INPLASY

From rehabilitation to surgery in pediatric lower limb length discrepancy: clinical, functional and radiographic thresholds for intervention—a systematic review with narrative synthesis protocol

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ADMINISTRATIVE INFORMATION

Support - Own.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 22 June 2026 and was last updated on 22 June 2026.

INTRODUCTION

Review question / Objective The purpose of this systematic review with narrative synthesis is to identify, compare, and synthesize the current evidence on clinical, functional, and radiographic thresholds used to guide conservative rehabilitation versus surgery in children and adolescents with lower limb length discrepancy.
The review will address the following question: In children and adolescents aged 0–18 years with anatomic or functional lower limb length discrepancy, what magnitude of discrepancy, skeletal maturity criteria, functional impairments, postural findings, and radiographic parameters support conservative treatment, epiphysiodesis, or limb lengthening?

Rationale Lower limb length discrepancy is a frequent pediatric orthopedic condition that may influence gait biomechanics, pelvic alignment, spinal balance, plantar loading, and postural control. Although minor discrepancies are often managed conservatively, the thresholds guiding the transition from observation, shoe lifts, orthoses, and rehabilitation to surgical procedures remain inconsistently defined across pediatric orthopedics, rehabilitation medicine, and posturology.

A clear synthesis of current evidence is needed to support timely and individualized decision-making. Defining clinical, functional, and radiographic thresholds may help avoid both delayed surgical referral, when the optimal window for intervention could be missed, and unnecessary or premature surgery in children who may benefit from conservative management. This review is therefore justified by the need to clarify how discrepancy magnitude, projected discrepancy at skeletal maturity, functional impairment, postural compensations, and radiographic parameters should be integrated when deciding between rehabilitation, epiphysiodesis, and limb lengthening in pediatric lower limb length discrepancy.

Condition being studied Pediatric lower limb length discrepancy is defined as a measurable difference in length between the two lower limbs in children and adolescents. It may be anatomical, caused by true bone length inequality, or functional, related to pelvic obliquity, joint contractures, postural compensation, or neuromuscular imbalance. The condition may be congenital, developmental, post-traumatic, post-infectious, neuromuscular, tumor-related, iatrogenic, or idiopathic.
Lower limb length discrepancy may affect gait biomechanics, pelvic alignment, spinal balance, plantar loading, and postural control. In mild cases, it may be asymptomatic or managed conservatively, whereas larger or progressive discrepancies may require surgical correction depending on projected discrepancy at skeletal maturity, functional impairment, and radiographic findings. In pediatric patients, timely assessment is essential because growth remaining and skeletal maturity strongly influence the choice between observation, conservative rehabilitation, epiphysiodesis, and limb lengthening.

METHODS

Search strategy The literature search will be conducted in PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library. Searches will include studies published between 1 January 2010 and 30 April 2026. The search strategy will combine controlled vocabulary terms, where available, and free-text terms related to lower limb length discrepancy, pediatric populations, conservative management, rehabilitation, postural assessment, neurosensory and sensorimotor dysfunctions, gait analysis, and surgical correction.

A preliminary PubMed/MEDLINE search strategy will be:

("leg length discrepancy" OR "limb length discrepancy" OR "limb length inequality" OR "lower limb length discrepancy" OR "leg length inequality")
AND
(pediatric OR paediatric OR child OR children OR adolescent OR adolescents)
AND
(epiphysiodesis OR "limb lengthening" OR "bone lengthening" OR "shoe lift" OR "shoe lifts" OR orthosis OR orthoses OR rehabilitation OR "conservative management" OR "conservative treatment" OR "gait analysis" OR "pelvic obliquity" OR scoliosis OR "postural control" OR "postural assessment" OR "sensorimotor integration" OR "sensory integration" OR "neurosensory dysfunction" OR "neurosensory dysfunctions" OR proprioception OR "somatosensory feedback" OR "vestibular function" OR "visual input" OR "oculomotor function" OR balance OR "sensory reweighting" OR "plantar pressure" OR "surgical indication" OR "surgical indications" OR threshold OR thresholds OR "skeletal maturity")

Search strings will be adapted for each database according to its specific syntax. Additional relevant studies will be identified by screening the reference lists of included articles, systematic reviews, clinical guidelines, and consensus statements. No minimum discrepancy threshold will be imposed at the search stage, because the objective of the review is to identify the clinical, functional, radiographic, and posturological thresholds reported in the literature.

Participant or population This review will include studies involving children and adolescents aged 0–18 years diagnosed with anatomical or functional lower limb length discrepancy. Eligible participants may present with congenital, developmental, post-traumatic, post-infectious, neuromuscular, tumor-related, iatrogenic, or idiopathic lower limb length discrepancy.
Studies including mixed adult and pediatric populations will be considered only if data for children and adolescents can be extracted separately. No minimum lower-limb length discrepancy threshold will be imposed at the population level, provided that the discrepancy is measurable and clinically relevant data are reported.

Intervention The interventions of interest will include conservative, rehabilitative, posturological, and surgical management strategies for pediatric lower limb length discrepancy. Conservative approaches will include observation, shoe lifts, orthoses, physical therapy, rehabilitation programs, gait training, postural assessment, and neurosensory or sensorimotor rehabilitation when reported.
Surgical interventions will include temporary or permanent epiphysiodesis, limb lengthening procedures, and other corrective orthopedic procedures used to manage lower limb length discrepancy in children and adolescents.
The review will evaluate how these interventions are indicated according to discrepancy magnitude, projected discrepancy at skeletal maturity, clinical symptoms, functional impairment, gait asymmetry, pelvic obliquity, compensatory scoliosis, plantar loading asymmetry, postural or neurosensory findings, radiographic parameters, and reported outcomes or complications.

Comparator Comparators will include observation versus conservative management, conservative management versus surgical correction, epiphysiodesis versus limb lengthening, and different intervention thresholds based on discrepancy magnitude, projected lower limb length discrepancy at skeletal maturity, functional impairment, postural findings, neurosensory or sensorimotor dysfunctions, and radiographic parameters.
When available, studies comparing different conservative strategies, such as shoe lifts, orthoses, rehabilitation, gait training, or posturological assessment, will also be considered. Studies without a formal comparator group will be included if they report clinically relevant thresholds, indications, outcomes, or decision-making criteria for conservative or surgical management of pediatric lower limb length discrepancy.

Study designs to be included Eligible study designs will include randomized controlled trials, prospective and retrospective cohort studies, case-control studies, cross-sectional studies, case series, clinical guidelines, and consensus statements. Existing systematic reviews will be screened for reference mining and contextual evidence, but primary data extraction will focus on original studies.

Eligibility criteria Studies will be eligible if they are published between 1 January 2010 and 30 April 2026 and report data relevant to the assessment or management of pediatric lower limb length discrepancy. Eligible studies must provide extractable information on at least one of the following: discrepancy magnitude, projected discrepancy at skeletal maturity, clinical or radiographic assessment, functional impairment, gait asymmetry, pelvic obliquity, compensatory scoliosis, plantar loading asymmetry, postural or neurosensory findings, conservative management, epiphysiodesis, limb lengthening, surgical indications, complications, or treatment outcomes.

No minimum lower limb length discrepancy threshold will be imposed at the eligibility stage, because one objective of the review is to identify the thresholds reported in the literature.
Studies will be excluded if they involve adult-only populations, mixed adult and pediatric populations without separately extractable pediatric data, upper limb discrepancies, orthopedic deformities without lower limb length data, animal or cadaveric studies, technical reports without clinical decision-making relevance, single case reports, editorials, letters, commentaries, conference abstracts without full text, or publications without sufficient data for extraction.

Information sources The main electronic information sources will include PubMed/MEDLINE, Scopus, Web of Science Core Collection, and the Cochrane Library. Searches will cover studies published between 1 January 2010 and 30 April 2026.
The main outcomes will be the clinical, functional, and radiographic thresholds used to guide treatment decision-making in pediatric lower limb length discrepancy. These will include the reported discrepancy magnitude, projected discrepancy at skeletal maturity, thresholds for conservative management, thresholds for epiphysiodesis, thresholds for limb lengthening, and imaging-based criteria used to support treatment selection.

Timing will be considered in relation to skeletal maturity, growth remaining, and projected discrepancy at maturity. When available, effect measures will include changes in discrepancy magnitude, correction achieved, residual discrepancy, gait or functional outcomes, complication rates, and need for additional procedures.Additional sources will include manual screening of the reference lists of included articles, relevant systematic reviews, clinical guidelines, and consensus statements related to pediatric lower limb length discrepancy, epiphysiodesis, limb lengthening, rehabilitation, gait analysis, and postural assessment.

Google Scholar may be used as a supplementary source to identify additional relevant publications not retrieved through the main databases. ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry Platform may be searched to identify registered or ongoing studies, where applicable.
Authors may be contacted if essential pediatric subgroup data or methodological information are missing from otherwise eligible studies.

Main outcome(s) The main outcomes will be the clinical, functional, and radiographic thresholds used to guide treatment decision-making in pediatric lower limb length discrepancy. These will include the reported discrepancy magnitude, projected discrepancy at skeletal maturity, thresholds for conservative management, thresholds for epiphysiodesis, thresholds for limb lengthening, and imaging-based criteria used to support treatment selection.
Timing will be considered in relation to skeletal maturity, growth remaining, and projected discrepancy at maturity. When available, effect

measures will include changes in discrepancy magnitude, correction achieved, residual discrepancy, gait or functional outcomes, complication rates, and need for additional procedures.

Additional outcome(s) Additional outcomes will include functional, postural, neurosensory, and treatment-related parameters associated with pediatric lower limb length discrepancy. These will include gait asymmetry, pelvic obliquity, compensatory scoliosis, spinal alignment changes, plantar pressure distribution, asymmetric weight-bearing, balance impairment, postural instability, proprioceptive alterations, sensorimotor integration deficits, and neurosensory or sensorimotor dysfunctions when reported.
Other secondary outcomes will include pain, fatigue, functional limitation, reduced walking tolerance, participation restriction, quality of life, and patient- or parent-reported outcomes. Treatment-related outcomes will include response to conservative management, tolerance and effectiveness of shoe lifts or orthoses, improvement after rehabilitation or postural intervention, correction achieved after epiphysiodesis or limb lengthening, residual discrepancy, recurrence or progression of discrepancy, complications, need for revision surgery, and need for additional procedures.
These outcomes will be analyzed as modifiers of treatment decision-making rather than isolated criteria, with particular attention to how functional impairment and postural compensation influence the transition from conservative rehabilitation to surgical correction.

Data management Search results from all databases will be exported to reference management software, and duplicate records will be removed before screening. Titles and abstracts will be screened against the predefined eligibility criteria, followed by full-text assessment of potentially eligible studies.
Data will be extracted using a standardized data extraction form. The extracted variables will include author, year of publication, country, study design, population characteristics, age range, etiology of lower limb length discrepancy, measurement method, discrepancy magnitude, projected discrepancy at skeletal maturity, skeletal maturity assessment, intervention type, conservative management strategy, surgical procedure, functional outcomes, postural or neurosensory findings, radiographic parameters, complications, and treatment outcomes.
Records excluded at the full-text stage will be documented with reasons for exclusion. The study selection process will be reported using a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.
If duplicate publications or overlapping cohorts are identified, the most complete or most recent dataset will be used. Extracted data will be organized in structured electronic tables and checked for consistency before synthesis.

Quality assessment / Risk of bias analysis The methodological quality and risk of bias of included studies will be assessed according to study design, using standardized and validated tools where applicable. Randomized controlled trials will be assessed using the Cochrane Risk of Bias 2 tool. Non-randomized interventional studies will be assessed using ROBINS-I. Observational cohort and case-control studies will be evaluated using the Newcastle–Ottawa Scale. Cross-sectional studies and case series will be assessed using appropriate Joanna Briggs Institute critical appraisal tools.
The assessment will consider potential bias related to participant selection, measurement of lower limb length discrepancy, assessment of skeletal maturity, classification of interventions, outcome measurement, follow-up duration, confounding factors, missing data, and selective reporting.
Clinical guidelines or consensus statements, if included for decision-making thresholds, will be appraised separately for methodological transparency and relevance. The results of the quality assessment will be used to interpret the strength and reliability of the evidence, but studies will not be excluded solely on the basis of methodological quality unless the risk of bias is considered critical or the data are insufficient for extraction.

Strategy of data synthesis A narrative synthesis will be conducted because substantial clinical and methodological heterogeneity is expected across the included studies regarding patient age, etiology of lower limb length discrepancy, measurement methods, skeletal maturity assessment, intervention type, surgical technique, rehabilitation approach, postural assessment, and reported outcomes.
Data will be synthesized according to the main decision-making domains: discrepancy magnitude, projected discrepancy at skeletal maturity, clinical symptoms, functional impairment, radiographic findings, gait abnormalities, postural compensations, neurosensory or sensorimotor dysfunctions, and treatment outcomes. Findings will be grouped by management strategy, including

observation, conservative management, shoe lifts, orthoses, rehabilitation, posturological or neurosensory approaches, epiphysiodesis, limb lengthening, and other corrective procedures.
When possible, results will also be organized according to commonly reported discrepancy categories, such as minor discrepancies managed conservatively, discrepancies considered for epiphysiodesis, and larger discrepancies considered for limb lengthening. Functional and posturological findings will be analyzed as decision-making modifiers rather than isolated surgical criteria.
Descriptive summaries will be used to report study characteristics, intervention thresholds, functional outcomes, radiographiy findings.

Subgroup analysis If sufficient data are available, subgroup analyses will be performed according to age group, etiology of lower limb length discrepancy, discrepancy magnitude, skeletal maturity, intervention type, and functional or postural impairment.
Age-related subgroups may include infants and preschool children, school-aged children, and adolescents. Etiological subgroups may include congenital, developmental, post-traumatic, post-infectious, neuromuscular, tumour-related, iatrogenic, and idiopathic lower limb length discrepancy.

Discrepancy magnitude may be analyzed according to commonly reported clinical categories, including minor discrepancies usually managed conservatively, discrepancies considered for epiphysiodesis, and larger discrepancies considered for limb lengthening. Additional subgroup analyses may consider projected discrepancy at skeletal maturity, open versus near-closed growth plates, conservative versus surgical management, epiphysiodesis versus limb lengthening, and the presence or absence of gait asymmetry, pelvic obliquity, compensatory scoliosis, plantar loading asymmetry, postural instability, or neurosensory/sensorimotor dysfunctions.

Subgroup analyses will be primarily descriptive and narrative, because substantial heterogeneity is expected across studies. Quantitative subgroup analysis will be considered only if sufficient clinically and methodologically comparable data are available.

Sensitivity analysis Sensitivity analysis will be performed, where applicable, to assess the robustness of the findings and the stability of the proposed intervention thresholds. The synthesis will be re-examined after excluding studies judged to have a high or critical risk of bias, studies with incomplete reporting of lower limb length discrepancy measurement methods, studies with insufficient information on skeletal maturity or projected discrepancy at maturity, and studies with unclear treatment indications.
Additional sensitivity analyses may be conducted by excluding studies with very small sample sizes, studies including mixed adult and pediatric populations with limited pediatric subgroup data, and studies in which functional, postural, or radiographic outcomes are poorly defined. If overlapping cohorts or duplicate publications are identified, sensitivity analysis will consider whether inclusion of the most complete dataset changes the interpretation of the findings.
The impact of these exclusions will be assessed narratively by comparing whether the main conclusions regarding conservative management, epiphysiodesis, limb lengthening, and functional or posturological decision-making modifiers remain consistent. Quantitative sensitivity analysis will only be performed if sufficient homogeneous data are available.

Language restriction Studies published in English, French, Italian, or Romanian will be included. Other languages will be considered if reliable translation is feasible.

Country(ies) involved Romania.

Other relevant information This systematic review will integrate evidence from pediatric orthopedics, rehabilitation medicine, posturology, and neurosensory/sensorimotor assessment. Particular attention will be given to the relationship between lower limb length discrepancy, pelvic-spinal compensation, gait asymmetry, plantar loading, postural control, and functional impairment.
The review aims to support a more individualized decision-making process by clarifying when conservative rehabilitation may be sufficient and when surgical correction should be considered. As this study will use data from previously published literature only, no direct recruitment of human participants will be performed.

Keywords lower limb length discrepancy; epiphysiodesis; limb lengthening; conservative management; postural assessment; sensorimotor integration.

Dissemination plans The findings of this systematic review will be submitted for publication in a peer-reviewed journal in the fields of

pediatrics, pediatric orthopedics, rehabilitation medicine, or posturology. Results may also be presented at national or international scientific meetings related to pediatric orthopedics, rehabilitation, gait analysis, postural assessment, and neurosensory integration.

The review is intended to support evidence-informed clinical decision-making regarding the transition from conservative rehabilitation to surgical intervention in children and adolescents with lower limb length discrepancy.

Contributions of each author

Author 1 - Maricela Dragomir - Conceptualization, methodology, literature search, study selection, data extraction, risk of bias assessment, data synthesis, interpretation of findings, protocol writing, manuscript drafting, and final approval of the submitted protocol.

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