The effectiveness of 3D-printed AFOs on walking speed, comfort and function in Upper Motor Neuron patients

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INTRODUCTION

Upper motor neuron (UMN) conditions, such as stroke and cerebral palsy, often impair gait and reduce mobility. Ankle-foot orthoses (AFOs) improve foot-ankle stability and walking function. Traditional thermoplastic AFOs are currently the standard practice when it comes to orthotic manufacturing but can be time-consuming, and wasteful to make. Advances in 3D printing offer potential for faster, more consistent, and flexible production, potentially transforming AFO design and personalisation, however little research has been conducted on this in UMN patients.

METHODOLOGY

A literature search was conducted across four databases **(PubMed**, **ProQuest**, **Scopus**, and **Cochrane Library)** using a defined PICO framework. Studies were selected based on strict inclusion and exclusion criteria and appraised using a **Modified Downs and Black** checklist to assess Risk of Bias.

RESULTS

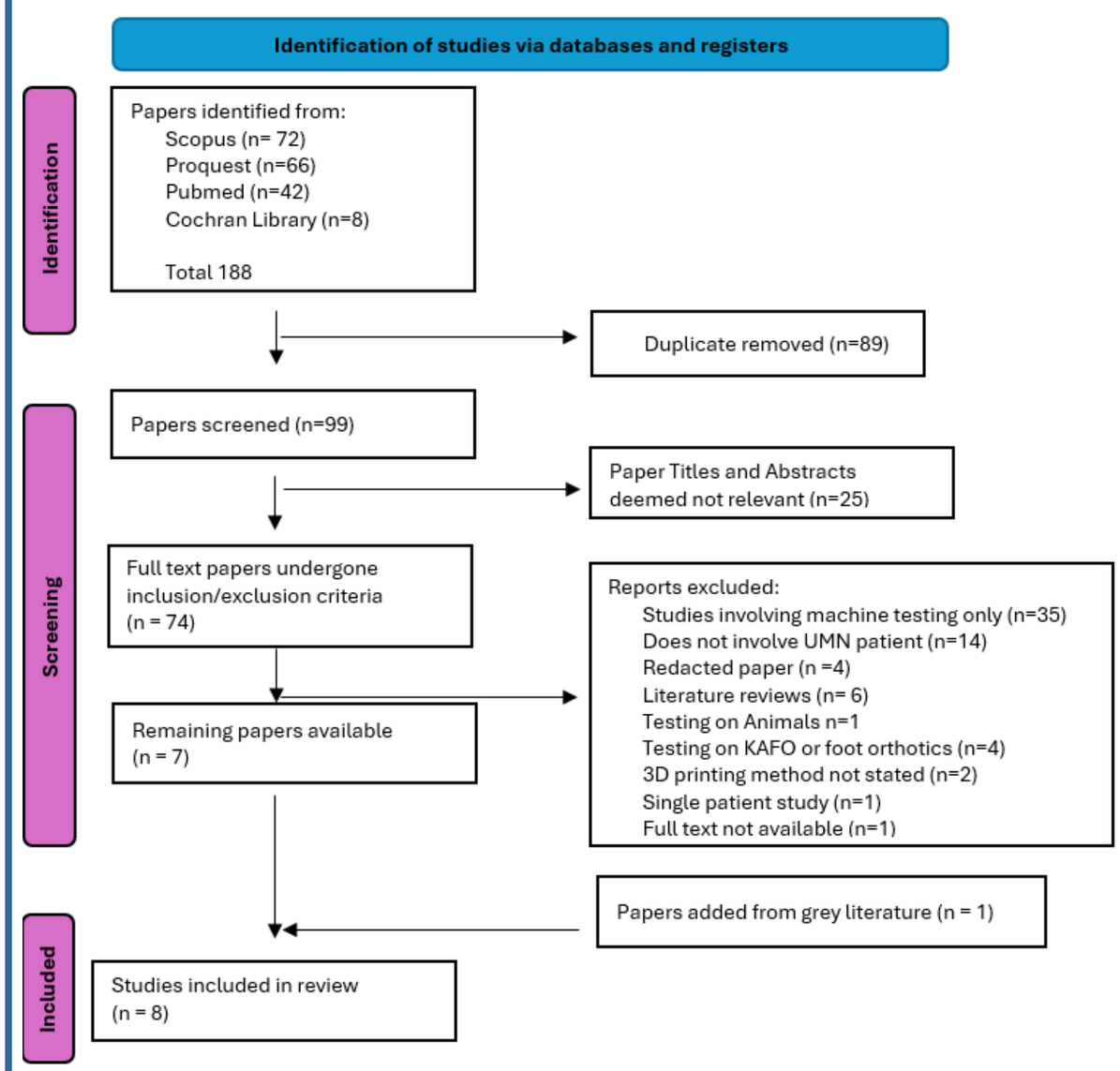
Eight studies on UMN patients found that 3D-printed AFOs generally improved gait performance compared to barefoot or shoe conditions, with similar overall function to traditional thermoplastic AFOs. Kinetic and kinematic results were inconclusive across studies:

- Comparable overall function to thermoplastic AFOs
- Mixed evidence for kinetic and kinematic gains
- Inconsistency in AFO designs between studies
- No studies scored as **Low** risk of bias with two being **High** and six **Moderate** risk

OBJECTIVE

This systematic review evaluates the effectiveness of 3D-printed AFOs on walking speed, comfort, and functional performance in individuals with UMN disorders.

STUDY SELECTION



CONCLUSION

3D-printed AFOs demonstrate promise in enhancing gait parameters in UMN populations, however limited evidence is present when comparing superiority to thermoplastic AFOs, with fundamental flaws noted in methodology and AFO design amongst most of the papers reviewed. Further high-quality clinical trials are needed to validate mechanical durability, user comfort, and long-term outcomes in diverse patient groups with standardised AFO as this would allow for direct comparison by isolating material behaviour while controlling for confounding variables like AFO shape or design preference.

Page, M.J. et al. (2021) 'The PRISMA 2020 statement: an updated guideline for reporting systematic reviews', BMJ, p. n71. Available at: https://doi.org/10.1136/bmj.n71.
Downs, S.H. and Black, N. (1998) 'The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions', Journal of Epidemiology & Community Health, 52(6), pp. 377–384. Available at: https://doi.org/10.1136/jech.52.6.377.