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Anterior Vertebral Body Tethering for Adolescent Idiopathic Scoliosis: A Systematic Review of the Evidence with Critical Integration of the First Brazilian Case

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ADMINISTRATIVE INFORMATION**Support** - No support.**Review Stage at time of this submission** - Completed but not published.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY202670124**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 30 July 2026 and was last updated on 30 July 2026.**INTRODUCTION**

Review question / Objective To systematically review the available evidence on Anterior Vertebral Body Tethering (AVBT) for the treatment of adolescent idiopathic scoliosis, evaluating its indications, clinical and radiographic outcomes, complications, and safety, while contextualizing these findings through the critical analysis of the first Brazilian case.

Rationale Anterior Vertebral Body Tethering (AVBT) has emerged as an alternative to posterior spinal fusion for the treatment of adolescent idiopathic scoliosis, particularly in patients with remaining growth potential. Although recent studies have reported promising results regarding deformity correction and preservation of spinal mobility, uncertainties remain concerning patient selection, indications, complications, and the long-term durability of outcomes. Furthermore, clinical experience with AVBT in Brazil is still limited, with scarce national scientific publications. Therefore,

this systematic review aims to critically synthesize the available evidence and contextualize it through the analysis of the first Brazilian case, contributing to the scientific basis of the technique and supporting its clinical application.

Condition being studied Adolescent idiopathic scoliosis (AIS), a three-dimensional spinal deformity affecting growing adolescents that may progress during skeletal growth and require surgical treatment in selected cases.

METHODS

Search strategy Electronic searches will be conducted in PubMed/MEDLINE, Embase, Scopus, and Web of Science. Controlled vocabulary (MeSH and Emtree) and free-text terms related to the topic will be used, including "Anterior Vertebral Body Tethering", "Vertebral Body Tethering", "Growth Modulation", "Adolescent Idiopathic Scoliosis", and "Scoliosis", combined using the Boolean operators AND and OR. The search strategy will be adapted to the indexing

characteristics of each database. In addition, the reference lists of all included studies will be manually screened to identify potentially eligible publications.

Participant or population Adolescents diagnosed with adolescent idiopathic scoliosis who underwent Anterior Vertebral Body Tethering (AVBT) will be included. Skeletally immature patients of either sex with remaining growth potential will be considered, provided that the studies report relevant clinical, radiographic, and/or postoperative outcomes.

Intervention The intervention of interest is Anterior Vertebral Body Tethering (AVBT), a growth modulation surgical technique performed through an anterior approach using vertebral screws and a flexible tether system to achieve progressive deformity correction in patients with adolescent idiopathic scoliosis and remaining growth potential.

Comparator Not applicable. This systematic review does not include a comparator intervention, as its objective is to evaluate the clinical, radiographic, and postoperative outcomes of Anterior Vertebral Body Tethering (AVBT) in patients with adolescent idiopathic scoliosis.

Study designs to be included Original observational studies evaluating patients with adolescent idiopathic scoliosis treated with Anterior Vertebral Body Tethering (AVBT) will be included, including prospective and retrospective studies, cohort studies, case series, and multicenter studies. Reviews, meta-analyses, editorials, letters to the editor, technical reports without clinical outcomes, and experimental studies will be excluded.

Eligibility criteria Studies were eligible if they were original full-text articles published in English, Portuguese, or Spanish that evaluated anterior vertebral body tethering (AVBT) in patients with adolescent idiopathic scoliosis. Studies involving other etiologies of scoliosis (e.g., congenital, neuromuscular, or syndromic scoliosis), review articles, systematic reviews, meta-analyses, editorials, letters, conference abstracts, technical notes without clinical outcomes, experimental or cadaveric studies, duplicate publications, and studies with insufficient data for extraction were excluded. When multiple publications reported overlapping patient cohorts, the most complete or recent study was included.

Information sources Electronic searches will be conducted in PubMed/MEDLINE, Embase, Scopus, and Web of Science. In addition, a manual search of the reference lists of the included studies will be performed to identify potentially relevant publications. Clinical trial registries, gray literature, and author contact will not be included in the search strategy.

Main outcome(s) The primary outcomes will include radiographic deformity correction (Cobb angle), clinical and functional outcomes, preservation of spinal mobility, procedure-related complications (including tether rupture, overcorrection, and reoperation), safety, and postoperative follow-up outcomes. These outcomes will be extracted and qualitatively synthesized from the included studies.

Additional outcome(s) Additional outcomes will include patient demographic characteristics (age, sex, and skeletal maturity), follow-up duration, surgical indication criteria, operative time, estimated blood loss, length of hospital stay, conversion to spinal fusion, need for revision surgery, and methodological characteristics of the included studies.

Data management Retrieved records will be exported to a reference management software for identification and removal of duplicates. Study selection will be performed independently by two reviewers through title and abstract screening followed by full-text assessment. Data from eligible studies will be extracted using a standardized data extraction form developed by the authors, including study characteristics, participant characteristics, intervention details, outcomes, and results. Any disagreements will be resolved by consensus or by consultation with a third reviewer.

Quality assessment / Risk of bias analysis The methodological quality and risk of bias of the included studies will be independently assessed by two reviewers using the Methodological Index for Non-Randomized Studies (MINORS), a validated tool for non-randomized surgical studies. Any disagreements will be resolved by consensus or consultation with a third reviewer. The quality assessment results will be reported descriptively and considered in the interpretation of the review findings.

Strategy of data synthesis Data will be synthesized using a narrative and descriptive approach, considering the methodological and clinical heterogeneity of the included studies. Study characteristics, patient demographics,

surgical indications, operative techniques, radiographic correction, clinical and functional outcomes, complications, reoperation rates, and follow-up duration will be summarized and compared. A meta-analysis is not planned due to the heterogeneity of study designs, patient populations, and reported outcomes. Data synthesis will be conducted in accordance with the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement, ensuring methodological rigor, transparency, and standardized reporting of the review findings.

Subgroup analysis Formal subgroup analyses are not planned due to the limited number of included studies and the methodological and clinical heterogeneity among them. When sufficient data are available, a narrative comparison of relevant subgroups will be performed according to patient age, skeletal maturity, curve magnitude, follow-up duration, and complication profile, in accordance with the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement.

Sensitivity analysis A formal sensitivity analysis is not planned because this systematic review will not include a meta-analysis and the included studies are expected to present substantial methodological and clinical heterogeneity. Instead, the robustness of the findings will be assessed qualitatively by considering the methodological quality, risk of bias, and consistency of the reported results across the included studies, in accordance with the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement.

Language restriction Yes. The search will be restricted to studies published in English, Portuguese, and Spanish.

Country(ies) involved Brazil.

Other relevant information This systematic review was developed in accordance with the PRISMA 2020 statement and aims to critically synthesize the available evidence on Anterior Vertebral Body Tethering (AVBT) for the treatment of adolescent idiopathic scoliosis. As a distinctive feature, the findings will be interpreted in the context of the first Brazilian experience with this technique, contributing to a better understanding of its clinical applicability and supporting evidence dissemination in a setting that remains underrepresented in the national literature. Any

protocol amendments will be clearly documented and justified in the final publication.

Keywords Adolescent Idiopathic; Scoliosis Anterior Vertebral Body Tethering; Growth Modulation; Spine Surgery; Motion Preservation; Systematic Review.

Dissemination plans The findings of this systematic review will be submitted to the Brazilian Society of Orthopaedics and Traumatology (SBOT) Congress, with the possibility of publication in the Revista da Sociedade Brasileira de Ortopedia e Traumatologia (Revista SBOT), subject to the scientific and editorial criteria of the congress and the journal.

Contributions of each author

Author 1 - Rodrigo Magalhães Falcão - The surgeon responsible for the first Brazilian case of Anterior Vertebral Body Tethering (AVBT) will serve as a manuscript reviewer, providing technical and scientific review of the content prior to submission, without influencing the methodological conduct of the systematic review.

Author 2 - Matheus Soares dos Santos - The surgeon responsible for the first Brazilian case of Anterior Vertebral Body Tethering (AVBT) will serve as a manuscript reviewer, providing technical and scientific review of the content prior to submission, without influencing the methodological conduct of the systematic review.

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Author 3 - Árgila Gonçalves de Carvalho Santana - Was responsible for drafting the Methods and Discussion sections of the manuscript, contributing to the methodological design, critical interpretation of the findings, and scientific revision of the final manuscript. Additionally, Author 3 served as the third reviewer during the study selection process, resolving disagreements between the two.

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Author 4 - Isabela Silva Santos Barbosa - Was responsible for drafting the Introduction section of the manuscript and for formatting and revising the references according to the American Medical Association (AMA) citation style.

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Author 5 - Julia Pereira Quintino - Was responsible for the selection of studies included in the systematic review, as well as for the organization, data extraction, and narrative synthesis of the included evidence.

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Author 6 - Roberto Carlos Almeida Leal Junior - Was responsible for conducting the literature search across the selected databases, screening

titles, abstracts, and full-text articles for eligibility, drafting the manuscript abstract, and contributing to the organization and narrative synthesis of the systematic review findings.

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Author 7 - Darlean Geovanne Souza Santos - Was responsible for drafting the Conclusion section of the manuscript, synthesizing the main findings of the systematic review and ensuring that the conclusions accurately reflected the available evidence.

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Author 8 - Bernardo Luz Ferreira - Was responsible for data extraction from the included studies, verification of extracted data, and assistance in the critical interpretation of the review findings.

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Author 9 - Taynara Maia Rego - Contributed to the assessment of the methodological quality and risk of bias of the included studies using the MINORS instrument, and participated in the scientific revision of the manuscript.

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