Title: Evaluating the Clinical Success of Clear Aligners for Rotational Tooth Movements: A Systematic Review

Research Question: To evaluate the accuracy and predictability of planned rotational tooth movements in orthodontic patients (adults and adolescents, permanent dentition) treated with clear aligners

Objectives:

Primary:

1. To evaluate the effectiveness and accuracy of clear aligners in producing rotational tooth movements by comparing planned versus achieved outcomes.

Secondary:

1. To identify which types of teeth show the highest or lowest predictability in rotational correction.
2. To evaluate the influence of aligner design features (e.g., attachment shape, optimized attachments, staging protocols) on rotational accuracy
3. To identify clinical or treatment-related factors (e.g., amount of rotation planned, use of auxiliaries) that may affect rotational outcomes
4. To compare the predictability of rotation between different clear aligner brands or systems, if applicable
5. To analyze the need for refinements

Methods:

- **Inclusion Criteria:**
  - Studies involving human patients with permanent dentition treated exclusively with clear aligners.
  - No age limits (adolescents, adults).
  - Studies reporting quantitative data on rotational tooth movement (planned vs achieved).
  - Any clear aligner system (e.g., Invisalign, Spark, ClearCorrect).
  - Clinical studies including RCTs, cohort studies, cross-sectional studies.

- **Exclusion Criteria:**
  - In vitro, ex vivo, or animal studies.
  - Studies on mixed or deciduous dentition.
  - Studies not reporting rotational movements or not providing quantitative data.
  - Case reports, reviews, editorials, expert opinions.
  - Studies involving combined appliance therapies (unless data on clear aligners are presented separately).

- **Sources:**
  - Systematic search in: PubMed, Scopus, Embase, Web of Science, Cochrane CENTRAL, LILACs, Ovid, ClinicalTrials.gov, ProQuest (searching until April 2025).

- **Study Selection:**
  - Two independent reviewers will screen titles, abstracts, and full texts. A third reviewer will resolve disagreements.
- **Data Extraction:**
  - Based on a standardized model including: study design, sample size, age, aligner brand, amount of planned and achieved rotation (degrees), type of teeth, presence/type of attachments, treatment duration, number of refinements.
- **Risk of Bias Assessment:**
  - **ROBINS-I** for non-randomized studies and **RoB 2** for RCTs.
  - The **GRADE** approach will be used to evaluate the certainty of evidence.

Note: This protocol will be registered on PROSPERO and developed in accordance with PRISMA guidelines.