evidence from observation studies</td>
<td>Strong recommendation; can apply to most patients in most circumstances</td>
</tr>
<tr>
<td>1C</td>
<td>Clear</td>
<td>Observation studies</td>
<td>Intermediate-strength recommendation; may change with stronger evidence available</td>
</tr>
<tr>
<td>2A</td>
<td>Unclear</td>
<td>Randomized trials without important limitations</td>
<td>Intermediate-strength recommendation; best action may differ depending on circumstances or patients’ or societal values</td>
</tr>
<tr>
<td>2B</td>
<td>Unclear</td>
<td>Randomized trials with important limitations (inconsistent results, methodologic flaws)</td>
<td>Weak recommendation; alternative approaches likely to be better for some patients under some circumstances</td>
</tr>
<tr>
<td>2C</td>
<td>Unclear</td>
<td>Observation studies</td>
<td>Very weak recommendations; other alternatives may be equally reasonable</td>
</tr>
</tbody>
</table>

RCT indicates randomized controlled trial.
decision and treat adult deformity in a similar manner to the problems encountered within the normal aging spine until further research is available.

Basic clinical research into all of these areas will be helpful to further clarify the options. The studies need to describe fully the population, study design, and intervention applied to the group as a minimum. Common surgical concerns include the origin of the curve. Is it the result of an aging adolescent idiopathic scoliosis, degenerative or “de novo” scoliosis? Additionally, the magnitude of the curves (Cobb) and associated secondary deformity such as rotaryolisthesis all play a role in surgical planning. These issues play large in the mind of the surgeon, and the surgeon makes distinctions within patient populations based on some of these borders. Nonsurgical clinicians have not traditionally seen these distinctions as relevant in reports of their clinical treatments. Including these descriptive categories will clarify any importance within future nonoperative treatment studies.

Specific research suggestions for bracing would include the use of custom or general “off the shelf” thoracolumbar orthosis, as needed, wearing pattern versus whenever out of bed, and progression within a brace to without a brace. Additional studies within physical therapy and chiropractic care share both the need to define the frequency and duration of treatment needed to establish a clinical effect. Physical therapy addresses ideal flexibility and strength compared with rotation and extension opposite to the curve’s configuration. Chiropractic treatment studies on the effect of manipulation to the curve and a description of techniques to reduce dysfunction that may be different from the nonadult deformity patient. Interventional technique studies should include denervation options for the facet joints within the curve such as medial branch radiofrequency ablation. Larger studies of transforaminal epidural injections will help clarify this option as a temporary pain relief measure or a true long-term option in patients without surgical options.

This study, using a systematic review design and strict specific presstudy inclusion and exclusion criteria is strict on which articles make the review. It gives us a clear view of the lack of support currently published for the treatment options suggested for this disorder. A repeat search in the future may be pursued and will hopefully shed light on alternative options in the conservative treatment of adult degenerative scoliosis.

Key Points

- There is Level III/IV, very weak evidence for any nonoperative treatment option for adult degenerative scoliosis.
- Current, Level 2c recommendations are for activity modification and NSAIDs. Beyond this, the presurgical treatment program should mirror the best clinical practice used for the degenerative aging spine until further evidence exists.
- Further research is necessary in all areas of conservative care in the treatment of adult deformity as it is likely the least studied subject within spine care with as large a patient population.

References