

Vertebral Body Tethering for Scoliosis

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[Instructions for Use](#)

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Commercial Policy
• Vertebral Body Tethering for Scoliosis

Application

This Medical Policy does not apply to the states listed below; refer to the state-specific policy/guideline, if noted:

State	Policy/Guideline
Indiana	Vertebral Body Tethering for Scoliosis (for Indiana Only)
Kentucky	Vertebral Body Tethering for Scoliosis (for Kentucky Only)
Louisiana	Vertebral Body Tethering for Scoliosis (for Louisiana Only)
Nebraska	Vertebral Body Tethering for Scoliosis (for Nebraska Only)
New Jersey	Vertebral Body Tethering for Scoliosis (for New Jersey Only)
Pennsylvania	Vertebral Body Tethering for Scoliosis (for Pennsylvania Only)
Tennessee	Vertebral Body Tethering for Scoliosis (for Tennessee Only)

Coverage Rationale

Vertebral body tethering for the treatment of scoliosis is unproven and not medically necessary due to insufficient evidence of safety and/or efficacy.

Applicable Codes

The following list(s) of procedure and/or diagnosis codes is provided for reference purposes only and may not be all inclusive. Listing of a code in this policy does not imply that the service described by the code is a covered or non-covered health service. Benefit coverage for health services is determined by federal, state, or contractual requirements and applicable laws that may require coverage for a specific service. The inclusion of a code does not imply any right to reimbursement or guarantee claim payment. Other Policies and Guidelines may apply.

CPT Code	Description
0656T	Vertebral body tethering, anterior; up to 7 vertebral segments

CPT Code	Description
0657T	Vertebral body tethering, anterior; 8 or more vertebral segments
22899	Unlisted procedure, spine

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Description of Services

Scoliosis is an abnormal lateral and rotational curvature of the vertebral column. Adolescent idiopathic scoliosis (AIS) is the most common form of idiopathic scoliosis, defined by the U.S. Preventive Services Task Force as “a lateral curvature of the spine with onset at ≥ 10 years of age, no underlying etiology, and risk for progression during puberty.” This type of scoliosis is referred to as idiopathic because it has no identifiable causes, but clinicians suspect that asymmetric growth, genetic variation, hormonal imbalance, and/or muscle imbalance, might be involved. Progression of the curvature during periods of rapid growth can result in deformity, accompanied by cardiopulmonary complications.

Fusion less surgical procedures, such as vertebral body tethering, are being evaluated as alternatives to spinal fusion or bracing. The goal of these procedures is to reduce the rate of spine growth unilaterally, thus allowing the other side of the spine to “catch up.” Anterolateral tethering uses polyethylene ligaments that are attached to the convex side of the vertebral bodies by pedicle screws or staples. The ligament can be tightened to provide greater tension than the staple. Vertebral Body Tethering System is indicated for skeletally immature patients that require surgical treatment to obtain and maintain correction of progressive idiopathic scoliosis. The mechanism of action is believed to be down-regulation of the growth plate on the convex (outer) side by compression and stimulation of growth on the endplate of the concave side by distraction. Patients should have failed bracing and/or be intolerant to brace wear.

Clinical Evidence

Currently, there is limited evidence on this Vertebral Body Tethering (VBT). Furthermore, existing studies are limited by the lack of comparison to other interventions, including well-established and safe usual care interventions. Additional studies, with a concurrent comparison group, larger number of total subjects and longer follow-up, are needed to evaluate the safety and efficacy of this procedure, as the evidence is currently insufficient to determine the long-term effects of the technology on health outcomes.

Baroncini et al. (2021) performed a retrospective review to determine the relevance of dynamic scoliosis correction (known as vertebral body tethering (VBT) in the United States) via bilateral anterior thoracic approach and instrumentation of the spine, for treatment of scoliosis in pediatric patients who are still growing. The study included the first 25 pediatric patients with double-curve scoliosis, whom the authors performed the VBT procedure on beginning June 2017. Due to a lack of complete perioperative data and variations in postoperative care, the authors performed analysis of 30-day complication rates and sub analysis for a potentially confounding learning curve by comparison of the first 12 patients versus the last 13 patients with a T test ($P < .05$). Of the 25 patients treated, one intraoperative complication occurred when VBT had to be abandoned on the opposite side due to the unexpected presence of pleural scarring, that would not allow pulmonary deflation. During the 30-day interval, four postoperative complications were noted (16%). Two patients had recurrent pleural effusions, one patient was diagnosed with pneumonia, and one patient, following 24-hour international flight, had pulmonary embolism without cardiopulmonary consequences. Another patient developed pleural effusion at 6-weeks post-surgery outside of the 30-day interval. Patients whose symptoms began after discharge (4) required hospitalization. Those with recurrent pleural effusions required invasive treatment including reinsertion of chest tube (2), and explorative thoracoscopy with reinsertion of chest tube (1). When comparing the first 12 patients with the next 13 patients, the authors observed a reduction of intubation time (first 12 patients = 453 minutes, next 13 patients = 397 minutes, $P = .02$), surgical time (first 12 patients = 328 minutes, next 13 patients = 280 minutes, $P = .03$), and blood loss (first 12 patients = 480 mL, next 13 patients = 197 mL, $P = .03$). All patients who received autologous or heterologous blood transfusions were within the early phase of the authors’ learning curve. The length of inpatient stay was also decreased (first 12 patients = 10.3 days, next 13 patients = 8.1 days, $P = .01$). The authors conclude that the study adds important information to the orthopedic literature showing that the procedure is feasible and does not require staging, however, complication rates are high. Additional research is required to understand root causes of the reported complications. In addition, the study is limited by its retrospective observations and small sample size. Further research with randomized controlled trials is needed before clinical usefulness of this procedure is proven.

Hayes (2021) conducted a literature review of clinical evidence for vertebral body tethering (VBT) for Progressive Pediatric and Adolescent Idiopathic Scoliosis (AIS). Review consisted of full-text clinical studies. No systematic reviews were identified. The authors concluded that VBT appears to give benefits for some patients, however, the currently available evidence is of low quality and limited to small observational studies. Additional evidence is needed to evaluate comparative efficacy and safety and to guide patient selection. Although the FDA approved a Humanitarian Device Exemption (HDE) in 2019, an ECRI Product Brief (2019, 2021) reached similar conclusions, stating that evidence is inconclusive with too few data on outcomes of interest.

Hegde et al. (2021) conducted a prospective study to evaluate the safety and efficacy of anterior vertebral body tethering (AVBT) in skeletally mature children with adolescent idiopathic scoliosis (AIS). The study included 10 patients with AIS who were operated on between 2018 and 2019 with the AVBT technique. There was a minimum of 1-year follow-up. Inclusion criteria for the study were skeletally mature children (Risser < 4 and Sanders > 7) with a single structural AIS curve (40°- 80°) with >50% flexibility on dynamic radiographs. To be eligible for AVBT, the curve should correct to >50% on dynamic radiographs. Data were recorded pre-operatively and post-operatively at the first visit, at 6 months, and at 12 months. All 10 patients were female. The mean age of the cohort at the time of surgery was 14.9 ± 2.7 years (range 12–17 years). The mean follow-up period was 24.1 ± 3.6 months (range 13 to 32 months). The mean height and weight values of the cohort were 157 cm and 44.4 kg, respectively. The mean body mass index was 18.04 kg/m². Mean Risser and Sanders scores were 4.2 ± 0.6 and 7.2 ± 0.6, respectively. Nine out of 10 patients were post-menarcheal at the time of surgery. Three patients had major thoracic curves, and seven patients had thoracolumbar/lumbar major curves. Mean pre-operative Cobb angle was 52.08 ± 11.68 (range 428 to 808). All underwent tethering with a mean of 7 ± 0.9 (range 6–9) levels with the upper instrumented vertebra being T5 and the lower instrumented vertebra being L4. The mean Cobb angle at the final follow-up was 15.38 ± 8.78 (range 38 to 288). There was a 71% correction (P < .0001). The mean pre-operative thoracic kyphosis was 21.78, which decreased to 15.58 on first erect and then gradually increased to 20.38 at the most recent follow-up (P < .0001). The mean pre-operative lumbar lordosis was 45.48, which reduced to 43.38 on first erect and increased to 47.58 at the most recent follow up (P < .0001). Mean pre-operative and post-operative SRS-22 scores were 78.0 ± 3.2 and 92.5 ± 3.1, respectively. The authors conclude that AVBT is a promising alternative to spinal fusion to stabilize progressive AIS, however, the small sample size and lack of a comparison group limit the generalizability of the findings. The significance of this study is limited by small sample size and short follow-up. Well-designed studies with larger patient populations are needed to further describe safety and long-term clinical outcomes.

Meyers et al. (2021) conducted a retrospective analysis of 90-day complication rates in patients with adolescent idiopathic scoliosis (AIS) who underwent anterior vertebral body tethering (AVBT) by a single surgeon. The study included 184 patients. Approaches included thoracic (71), thoracolumbar (45), and double (68). Of the 184 consecutive AVBT cases, 143 (77.7%) were female and 41 (22.3%) were male. The mean age at surgery was 15.0 ± 2.4 years and differed between males (16.1 ± 1.9) and females (14.7 ± 2.4, p = 0.001). The mean pre-operative Cobb angle was 54.3° ± 10.5° and was similar between genders (p = 0.06). There were 22 (12.0%) patients who had a rib resection and the mean number of ribs resected was 2.5 ± 1.2. Mean operative time was 186.5 ± 60.3 min and mean estimated blood loss (EBL) was 167.2 ± 105.0 mL. No patient received an allogenic blood transfusion. Patients received either a thoracic tether (71 [38.6%]), thoracolumbar tether (45 [24.5%]), or both (68 [37.0%]) and of these, 121 (65.8%) had single-corded tethers while 63 (34.2%) had double-corded tethers on at least one curve. Major complications included hospital re-admission or re-operation, prolonged use of invasive materials such as chest tubes, or resultant spinal cord or nerve root injury. Minor complications resolved without invasive intervention. Mean operative time and blood loss were 186.5 ± 60.3 min and 167.2 ± 105.0 ml, respectively. No patient required allogenic blood transfusion. Six patients experienced major (3.3%), and six had minor complications (3.3%). Major complications included three chylothoracies, two hemothoracies, and one lumbar radiculopathy secondary to screw placement requiring re-operation. Minor complications included one patient with respiratory distress requiring supplementary oxygen, one superficial wound infection, two cases of prolonged nausea, and 1 Raynaud phenomenon. In 184 patients who underwent AVBT for AIS, major and minor complication rates were both 3.3%. While the authors concluded that AVBT demonstrated some success, complications may be more pulmonary in nature than those seen with spinal fusion. The authors also note that surgeons who perform AVBT should be cautious when using rib resection to optimize screw trajectory due to related major complications. The findings of this study need to be validated by well-designed studies with multiple providers. Further investigation is needed. Therefore, no conclusions can be made regarding the relative efficacy, effectiveness, or safety of treatment.

Pehlivanoglu et al. (2021) conducted a retrospective cohort study comparing the effectiveness of vertebral body tethering (VBT) and posterior spinal fusion (PSF) in skeletally immature patients with adolescent idiopathic scoliosis (AIS). The study included 43 patients divided into two separate groups: 1) VBT (n = 21); and 2) PSF (n = 22). The mean follow-up duration for both groups was 39.4 months. Major curve magnitude (degrees) revealed pre-operative VBT = 48.2; and PSF = 48.8 (P = NR) [NR = Not Reported]. Last follow-up: VBT = 9.1; and PSF = 9.7 (P=NR). Coronal balance revealed pre-operative VBT = 1.9; and PSF = 1.8

(P = NR). Last follow-up VBT = 0.8; and PSF = 0.3 (P = NR). Sagittal balance revealed pre-operative VBT = 1.2; and PSF = 1.0 (P = NR). Last follow-up VBT = 0.4; and PSF = 0.3 (P = NR). Lumbar range of motion (ROM) (degrees) revealed Flexion VBT = 78.2; and PSF = 58.1 (P < 0.001), Extension VBT = 34.6; and PSF = 19.4 (P < 0.001), Lateral Bend VBT = 34.4; and PSF = 18.3 (P < 0.001), and Rotation VBT = 45.4; and PSF = 24.1 (P < 0.001). Average lumbar bending flexibility (cm) revealed Anterior VBT = 3.7; and PSF = 23.4 (P < 0.001). Lateral VBT = 22.4; and PSF = 11.3 (P = 0.003). Average trunk endurance (seconds) revealed Flexor VBT = 65.1; and PSF = 19.2 (P < 0.001). Extensor VBT = 60.8; and PSF = 28.7 (P < 0.001). SRS-22 total score pre-operative VBT = 3.2; and PSF 3.2 (P = NS) [NS = Not Statistically Significant]. Last follow-up VBT = 56.9; and PSF = 53.1 (P < 0.001). Complications were not reported. The authors concluded that this study is first-time literature being presented. They suggest that lumbar ROM was greater among VBT patients compared with PSF patients with mean follow-up of 39.4 months. In addition, they note QOL scores being higher following VBT versus PSF. Strengths include PSF comparison group with between group statistical comparison. Limitations, however, include retrospective design, small sample size, and both analysis for curve magnitude and safety outcomes were not reported. Additional studies with larger study populations are needed to further establish the efficacy and safety of this procedure.

Rushton et al. (2021) performed a prospective case study to determine the efficacy of anterior vertebral body tethering (AVBT) in skeletally immature patients. The study included 112 patients, who underwent 116 primary tethering procedures (108 thoracic and eight lumbar tethers). Four patients had primary tethering of both lumbar and thoracic curves. At surgery mean age was 12.7 ± 1.4 years (8.2-16.7) and Risser 0.5 ± 0.9 (0-3). Follow up was mean 37 ± 9 months (15-64). Preoperative mean coronal Cobb angle of the 130 tethered curves was $50.8^\circ \pm 10.2$ (31-81) and corrected significantly to $26.6^\circ \pm 10.1$ (-3-61) at FE radiograph (P < 0.001). Further significant improvement was seen from FE to 1-year, to mean $23.1^\circ \pm 12.4$ (-37-57) (P < 0.001). There was a small but significant increase between 1-year and FU to $25.7^\circ \pm 16.3$ (-32-58) (P < 0.001), which appeared to reflect tether breakage. Untethered minor curves were corrected from $31.0^\circ \pm 9.5$ (3-57) to $20.3^\circ \pm 10.3$ (0-52) at FU (P < 0.001). Rib hump was corrected from 14.1 ± 4.8 (0-26) to $8.8^\circ \pm 5.4$ (0-22) at FU (P < 0.01). Twenty-five patients (22%) had 28 complications. Fifteen patients (13%) requiring 18 revision operations including six completed and one awaited fusion(s). The authors concluded that AVBT of immature cases is associated with satisfactory deformity correction in most cases. However, the authors note that complication and revision rates suggest the need for improved implants and patient selection. The value of AVBT is currently unclear given the paucity of available data. Long-term evaluations of the results and prospective randomized studies are still needed.

Shin et al. (2021) conducted meta-analysis and systematic review comparing post-operative outcomes between patients with adolescent idiopathic scoliosis (AIS) undergoing posterior spinal fusion (PSF) and anterior vertebral body tethering (AVBT). The primary objective was to compare complication and reoperation rates at available follow-up times. Secondary objectives included comparing mid-term Scoliosis Research Society (SRS)-22 scores, and coronal and sagittal-plane Cobb angle corrections. Systematic review of outcome studies following AVBT and/or PSF procedures was completed. The inclusion criteria included the following: AVBT and/or PSF procedures; Lenke 1 or 2 curves; an age of 10 to 18 years for > 90% of the patient population; < 10% non-AIS scoliosis etiology; and follow-up of ≥ 1 year. A single-arm, random-effects meta-analysis was performed. Deformity corrections, complication and reoperation rates, and postoperative SRS-22 scores were recorded. The study included 10 AVBT studies (211 patients) and 14 PSF studies (1,069 patients). The mean follow-up durations were similar for both groups. Pooled complication rates were 26% for AVBT versus 2% for PSF, and reoperation rates were 14.1% for AVBT versus 0.6% for PSF with nonoverlapping confidence intervals (CIs). The pooled reoperation rate among studies with follow-up times of ≥ 36 months was 24.7% in AVBT versus 1.8% in PSF. Deformity correction, clinical outcomes, and mid-term SRS-22 scores were similar. The authors concluded that the study showed greater rates of complications and reoperations with AVBT compared with PSF. Reoperation rates were greater in AVBT studies with longer follow-up (≥ 36 months). Deformity correction, clinical outcomes, and mid-term SRS-22 scores were similar. While a potential fusionless treatment for AIS merits excitement, clinicians should consider AVBT with caution. Future long-term randomized prospective studies are needed. (Authors Samdani et al. (2014), Sandami et al. (2015), and Newton et al. (2018) which were previously cited in this policy are included in this systematic and meta-analysis review).

Yucekul et al. (2021) conducted a prospectively followed consecutive patient cohort to determine changes in the intermediate and adjacent levels at least two years following thoracoscopic vertebral body tethering (VBT) surgery was performed between 2014 and 2017. Outcome measure included degeneration of the intervertebral discs using the Pfirrmann classification; degeneration of facet joints using a scale of 0 to 3. A total of 25 patients with a mean of 38.6 ± 10.6 months (24-62) of follow-up were included in the study. The mean age at surgery was 12.2 (10-14), and the median Sanders stage was 3 (1-7). A mean of 7.7 ± 1.1 (6-11) levels were tethered. The mean preoperative main thoracic curve magnitude of $46^\circ \pm 7.7^\circ$ was corrected to $23.3^\circ \pm 5.9^\circ$ postoperatively, which was subsequently modulated to $12^\circ \pm 11.5^\circ$ during the follow-up. At the time of the MRI (mean

29±9.5 (24-62) months), the median Sanders stages was 7 (5-8). A total of 217 levels of discs and bilateral facet joints were evaluated in the preoperative and follow-up MRI images. Analyses of disc and facet scores revealed no significant differences between patients. Deterioration of previously degenerated discs was noted in one patient (from grade 2 to 3), while previously healthy lower adjacent facet joints were degenerated (grade 2) in another patient. The authors concluded that intermediate discs and facet joints were preserved after growth modulation with VBT surgery at a mean of 29 months of follow-up. Well designed, comparative studies with larger patient populations and longer follow-up are needed to further describe safety and the clinical effects of relative stabilization and altered biomechanical loads.

Qui et al. (2020) performed a retrospective cohort study by collecting data from a multicenter database of patients who underwent posterior spinal fusion and from a single center database of patients from an FDA approved investigational device exemption trial who received anterior vertebral body tethering (AVBT). This study compared patients who underwent AVBT with those treated with standard-of-care posterior spinal fusion (PSF) to determine inherent differences in patients and families who seek cutting-edge treatments. The authors studied demographics, preoperative clinical and radiographic variables, and health-related quality of life (HRQOL). No differences in demographics, clinical variables, and radiographic measures were detected between the PSF and AVBT cohorts. The AVBT group showed more thoracic flexibility on bending radiographs, correcting on average 59% compared with 43% for PSF patients ($P=.005$). Patients had similar HRQOL total scores and scores across each of the five domains of the Scoliosis Research Society Questionnaire Version 22. Study limitations included a methodology that compared a multicenter database to that of a single center perspective and lack of randomization, which could have introduced biases in the analyses. The authors stated that to combat this limitation, there is an analogous multicenter trial being planned. It is also essential that as many data points for predefined variables be collected. In addition, the study did not report outcomes of the treatment options due to lack of sufficient follow up. Research on this new technology is ongoing which will result in future development of this new emerging technology.

Miyanji et al. (2020) conducted a retrospective multicenter case series to determine the clinical efficacy of anterior vertebral body tethering (AVBT) in skeletally immature patients with idiopathic scoliosis. The authors note that spinal fusion remains the gold standard in the treatment of idiopathic scoliosis. Yet, anterior vertebral body tethering (AVBT) is gaining widespread interest, despite the limited data on its efficacy. All consecutive skeletally immature patients with idiopathic scoliosis treated with AVBT enrolled in a longitudinal, multicenter, prospective database between 2013 and 2016 were analyzed. All patients were treated by one of two surgeons working at two independent centers. Data was collected prospectively in a multicenter database and supplemented retrospectively where necessary. Patients with a minimum follow-up of two years were included in the analysis. Clinical success was considered a major coronal Cobb angle of $< 35^\circ$ at the most recent follow-up. A total of 57 patients were included in the study. Their mean age was 12.7 years (SD 1.5; 8.2 to 16.7), with 95% being female. The mean preoperative Sanders score and Risser grade was 3.3 (SD 1.2), and 0.05 (0 to 3), respectively. The majority were thoracic tethers (96.5%), and the mean follow-up was 40.4 months (SD 9.3). The mean preoperative major curve of 51° (SD 10.9° ; 31° to 81°) was significantly improved to a mean of 24.6° (SD 11.8° ; 0° to 57°) at the first postoperative visit (45.6% (SD 17.6%; 7% to 107%); $p < 0.001$) with further significant correction to a mean of 16.3° (SD 12.8° ; -12 to 55 ; $p < 0.001$) at one year and a significant correction to a mean of 23° (SD 15.4° ; -18° to 57°) at the final follow-up (42.9% (-16% to 147%); $p < 0.001$). Clinical success was achieved in 44 patients (77%). Most patients reached skeletal maturity, with a mean Risser score of 4.3 (SD 1.02), at final follow-up. The complication rate was 28.1% with a 15.8% rate of unplanned revision procedures. The authors concluded that AVBT is associated with satisfactory correction of deformity and an acceptable complication rate when used in skeletally immature patients with idiopathic scoliosis. Improved patient selection and better implant technology may improve the 15.8% rate of revision surgery in these patients. The study is limited by lack of contemporary comparison group. Also, a minimum two-year follow-up is not an adequate standard for these patients and clearly longer follow-up is required to make any conclusive statements about the true value of this technique. The authors also concluded that further examination of the true effectiveness and long-term risks of this technique remains critical.

Newton et al. (2020) conducted a retrospective cohort study comparing the outcomes of patients with thoracic idiopathic scoliosis between a group of patients who underwent AVBT and a matched cohort of patients treated with posterior spinal fusion and instrumentation (PSF). The inclusion criteria were determined on the basis of the AVBT cohort: primary thoracic idiopathic scoliosis with a curve magnitude between 40° and 67° , Risser stage of ≤ 1 , age of 9 to 15 years, no prior spine surgery, index surgery between 2011 and 2016, and minimum follow-up of 2 years. Demographic, radiographic, clinical, and patient-reported outcomes, and revisions were compared between groups. There were 23 patients in the AVBT cohort and 26 patients in the PSF cohort. The mean follow-up (and standard deviation) was similar between groups: 3.4 ± 1.1 years for the AVBT group and 3.6 ± 1.6 years for the PSF group ($p = 0.6$). Preoperatively, the groups were similar in all measurements of radiographic and clinical deformity, with mean main thoracic curves of $53^\circ \pm 8^\circ$ for the AVBT group and $54^\circ \pm$

7° for the PSF group ($p = 0.4$). At the time of final follow-up, the AVBT cohort had significantly more residual deformity, with a mean thoracic curve of $33^\circ \pm 18^\circ$ compared with $16^\circ \pm 6^\circ$ for the PSF group ($p < 0.001$). There were nine revision procedures in the AVBT cohort (with three conversions to PSF and three more pending) and none in the PSF cohort. Revisions occurred at a mean postoperative time of 2.3 years (range, 1.2 to 3.7 years). Twelve patients (52%) had evidence of broken tethers; of these patients, four underwent revision. The post-intervention patient-reported outcomes were similar. Both AVBT and PSF resulted in postoperative correction; however, 2-year correction was better maintained in the PSF group. There were no differences in post-intervention patient-reported outcomes. AVBT resulted in less deformity correction and more revision procedures than PSF, suggesting inferior outcomes compared to the established approach, but resulted in the delay or prevention of PSF in many patients. Study limitations included the potential for selection bias for patients in the AVBT group. Most patients were skeletally mature at the post-op follow-up. Although the immediate follow-up shows valuable information for those who may be considered AVBT candidates, larger studies with longer-term follow-up are both needed to fully understand the procedures strengths, weaknesses, and indications.

Hayes (2019) conducted a literature review of clinical evidence for VBT for Adolescent Idiopathic Scoliosis (AIS). The authors noted that there is a paucity of peer-reviewed, published literature addressing VBT specifically for AIS. The search results for this report were limited to include only abstracts addressing AIS. The authors concluded that there is insufficient published evidence to assess the safety and/or impact on health outcomes or patient management for vertebral body tethering for adolescent idiopathic scoliosis. An ECRI Product Brief (2019) reached similar conclusions, stating that evidence is inconclusive.

Newton et al. (2018) conducted a retrospective review of patients with thoracic scoliosis who underwent anterior spinal growth tethering (ASGT) with a minimum of 2 years of follow-up. Patient demographics, perioperative data, and radiographic outcomes were reported. Seventeen patients met the inclusion criteria. The etiology was idiopathic for 14 and syndromic for three. The mean follow-up was 2.5 years (range, 2 to 4 years). Preoperatively, all patients were at Risser stage 0, with a mean age at surgery of 11 ± 2 years (range, 9 to 14 years). There was an average of 6.8 ± 0.5 vertebrae tethered per patient. The average thoracic curve magnitude was $52^\circ \pm 10^\circ$ (range, 40° to 67°) preoperatively, $31^\circ \pm 10^\circ$ immediately postoperatively, $24^\circ \pm 17^\circ$ at 18 months postoperatively, and $27^\circ \pm 20^\circ$ at latest follow-up (51% correction; range, 5% to 118%). Revision surgery was performed in seven patients: four tether removals due to complete correction or overcorrection, one lumbar tether added, one tether replaced due to breakage, and one revised to a posterior spinal fusion. In three additional patients, posterior spinal fusion was indicated due to progression. Eight (47%) of the patients had a suspected broken tether. A "successful" clinical outcome was defined as a residual curve of $< 35^\circ$ and no posterior spinal fusion indicated or performed at latest follow-up. Ten (59%) of the 17 were considered clinically successful. The authors concluded that despite most patients having some remaining skeletal growth at the time of review, the results of the current study demonstrate that at mid-term follow-up, ASGT showed a powerful, but variable, ability to modulate spinal growth and did so with little perioperative and early postoperative risk. Fusion was avoided for 13 of the 17 patients. The overall success rate was 59%, with a 41% revision rate. While the study participants' condition improved, in the absence of a comparative group, it is not possible to conclude whether or not the changes can be attributed to the procedure or other concurrent treatments.

Samdani et al. (2015) also published 1-year results of anterior VBT. Clinical and radiographic data were retrospectively analyzed. The authors reviewed 32 patients who underwent thoracic VBT with a minimum 1-year follow-up. Patients underwent tethering of an average of 7.7 levels (range 7-11). Their early results indicate that anterior VBT is a safe and potentially effective treatment option for skeletally immature patients with idiopathic scoliosis. These patients experienced an improvement of their scoliosis with minimal major complications. While the study participants' condition improved, in the absence of a comparative group, it is not possible to conclude whether or not the changes can be attributed to the procedure or other concurrent treatments.

Samdani et al. (2014) reported the 2-year results of the initial cohort undergoing anterior vertebral body tethering (VBT). Retrospective review was performed on their first 11 consecutive patients who underwent anterior VBT with at least 2-year follow-up. All underwent tethering of an average of 7.8 ± 0.9 (range of 7 to 9) levels, with the most proximal being T5 and the most distal L2. Pre-operative thoracic Cobb angle averaged 44.2 ± 9.0 and corrected to 20.3 ± 11.0 on first erect, with progressive improvement at 2 years (Cobb angle = 13.5 ± 11.6 , % correction = 70 %). Similarly, the pre-operative lumbar curve of 25.1 ± 8.7 demonstrated progressive correction (first erect = 14.9 ± 4.9 , 2 year = 7.2 ± 5.1 , % correction = 71 %). Thoracic axial rotation as measured by a scoliometer went from 12.4 ± 3.3 pre-operatively to 6.9 ± 3.4 at the most recent measurement). No major complications were observed. As anticipated, two patients returned to the operating room at 2 years post-operatively for loosening of the tether to prevent overcorrection. The authors concluded that anterior VBT is a promising technique for skeletally immature patients with idiopathic scoliosis. Two major limitation of this study are a lack of comparison group

undergoing a different treatment and the large lost to follow-up. Only 11 out of the 65 participants who underwent VBT reached the two-year follow-up cutoff necessary to be included in the study. This raises a significant concern for biased findings and the possibility of unreported adverse events.

U.S. Food and Drug Administration (FDA)

This section is to be used for informational purposes only. FDA approval alone is not a basis for coverage.

The FDA granted a Humanitarian Device Exemption approval to Zimmer Biomet Holdings, Inc.'s (Warsaw, IN, U.S.) Tether™ - Vertebral Body Tethering System for treating idiopathic scoliosis in skeletally immature patients considering spinal fusion surgery, the company announced on August 16, 2019. This device is indicated for skeletally immature patients that require surgical treatment to obtain and maintain correction of progressive idiopathic scoliosis, with a major Cobb angle of 30 to 65 degrees whose osseous structure is dimensionally adequate to accommodate screw fixation, as determined by radiographic imaging. Patients should have failed bracing and/or be intolerant to brace wear. See the following website for more information: https://www.accessdata.fda.gov/cdrh_docs/pdf19/H190005D.pdf.

References

- Baroncini A, Rodriguez L, Verma K, et al. Feasibility of single-staged bilateral anterior scoliosis correction in growing patients. *Global Spine J.* 2021 Jan;11(1):76-80.
- ECRI Institute. (Custom Product Brief) The Tether (Zimmer Biomet) Vertebral Body Tethering System for Treating Scoliosis. Plymouth Meeting (PA): ECRI Institute; 2019 Dec 27.
- Hayes, Inc. Search and Summary. The Tether (Zimmer Biomet) Vertebral Body Tethering System for Treating Scoliosis. Lansdale, PA: March 2021.
- Hayes, Inc. Search and Summary. Vertebral Body Tethering for Adolescent Idiopathic Scoliosis. Lansdale, PA: March 2019.
- Hegde SK, Venkatesan M, Akbari KK, et al. Efficacy of anterior vertebral body tethering in skeletally mature children with adolescent idiopathic scoliosis: a preliminary report. *Int J Spine Surg.* 2021 Oct;15(5):995-1003.
- Meyers J, Eaker L, von Treuheim TDP, et al. Early operative morbidity in 184 cases of anterior vertebral body tethering. *Sci Rep.* 2021 Nov 29;11(1):23049.
- Miyajima F, Pawelek J, Nasto LA, Simmonds A, Parent S. Safety and efficacy of anterior vertebral body tethering in the treatment of idiopathic scoliosis. *Bone Joint J.* 2020 Dec;102-B(12):1703-1708.
- Newton PO, Bartley CE, Bastrom TP, Kluck DG, Saito W, Yaszay B. Anterior spinal growth modulation in skeletally immature patients with idiopathic scoliosis: A comparison with posterior spinal fusion at 2 to 5 years postoperatively. *J Bone Joint Surg Am.* 2020 May 6;102(9):769-777.
- Newton PO, Kluck DG, Saito W, et al. Anterior spinal growth tethering for skeletally immature patients with scoliosis: a retrospective look two to four years postoperatively. *J Bone Joint Surg Am.* 2018 Oct 3;100(19):1691-1697.
- Pehlivanoglu T, Oltulu I, Erdag Y, et al. Comparison of clinical and functional outcomes of vertebral body tethering to posterior spinal fusion in patients with adolescent idiopathic scoliosis and evaluation of quality of life: preliminary results. *Spine Deform.* 2021 Jul;9(4):1175-1182.
- Qiu C, Talwar D, Gordon J, Capraro A, Lott C, Cahill PJ. Patient-reported outcomes Are equivalent in patients who receive vertebral body tethering versus posterior spinal fusion in adolescent idiopathic scoliosis. *Orthopedics.* 2020 Nov 25:1-5.
- Rushton PRP, Nasto L, Parent S, et al. Anterior vertebral body tethering for treatment of idiopathic scoliosis in the skeletally immature: results of 112 Cases. *Spine (Phila Pa 1976).* 2021 Nov 1;46(21):1461-1467.
- Samdani AF, Ames RJ, Kimball JS, et al. Anterior vertebral body tethering for immature adolescent idiopathic scoliosis: one-year results on the first 32 patients. *Eur Spine J.* 2015 Jul;24(7):1533-9.
- Samdani AF, Ames RJ, Kimball JS, et al. Anterior vertebral body tethering for idiopathic scoliosis: two-year results. *Spine (Phila Pa 1976).* 2014 Sep 15;39(20):1688-93.
- Shin M, Arguelles GR, Cahill PJ, et al. Complications, reoperations, and mid-term outcomes following anterior vertebral body tethering versus posterior spinal fusion: a meta-analysis. *JB JS Open Access.* 2021 Jun 23;6(2):e21.00002.

Policy History/Revision Information

Date	Summary of Changes
06/01/2022	<p data-bbox="337 312 487 344">Application</p> <p data-bbox="337 348 735 380"><i>Mississippi and North Carolina</i></p> <ul data-bbox="337 384 1458 449" style="list-style-type: none"><li data-bbox="337 384 1458 449">• Updated language to indicate this Medical Policy applies to the states of Mississippi and North Carolina (retired state-specific policy versions) <p data-bbox="337 453 639 485">Supporting Information</p> <ul data-bbox="337 489 857 520" style="list-style-type: none"><li data-bbox="337 489 857 520">• Archived previous policy version CS170.D

Instructions for Use

This Medical Policy provides assistance in interpreting UnitedHealthcare standard benefit plans. When deciding coverage, the federal, state or contractual requirements for benefit plan coverage must be referenced as the terms of the federal, state or contractual requirements for benefit plan coverage may differ from the standard benefit plan. In the event of a conflict, the federal, state or contractual requirements for benefit plan coverage govern. Before using this policy, please check the federal, state, or contractual requirements for benefit plan coverage. UnitedHealthcare reserves the right to modify its Policies and Guidelines as necessary. This Medical Policy is provided for informational purposes. It does not constitute medical advice.

UnitedHealthcare may also use tools developed by third parties, such as the InterQual[®] criteria, to assist us in administering health benefits. The UnitedHealthcare Medical Policies are intended to be used in connection with the independent professional medical judgment of a qualified health care provider and do not constitute the practice of medicine or medical advice.