White Rose Research Online

eprints@whiterose.ac.uk
https://eprints.whiterose.ac.uk
Universities of Leeds, Sheffield and York

Deposited via The University of Sheffield.

White Rose Research Online URL for this paper:
https://eprints.whiterose.ac.uk/id/eprint/242168/

Version: Published Version

Proceedings Paper:
Cole, A. and Swaby, L. (2026) Bracing research in idiopathic scoliosis. In: Chockalingam, N., (ed.) Research into Spinal Deformities 12: Proceedings of the International Research Society of Spinal Deformities. International Research Society of Spinal Deformities, 18-20 Jun 2026, Novi Sad, Serbia. Studies in Health Technology and Informatics, 337. IOS Press, pp. 66-70. ISSN: 0926-9630. EISSN: 1879-8365.

https://doi.org/10.3233/shti260745

Reuse
This article is distributed under the terms of the Creative Commons Attribution-NonCommercial (CC BY-NC) licence. This licence allows you to remix, tweak, and build upon this work non-commercially, and any new works must also acknowledge the authors and be non-commercial. You don't have to license any derivative works on the same terms. More information and the full terms of the licence here:
https://creativecommons.org/licenses/

Takedown
If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

UNIVERSITY OF LEEDS
University of Sheffield
UNIVERSITY of York

Research into Spinal Deformities 12
N. Chockalingam (Ed.)
© 2026 The Authors.
This article is published online with Open Access by IOS Press and distributed under the terms of the Creative Commons Attribution Non-Commercial License 4.0 (CC BY-NC 4.0).
doi:10.3233/SHTI260745

Bracing Research in Idiopathic Scoliosis

Ashley Cole[a], Lizzie Swaby[b]
[a] *Sheffield Children's Hospital, Sheffield*
[b] *SCHARR, University of Sheffield*
ORCID ID: Ashley Cole https://orcid.org/0000-0003-2504-2402, Lizzie Swaby https://orcid.org/0000-0001-9443-7681
Corresponding author: Ashley Cole, ashley.cole4@nhs.net

Abstract.

Bracing remains an important treatment for idiopathic scoliosis, but many questions about effectiveness, patient selection, adherence, and long-term outcomes remain unanswered. This paper reviews key developments in bracing research, including standardised study criteria, major clinical trials, and patient-led research priorities. It also considers future research methods, including randomised controlled trials, trials within cohorts, target trial emulation, observational studies, and health economic evaluation. Important areas for future work include skeletal maturity assessment, optimisation of brace design and adherence, psychological impact, and the role of bracing in early-onset and non-idiopathic scoliosis. Better use of registries and robust prospective study designs will be essential to improve evidence and guide personalised care.

Keywords. Scoliosis, bracing, studies

1. Introduction

Early bracing studies were difficult to interpret, in part due to a lack of agreement about inclusion criteria. In 2005, the Scoliosis Research Society published standardised criteria for bracing studies in Adolescent Idiopathic Scoliosis (AIS) with inclusion criteria (Risser 0-1, Cobb angle 25-40 degrees, no prior brace treatment), definitions of progression and 2-year post-brace follow-up [1]. Early attempts to demonstrate the value of bracing in AIS were reviewed by Dolan and Weinstein (2007); a pooled analysis of 18 studies found no difference between curve progression to surgery in the observation versus the brace treated group, although there were only 139 patients in the three pooled observation studies [2]. The subsequent Bracing in Adolescent Idiopathic Scoliosis Trial (BRAIST) was a part randomised, part preference multi-centre study of 242 AIS patients [3]. Treatment success was a curve less than 50 degrees at skeletal maturity. The study was stopped early as treatment success was 72% in the brace-treated group and 48% with observation group. It should be noted that this study included curves 20-40 degrees.

2. Research Priorities

The James Lind Alliance Priority Setting Partnership worked with scoliosis patients to develop priorities for research. These were published in 2017 (https://www.jla.nihr.ac.uk/priority-setting-partnerships/scoliosis):

1. What are the best strategies for reducing or preventing the curve from getting worse, combining treatment and self-management approaches to avoid the need for surgery?
2. How is quality of life affected by scoliosis and its treatment? How can we measure this in ways that are meaningful to patients?
3. Could surgical procedures be improved to become less invasive, reduce scarring and increase flexibility?
4. What are the long-term outcomes and side-effects of surgery?
5. How likely is scoliosis to get worse over time, either with or without treatment? Should people be monitored?
6. What is the best method of imaging scoliosis that also reduces exposure to radiation?
7. Which type of brace (e.g. rigid or dynamic) is most effective in the treatment of (a) early onset scoliosis and (b) adolescent idiopathic scoliosis?
8. What forms of postural care are most effective (standing frames, seats, sleep suits and wheelchairs) for managing early onset, neuromuscular and syndromic scoliosis?
9. If scoliosis is diagnosed earlier, does this change the choice of treatment and/or lead to better outcomes?
10. How are the psychological impacts (including on body image) of diagnosis and treatment best managed?
11. Can the instrumentation (rods/ implants etc) cause harm in the short or long term?
12. How is scoliosis affected by hormonal changes in women (puberty, pregnancy and the menopause) and does this have implications for treatment using HRT?

In many medical areas, research priorities are developed by scoping or systematic reviews. A scoping review of published reviews in scoliosis bracing has reviewed all the research priorities [4].

3. Future Research in Scoliosis

3.1. Methodology

3.1.1. Randomised Controlled Trials

Randomised controlled trials (RCT) are accepted as the gold standard for studies of causal inference to determine whether a treatment causes an outcome by eliminating bias before the start of treatment. However, these studies rely on clinician and patient equipoise otherwise recruitment is difficult. There is a tendency to widen eligibility criteria making the results more generalisable, but less likely to produce a significant result in the patient group where clinicians have the most equipoise. Excluding large numbers of eligible patients due to lack of equipoise may bias the study. For brace treatment, RCTs can only answer limited questions. The Bracing in AdoleScent

Idiopathic Scoliosis (BASIS) study is a non-inferiority RCT evaluating whether night-time bracing (NTB) is non-inferior to full-time bracing (FTB) [5]. Patient preference is mostly for the NTB despite the lack of high-quality evidence, and the study relies on the NTB being unavailable generally in the National Health Service in the UK. Cross-over from full-time to night-time bracing is not possible within the study. Recruitment finishes in late 2026 and the results are likely to be available in 2031. BASIS 2 is a superiority RCT evaluating whether 6 months additional bracing at skeletal maturity reduces curve progression two years after skeletal maturity [6]. This is similar to the RCT by Cheung et al. (2024) which found that brace weaning produced no reduction in post-weaning curve progression [7].
Summary: RCT methodology must be considered and excluded with well documented reasons

3.1.2. Cohort multiple RCTs

Cohort multiple RCTs are potentially suitable where every patient is entered into a database or registry. Patients are consented to be contacted if there is a trial they are eligible for and they are randomised to the treatment arm. If they are randomised to the control arm, they proceed with usual care and are not contacted [8]. This relies on the primary outcome measure being routinely collected in the database or registry. These studies, otherwise known as Trials Within Cohorts (TWiCS), are much cheaper than RCTs and may prevent resentful demoralisation in the control group if the intervention is expensive or desirable. Patients randomised to the intervention arm are contacted to see whether they want to take part in the study.
Summary: As good as an RCT but less expensive and good for desirable interventions such as a new brace design.

3.1.3. Target Trials

Target Trial Emulation uses observational data to determine causal inference and is probably the best methodology in scoliosis research [9]. These studies are less expensive than RCTs. Key factors include a rigid well designed protocol as would be employed for a RCT. Confounding variables that may affect treatment choice or outcome must be collected so they can be controlled for during the statistical analysis. These are currently not defined for bracing but would include surgeon, skeletal maturity, curve size and curve type. Sample sizes are generally larger, but treatment can be determined by clinician and patient choice.
Summary: Target trials are a good option where RCTs are not practical or ethical. They are more generalisable.

3.1.4. Observational studies

These can be useful if performed prospectively, with a defined protocol and large numbers such as in a Registry. They are useful in rare diseases, where long-term follow-up is required and to evaluate predictive factors.
Summary: These are the most common type of study performed but should be done prospectively with a defined protocol and research question.

3.1.5. Health Economic Analysis

A health economic analysis should be considered for all studies as cost-effectiveness is becoming increasingly important with rising healthcare costs. Implementation of research is always easier when it is cost-effective.

3.2. Future Clinical Studies

3.2.1. Skeletal Maturity

There have been advances in skeletal maturity assessments moving on from traditional Risser stage, menarche and height change to include hand and wrist bone ages (Sanders' score, distal radius and ulna stages, thumb ossification composite index, Tanner-Whitehouse 3 and Greulich Pyle), proximal humerus ossification system and proximal femoral maturity index. The interaction between these different scoring systems and accuracy for predicting skeletal maturity or cessation of curve progression needs to be established. There must be a better way of predicting who would benefit from bracing beyond using Risser 0-2.

3.2.2. Brace Studies

The BASIS study will hopefully determine the efficacy of night-time bracing. This may be the answer for all patients although full-time bracing is likely to still be required. Bracing does have a negative effect on psychosocial functioning, and this is likely to have a negative effect on brace adherence which is known to be associated with bracing success and failure.

There is a need to for agreed definitions in brace treatment such as dosage (number of hours prescribed each day) and time out-of-brace before x-ray.

Future studies are needed to evaluate factors associated with improved bracing success which may include improved in-brace correction, better adherence, improved appearance and comfort, reduced visibility and scoliosis specific exercises.

We also need to improve the negative psychological effects and impaired social functioning associated with bracing. Factors like family and peer support, compliance monitoring and psychological support (where needed) are potentially important. This may also be important in improving brace adherence and hence success.

Studies on who to brace with curves 15-25 degrees and curves 40-50 degrees will allow us to offer brace treatment outside current SRS guidelines.

We must also remember that whilst mean changes are important, there will be an increased move to personalised medicine. With large datasets, we may be able to optimise brace treatment in more patients; there will be some patients where brace treatment is not the correct option, either due to inevitable curve progression or psychosocial issues. If we can avoid unsuccessful, prolonged attempts at bracing this will be psychologically beneficial and cost-effective.

3.2.3. Brace treatment in Early Onset Scoliosis

A recent review article suggests brace treatment is very successful in idiopathic early onset scoliosis with 40% requiring surgery [10]. These patients are often braced for many years with success defined as avoidance of surgery, or even delaying surgery to an age where a definitive fusion can be performed, avoiding growth-friendly instrumentation.

Further studies on these patients are likely to be observational. Registries will allow larger numbers and longer follow-up at a more affordable cost.

3.2.4. Brace studies in neuromuscular, syndromic and congenital scoliosis

There is very limited evidence for brace treatment in non-idiopathic scoliosis. Brace tolerance and adherence are significant problems and future studies need to address these issues first.

4. Conclusions

There are still many unanswered questions in brace treatment in scoliosis. New research methodologies and registry-based data collection will allow us to address these. The methodology must be chosen carefully to ensure that the study definitively answers the questions posed. There will always be a balance between easier to perform observational studies and high quality RCTs which are best to test the efficacy of a treatment but with potential generalisability issues. Clinical bracing studies unfortunately take many years, with patients followed to beyond skeletal maturity.

References

[1] Richards BS, Bernstein RM, D'Amato CR, Thompson GH. Standardization of Criteria for Adolescent Idiopathic Scoliosis Brace Studies: SRS Committee on Bracing and Nonoperative Management. Spine. 2005 Sep;30(18):2068-75. doi:10.1097/01.brs.0000178819.90239.d0

[2] Dolan LA, Weinstein SL. Surgical Rates After Observation and Bracing for Adolescent Idiopathic Scoliosis: An Evidence-Based Review. Spine. 2007 Sep;32(Supplement):S91-100. doi:10.1097/BRS.0b013e318134ead9

[3] Weinstein SL, Dolan LA, Wright JG, Dobbs MB. Design of the Bracing in Adolescent Idiopathic Scoliosis Trial (BrAIST). Spine. 2013 Oct;38(21):1832-41. doi:10.1097/01.brs.0000435048.23726.3e

[4] Hahn D, Artajos A, Elliot X, Jevric T, Moore A, Swaby L, et al. A scoping review of published reviews on the use of bracing in scoliosis. Spine Deform. 2026 Mar 3. doi:10.1007/s43390-026-01319-9

[5] Swaby L, Perry DC, Walker K, Hind D, Mills A, Jayasuriya R, et al. Bracing Adolescent Idiopathic Scoliosis (BASIS) study: night-time versus full-time bracing in adolescent idiopathic scoliosis: study protocol for a multicentre, randomized controlled trial. Bone Joint Open. 2023;4(11):873-80.

[6] Ridsdale K. Bracing AdoleScent Idiopathic Scoliosis after skeletal maturity (BASIS 2): study protocol for a randomized controlled trial within a larger trial. Bone Joint Open. 2026;7(1):130-7.

[7] Cheung PWH, Chan OKO, Wu H, Lai MKL, Wong LPK, Tang S, et al. Immediate vs Gradual Brace Weaning Protocols in Adolescent Idiopathic Scoliosis: A Randomized Clinical Trial. JAMA Pediatr. 2024 Jul 1;178(7):657. doi:10.1001/jamapediatrics.2024.1484

[8] Relton C, Torgerson D, O'Cathain A, Nicholl J. Rethinking pragmatic randomised controlled trials: introducing the cohort multiple randomised controlled trial design. BMJ. 2010 Mar 24;340:c1066. doi:10.1136/bmj.c1066

[9] Matthews AA, Danaei G, Islam N, Kurth T. Target trial emulation: applying principles of randomised trials to observational studies. BMJ. 2022 Aug 30;e071108. doi:10.1136/bmj-2022-071108

[10] Bellamy M, Tung WS, Jayasuriya R, Hind D, Swaby L, Totton N, et al. Bracing effectiveness in idiopathic early onset scoliosis followed to skeletal maturity: a systematic review and meta-analysis. Spine Deform. 2025 Jan 22. doi:10.1007/s43390-025-01043-w