Evaluation of treatment outcomes with passive presurgical infant orthopaedics in patients with non-syndromic cleft lip and or palate: A systematic review conducted according to PRISMA guidelines and the Cochrane Handbook for Systematic Reviews of Interventions



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Abstract

Aim The primary goal of the present comprehensive systematic review is to assess the treatment results attained through PSIO in individuals with NSCLP, as well as to explore its effectiveness. This will be accomplished by examining a range of existing published studies that focus on patient groups who have undergone PPIO. **Materials and Methods** A comprehensive search strategy was devised by a single author for each database without language restrictions. The databases searched were PubMed, Cochrane library Google Scholar, Web of Science and Scopus. The search period was limited to the years 2001 to 2023. Duration and study design filter was used. Furthermore, conference proceedings, abstracts, and reference lists of relevant studies were sought to obtain additional records. **Results** Titles, abstracts, and full texts of studies identified from the literature search were screened by two authors independently and then combined together. The information from the short-listed studies that were considered were: first author, year of publication, the groups, type of intervention and outcome parameters like maxillary arch collapse, speech defects, facial aesthetics, anthropometry and oral motor skills, transverse and maxillary arch relationship and the results of these studies was tabulated. Bias was analysed using the Cochrane's Risk of Bias tool (RoB 2). Total 8 articles which met the inclusion criteria were included in this review. The was no statistically significant difference in the treatment outcomes achieved after performing PSIO in patients with UCLP. **Conclusion** The examined protocols for passive presurgical infant orthopaedics (PPIO) in individuals with CLP typically did not reveal notable treatment outcomes when compared to a lack of treatment across a range of domains. These domains encompass feeding patterns, facial aesthetics, maxillary dentoalveolar factors, cephalometric measurements, speech and language-related aspects, dental arch alignments, economic assessments, as well as occurrences of adverse effects or complications associated with applied appliances or procedures.

KEYWORDS Nonsyndromic cleft lip and palate, unilateral cleft lip and palate, passive pressure pre-surgical infant orthopaedics (PPIO), Infant Orthopaedics (IO).

Introduction

Non-syndromic cleft lip and palate (NSCLP) is one of the most common congenital anomalies affecting the craniofacial region [Wyszynski and Beaty, 1996]. The morphogenesis of the palate and lips occurs during the sixth and the twelve weeks of fetal development. The disruption in the fusion of the maxillary prominences with the nasal prominences and the fusion of the primary palate with the palatal shelves face leads to the occurrence of a cleft defect. This defect encompasses both the soft tissues and bony structures within the oral cavity [Berkowitz, 2015]. The management of NSCLP requires a multidisciplinary approach, with surgical intervention being the primary mode of treatment. However, the optimal timing and sequencing of surgical procedures for NSCLP patients have been the subject of ongoing debate [Davidopoulou et al., 2022; Quek et al., 2022; Vallés et al., 2022]. Passive presurgical infant orthopaedics (PPIO) is a treatment modality that has gained attention in recent years as a potential adjunct to surgical intervention in NSCLP patients [Minervini et al., 2023a]. PPIO was developed and diffused in the 60s'-70s' (e.g. Weil, Hotz). PPIO involves the use of specialised devices, such as nasoalveolar molding (NAM) appliances, to mold and reshape the nasal cartilage, alveolar arch, and lip tissues before primary surgical repair. The goal of PPIO is to improve the surgical outcome by reducing the severity of the cleft deformity, optimising tissue alignment, and facilitating the surgical repair process . One of the most popular techniques of PPIO is presurgical nasoalveolar molding by Grayson et al. [1999] which helps to improve the treatment outcomes for complete cleft lip and palate. NAM is a peculiar modification of PPIO, introduced in the 90s', which adds nasal molding to alveolar molding and needs to be combined to primary surgery of the nose. Presurgical infant orthopaedics can be classified as active or passive. The active PSIO is a method in which the two palatine shelves are "pulled" towards each other under tension whereas the passive PSIO involves a passive "palatal plate" which simply shields off the tongue from moving into the cleft defect, in between the two palatal shelves, thereby allowing the two palatal shelves to move towards each other and in turn

reduce the volume of the cleft defect without actually applying pressure. Evaluating the effectiveness of PPIO requires a comprehensive assessment of various factors, including facial aesthetics, dental arch relationship, speech outcomes, and psychosocial impact on patients and their families.

The present systematic review aims to evaluate the treatment outcomes achieved with PPIO in patients with NSCLP along with investigating its efficacy, by analysing various published literature that studies a cohort of patients who underwent PPIO. This systematic review hereby assesses the impact of PPIO on the severity of cleft deformity, dental arch relationship, speech development, and patient satisfaction, by evaluating the quality of available evidence.

Materials and Methods

Eligibility criteria

Utilising the PICOS (Participants, Intervention, Comparison, Outcomes, Study design) framework, the eligibility criteria were established in the following manner:

- (P) Participants: consisted of Infants with Non Syndromic Cleft Llip Palate defect.

(I) Intervention consisted of Infants treated with passive presurgical infant orthopaedic device

- (C) Comparison consisted of Infants undergoing surgical repair, without presurgical infant orthopaedic intervention.
- (O) Outcomes: Maxillary arch collapse, Speech evaluation, facial appearance, Anthropometry and Oral motor skill, transverse dental arch relationship, Maxillary arch dimension.
- (S) Study design: Randomised Controlled Trials (RCTs) included. Systematic reviews and meta-analyses were excluded.

The following inclusion criteria was used:

1. Articles in English;
2. Human studies;
3. Randomised control trials.

Exclusion criteria were:

1. Articles that did not comply with PICOS;
2. Duplicate articles;
3. Books;
4. Letters to editor;
5. Articles written in any other language but English;
6. Posters and abstracts;
7. Studies performed on Animals;
8. Articles involving Infants with Syndromic cleft lip and palate;
9. Infants with systemic disorders;
10. Patients under drug therepy.

Search Strategy

A comprehensive search strategy was devised by a single author for each database without language restrictions. The databases searched were PubMed, Cochrane library Google Scholar, Web of Science and Scopus. The search period was limited to the years 2001 to 2023. Duration and study design filter was used. Furthermore, conference proceedings, abstracts, and reference lists of relevant studies were sought to obtain additional records. Table 1 outlines this search strategy. The web search was assisted using the MESH (Medical subjects Headings) . In addidtion, a manual search of earlier systematic reviews on the same subject was also performed. The MeSh terms were used to search in the PubMed search engine,

SEARCH BUILDER	SEARCH TERMS
PUBMED SEARCH	(((randomised controlled trial[pt]) OR (controlled clinical trial[pt]) OR (randomised[tiab]) OR (placebo[tiab]) OR (drug therapy[sh]) OR (randomly[tiab]) OR (trial[tiab]) OR groups[tiab])) NOT ((animals[mh] NOT humans[mh])) AND ((cleft lip) OR (cleft-lip) OR (cleft lip and palate) OR (cleft-lip and palate) OR (alveolar cleft*)) AND (infant OR presurgical OR pre-surgical OR preoperative OR pre-operative OR early) AND (orthodon* OR orthopaedic* OR orthopaedic* OR nasoalveolar OR moulding OR molding OR pnam OR nam OR plate*) AND ((randomizedcontrolledtrial[Filter]) AND (2001:2023[pdat]))
COCHRANE	((cleft lip) OR (cleft-lip) OR (cleft lip and palate) OR (cleft-lip and palate) OR (alveolar cleft*)) AND (infant OR presurgical OR pre-surgical OR preoperative OR pre-operative OR early) AND (orthodon* OR orthopaedic* OR orthopaedic* OR nasoalveolar OR moulding OR molding OR pnam OR nam OR plate*) in Title Abstract Keyword - (Word variations have been searched)
GOOGLE SCHOLAR	allintitle: cleft presurgical orthopaedics
WEB OF SCIENCE	(((((((ALL=(Unilateral cleft lip and palate)) AND ALL=(Passive presurgical infant orthopedics)) OR ALL=(Nasoalveolar moulsing)) AND ALL=(Cleft lip and palate)) OR ALL=(Cleft lip and palate)) AND ALL=(Infant)) NOT ALL=(Bilateral cleft lip and palate)) AND ALL=(Randomised control trial
SCOPUS	cleft AND lip AND palate AND passive AND presurgical AND infant AND orthopaedics AND cleft AND psio AND infants AND nasoalveolar AND moulding AND nam AND randomised AND control AND trials OR rct

TABLE 1 Showing Search strategies.

however manual search was performed in other search engines to make up for the lack of use of the MeSh terms. Preferred Reporting Items for Systematic Review and Meta Analysis (PRISMA) guidelines and the Chochrane handbook for Systematic Reviews of Interventions were followed in this systematic review. PROSPERO's International Prospective Register of Systematic Reviews lists our systematic review protocol under the provisional accession number CRD42023450522.

Data Extraction

Two authors (N.B. and N.R.) independently screened the gathered records by reading the title, abstract and keywords for eligibility without being blinded to the authors' identities, affiliations, or research outcomes. Those records that were eligible were further screened for eligibility by reading the full text. Any disagreements that arose were discussed and resolved with consultation of the third author (A.K.) when necessary. Cross references for all the selected studies were further screened for any relevant papers. Data collection forms were employed to gather required information, encompassing the study's bibliographic details, clarification of study design and

AUTHOR/YEAR/ JOURNAL	STUDY DESIGN	INTERVENTION	SAMPLE SIZE	GROUPS	FOLLOW-UP/ RECORDS AT	MEASUREMENT TOOL	OUTCOMES
Prahl et al [2003] Cleft Palate Craniofacial Journal	Prospective two arm RCT	Passive IO plate	54 infants with complete UCLP	Group 1(IO group):27 infants Group 2 : (Non IO group)27 infants	T1 < 2weeks T2 at 15 weeks T3 at 24 weeks T4 at 48 weeks T5 at 58 weeks T6 at 78 weeks	Plaster casts	Primary: Presence of collapse/overlap of Maxillary segments Secondary: Survival experience of contact and collapse time; Frequency of different arch forms and severity of the collapse.
Konst et al [2004] Cleft Palate Craniofacial Journal	Prospective two arm RCT	Passive IO plate	54 infants with complete UCLP	Group 1 (IO group):27 infants Group 2 (Non IO group): 27 infants	2 years, 5 months, 24 days to 2 years 6 months, 9 days.	For speech measurement: EAI rating scale with certain specific criteria	Primary: Speech Evaluation Secondary: cost-effectiveness evaluation
Prahl et al [2006] Cleft Palate Craniofacial Journal	Prospective two arm RCT	Passive Maxillary IO plate	41 infants with complete UCLP	Group 1 (IO group): 21 infants Group 2 (Non IO group) : 20 infants	18 Months of age	To score facial appearance, two metrical response modalities were used i.e., visual analog scales and reference scores. Full-face and cropped photographs were compared with reference photographs and were judged.	Primary : Facial appearance
Masarei et al [2007] Cleft Palate Craniofacial Journal	RCT	Passive IO plate	50 non syndromic infants	Group 1: 34 infants with complete UCLP Group 2: 16 infants with soft palate cleft and at least 2/3rd of hard palate cleft	At 3 months (pre surgery) and at 12 months (post surgery)	1)Anthropometry 2)Oral motor skill – using NOMAS developed by Braun and Meyer Palmer 3)Sucking – using Great Ormond Street Measure of Infant Feeding	Primary : Anthropometry and Oral motor skill Secondary : Sucking asessment
Bongaarts et al [2008] Cleft Palate Craniofacial Journal	Prospective two-arm randomised controlled clinical trial	Passive IO plate	54 infants with complete UCLP	Group 1 : (IO group): 27 infants Group 2: (Non IO group) : 27 infants	At 4 years and at 6 years	Assessed on full face photographs and photographs showing only nose and mouth. Ratings were performed on a VAS-scale	Primary : Facial appearance at 4 and 6 years of age
Noverraz et al [2015] Clinical Oral Investigtion	A prospective two-arm randomised controlled trial	Passive IO Maxillary plates	54 infants with complete UCLP	Group 1: (IO group): 27 infants Group 2: (Non IO group) : 27 infants	At Birth 4 months 12 months 9 years	Assessed on dental casts using the modified Huddart/ Bodenham score to measure the maxillary arch constriction at 9 and 12 years of age.	Primary : Transverse dental arch relationship
Shetty et al [2017] International Journal of Oral and Maxillofacial Surgery	A prospective randomised controlled trial	Passive PNAM plate	120 non-syndromic infants with complete UCLP	Group 1: 60 infants • SG 1: 20 (PNAM before 1month) • SG 2: 20 (1-6 months) • SG 3: 20 (6months – 1 year) Group 2: 60 infants No PNAM – underwent surgery directly	T1 = at 1 month T2= at 6 months T3= at 1 year	Linear measurements on patient cast	Primary: long-term effect of PNAM on the growth of maxillary arch
El- Ghafour et al [2020] The Cleft PalateCraniofacial Journal	A prospective, balanced, randomised, parallel groups, single-blinded, controlled trial	Novel 3D-Printed Nasoalveolar Molding Appliance (D-NAM)	34 non-syndromic infants with complete UCLP	Group 1: 17 infants – undergoing D-NAM therepy Group 2: 17 infants-control group	T1: Before starting presurgical IO T2: After NAM and before lip repair	3D digital models	Maxillary Arch dimension

TABLE 2 Characteristics table.

AUTHOR/YEAR/ JOURNAL	RESULTS / OUTCOMES	CONCLUSION
Prahl et al [2003] Cleft Palate Craniofacial Journal	Overlap of the alveolar segments: • At1½ years, half of the patients had overlap of the alveolar segments • Moderate collapse occurred first at T4 • T6 showed first evidence of severe collapse. The average collapse severity scores at T5 were 0.4 (SD 0.6) for the IO(+) group and 0.6 (SD 0.7) for the IO(-) group. By T6, these scores had risen to 0.6 (SD 0.7) for the IO(+) group and 1.0 (SD 0.9) for the IO(-) group.	• For patients with UCLP, the use of IO did not bring about either the contact between the maxillary segments, nor prevent the alveolar segments from collapsing. • IO did not have any effect on the alveolar collapse from birth till 18 months of age. The conclusion drawn was that IO had no significant effect, and it may be dismissed as a treatment option for preventing maxillary arch collapse.
Konst et al [2004] Cleft Palate Craniofacial Journal	• The mean number of speech therapy sessions required was 34.6 in the IO group while it was 45.8 in the non-IO group. • The mean cost saved from preventing the need for speech therapy was €270	• The outcomes of the perceptual assessment using the «total impression of speech» scale at the age of 2.5 years indicated a positive impact of IO treatment. This can be viewed as a significant clinical improvement that contributes to advancing the speech and language development of children with cleft lip and palate. • Considering the overall expenses associated with the care of children affected by cleft lip and palate, the financial investment needed to achieve this enhancement appears to be minimal.
Prahl et al [2006] Cleft Palate Craniofacial Journal	There were no statistically significant differences noted between the assessments conducted by non-experts and experts regarding VAS, reference scores, and total z scores (all p-values > .70).	In terms of facial aesthetics: • The evaluations of laypeople and professionals did not show any significant differences. • Full face photographs were perceived as more attractive compared to the cropped photographs. • Thus, from an orthodontic and surgical perspective, there appears to be no necessity to conduct IO in children with UCLP.
Masarei et al [2007] Cleft Palate Craniofacial Journal	• Weight-0.50 (No PSO) 0.81 (PSO) • Height - 0.38 (No PSO) 0.06 (PSO) • Head circumference- 0.08 (No PSO) 0.53 (PSO) • Body mass index - 0.68 (No PSO) 0.39 (PSO)	• PSO did not result in an enhancement of feeding efficiency either prior to palate repair at 3 months of age or following palate repair at 12 months of age. • With regards to bottle feeding, no significant differences were found, including for parameters like the duration of sucking bursts, sucking rate, intervals from peak to peak, proportion of positive pressure generation, and the suck-swallow ratio. This applied to both groups of infants managed with or without PSO, irrespective of cleft type, prior to palate repair at 3 months. • In terms of physiological metrics (weight, length, head circumference, BMI), there were no significant differences between the PSO and No PSO groups in each cleft type at the 3-month and 12-month evaluations. No noteworthy distinctions were found in anthropometric averages.
Bongaarts et al [2008] Cleft Palate Craniofacial Journal	Interceptive orthodontics (IO) demonstrated a favourable impact on the overall facial aesthetics of 4-year-old children affected by UCLP. However, by the age of 6, only experts noted a beneficial influence of IO on the assessment of nasolabial photographs.	The utilisation of IO is not warranted for individuals with UCLP.
Noverraz et al [2015] Clinical Oral Investigtion	Differences in transverse dental arch relationships at 9 and 12 years of age do not exist between children with UCLP who underwent IO treatment and those who did not.	There is no orthodontic necessity to carry out interceptive orthodontics in the manner implemented within this research for children with UCLP.
Shetty et al [2017] International Journal of Oral and Maxillofacial Surgery	• The interincisal distance (ISD) within both the study and control subgroups did not demonstrate any notable disparity at T1 and T3. However, a significant distinction was evident at T2, where the mean ISD of the study subgroups (5.38 mm) was notably smaller compared to the control subgroups (14.13 mm). • In terms of intercanine width (ICW) within both the study and control subgroups, there were no significant discrepancies at T1 and T2. Nevertheless, a substantial difference was observed at T3, where the mean ICW of the study subgroups (30.10 mm) was significantly greater than that of the control subgroups (27.90 mm). • The posteroanterior width (PAW) in both the study and control subgroups did not manifest any noteworthy differences at T1, T2, and T3.	• The influence of PNAM demonstrated significance across all three study subgroups, with the most advantageous results observed in patients who underwent treatment prior to reaching 1 month of age. • A significant decrease in the cleft gap was observed, contributing not only to the prevention of arch collapse but also leading to an enhancement of the arch form's stability and symmetry by the age of 6.

El- Ghafour et al [2020] The Cleft Palate-Craniofacial Journal	• Measurements made- Mean difference • Ant. Cleft width (mm)= 6.7 mm • Canine cleft with (mm)= 5.8mm • Middle cleft with (mm)=4.2mm • Posterior cleft width(mm)=2.6 • Intercanine region width(mm) =2.2 mm • Middle arch with (mm)= 1.03 mm • Posterior arch width (mm)= 0.54 mm • Arch Symmetry (mm) = 3.22 mm In contrast to the control group, The D-NAM method yielded positive outcomes. A notable enhancement, both clinically and statistically, was identified in all the measured maxillary arch dimensions at T2, in comparison to the control group. The D-NAM technique proved effective in approximating the two maxillary segments, reducing the cleft gap, and enhancing the symmetry of the arch.	• The novel D-NAM method proves effective in enhancing maxillary arch dimensions before undergoing surgical lip repair in infants with UCLP. • Moreover, it appears that the entirely 3D-printed iteration of the CAD/NAM holds potential for utilisation as a streamlined variation of the NAM appliance.

TABLE 3 Results and Outcomes of included studies.

confirmation of study eligibility, characteristics of participants (including numerical count, age, and gender where available), attributes of the intervention (specifications of the employed PSIO appliance, the treatment protocol followed for PSIO), details of evaluated outcomes and the methodologies used for assessment, as well as any supplementary pertinent information (including pre-determined sample size calculations, assessments of methodological reliability, and data regarding adherence to the designated intervention protocol). The results associated with PSIO appliance treatment, as indicated in the studies considered in this review, were classified into specific categories. Quantitative results covered measurements of cephalometric parameters, maxillary dentoalveolar variables, and dental arch relationships. On the other hand, qualitative outcomes encompassed a variety of factors including feeding behaviors and nutritional status, facial aesthetics, auditory evaluations, assessments of speech and language, feedback from patients and caregivers, economic evaluations, and also adverse effects and complications arising from the use of PSIO appliances and procedures.

Quality Assessment

Two authors conducted an assessment of the risk of bias parameters for each study included in the analysis. The risk of bias was evaluated on the following parameters: implementation of a single-operator protocol, random sequence generation, presence of a control group, blinding of the testing machine operator, sample preparation standardisation, evaluation of the failure mode, adherence to manufacturer's instructions for material usage, and sample size calculation clarification. Studies that reported the examined parameter received a "YES" while those lacking information were marked as "NO." The RoB for each study was categorised based on the total number of "YES" answers received. The study which stated "NO" for even one of the 6 parameters was classified as having a high RoB. The RoB is explained in Figure 1.

Results

Study characteristics

101 articles were obtained in total from electronic databases and manual search from which 56 studies were eliminated as duplicates after which 45 studies qualified for full-text screening. 21 studies were eliminated as the intervention and comparator groups were different from what was being assessed in this SR, 1 study was eliminated as it was not RCTs, 6 studies were eliminated due to difference in methodology, while 2 studies were eliminated as they assessed bilateral cleft defect. Finally, 8 randomised control trials which met all inclusion criteria were identified to undergo qualitative analysis. This PRISMA 2020 flowchart (Figure 2) shows the selection of studies. The included studies were selected from 2003 to 2020. All 8 studies were RCTs. All studies have assessed treatment outcomes using the passive pressure plate and compared it to no intervention. A total of 461 infants were assessed. All studies have evaluated the outcomes at different time intervals, ranging from less than 2 weeks to 9 years.

Quality Assessment and risk of bias

The risk of Bias was assessed using the RoB 2.0 tool. Out of the 8 studies, 6 studies had high RoB whereas the remaining 2 had unclear risk. The study by Bongartz et al. [2008] and Noverraz et al. [2015] were categorised as high RoB based on performance bias as the blinding of personnel was not performed in both studies. Studies by Masserai et al [2007] were categorised as high RoB as it did not mention about allocation

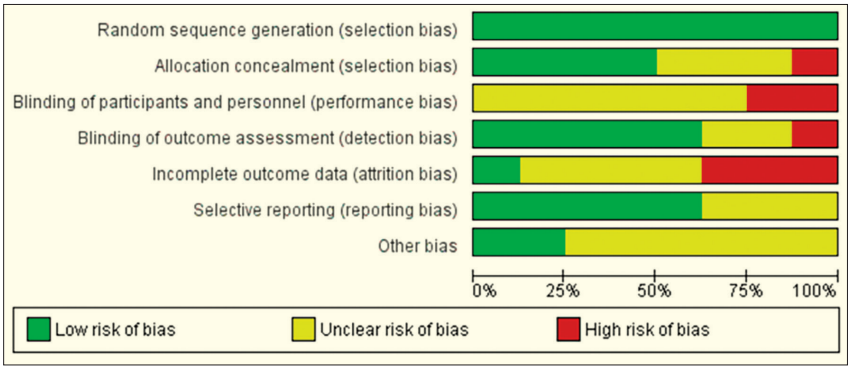


FIG. 1
Risk of bias chart.

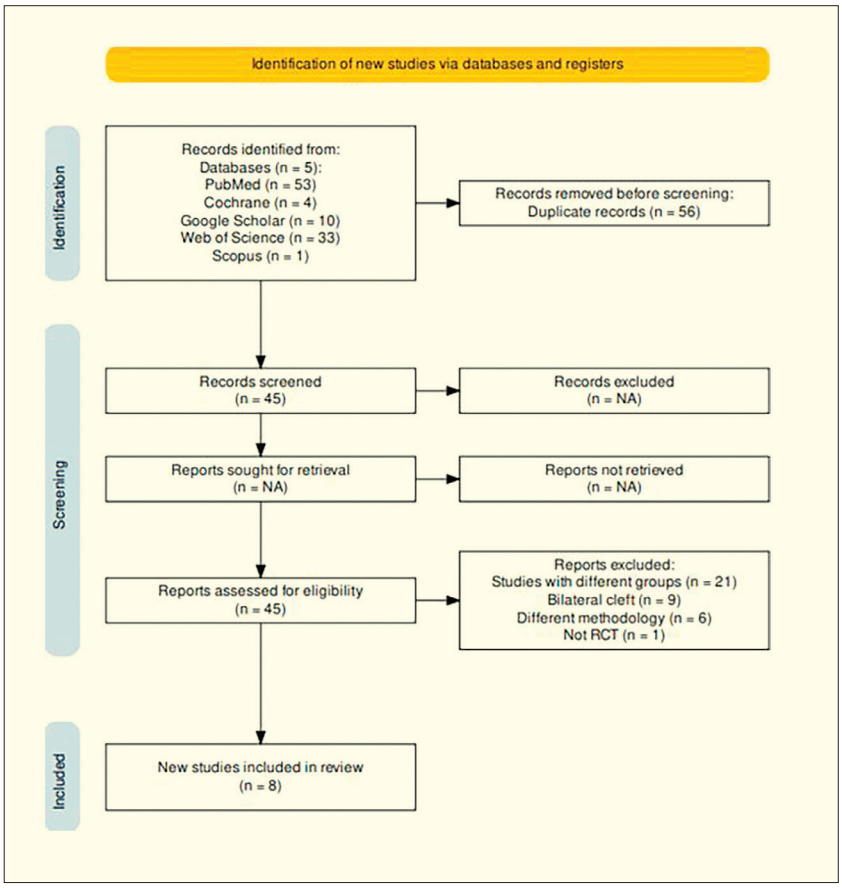


FIG. 2
Prisma 2020 Flowchart

concealment. Studies by Konst et al. [2004] and Prahl et al [2003] were also categorised as high RoB due to high levels of attrition in the study participants. Lastly, the study by Shetty et al. [2017] was categorised as high RoB as it showed both, detection bias as well as attrition bias.

Discussion

The concept of passive presurgical infant orthopaedics (PSIO) has been widely adopted by dedicated treatment teams worldwide for patients with cleft lip and/or palate, as evident in various sources [Lohmander et al., 2004; Masarei et al., 2007; Prahl et al., 2001] .Nevertheless, according to the results obtained from the current SR, the examined PSIO devices did not demonstrate any significant effects when compared to the absence of treatment. In the systematic review, an initial screening was conducted on 67 articles derived from randomised controlled trials that specifically targeted infants with UCLP or cleft palate [Libonati et al., 2018]. Only eight randomised controlled trials that met the inclusion criteria were included in this paper, emphasising the lack of evidence at the top of the widely recognised scientific hierarchy. Although well-designed and meticulously executed randomised controlled trials are known to provide the best data on the effectiveness of healthcare interventions, it is worth noting that substantial research has also been conducted on non-randomised trials [Moher et al., 2012] which have not been included in this systematic review. The included studies assessed outcomes related to Maxillary arch collapse, Speech evaluation, facial appearance, Anthropometry and Oral motor skill, transverse dental arch relationship, and Maxillary arch dimension.

The study conducted by Prahl et al in 2003 [Prahl et al., 2003], evaluated the extent of maxillary arch collapse in infants being treated with passive PSIO versus those without any presurgical intervention. The results of this study concluded that for patients with UCLP, the use of IO did not bring about the approximation of the maxillary segments, nor did it prevent or affect the extent of collapse of the alveolar segments until 18 months of age. This showed that IO had no significant effect compared to no treatment . The results of this study were in accordance with the studies performed by Huddart et al. [Laitinen, 1993] and Minervini et al. [2023c] stated that PSIO had no clear outcome measures in terms of maxillary arch collapse. The evaluation of ''total impression of speech'' at 2.5 years of age performed by Konst et al. [2004] showed that PSIO brought about a clinically important change that would bring the cleft child one step closer to normal speech and language development. The results of this study by Konst et al. [2004] (are also in accordance with the study performed by Minervini et al. [2023d] who studied the effect of the pre-operative orthopaedic plate on articulatory function in 17 CLP children. The outcomes revealed that the continuous utilisation of an orthopaedic plate effectively prevented palatalised speech. However, the findings of these investigations contrast with those from the study conducted by Karling et al. [1993] which assessed the impact of T traction on speech in unilateral and bilateral cleft patients compared to a non-cleft control group, revealing no noteworthy differences between the groups. Overcoming nasal deformities remains a significant challenge in cases of cleft lip and palate (CLP). This intricate process influences nasal structure from multiple spatial perspectives. The initial documentation of reshaping newborn nasal cartilage through pre-surgical molding was undertaken by Matsuo et al. [1989]. Subsequently, Minervini et al. [2023b] introduced a device featuring a nasal extension connected to

the front of an acrylic alveolar molding plate, marking the introduction of nasoalveolar molding (PNAM) appliances. While passive PSIO appliances did not significantly alter general perceptions of facial aesthetics, the treatment group received better evaluations from professionals when images focusing on the nasolabial region were examined at 6 years of age. Assessments made by experts based on cropped photographs are generally considered more reliable as they can eliminate biases from other facial characteristics and variations in response to expressions that may positively influence overall ratings. However, in real-world interactions with the general population, the favorable impact observed in expert evaluations was found to lack relevance for individuals who are affected [Bongaarts et al., 2004]. The investigations by Prahl et al. in 2006 have confirmed the aforementioned findings. However, these outcomes contrast with those deduced from a study by Minervini et al. [2023a] who compared the growth and cosmetic outcomes of 97 UCLP patients using traditional plaster models versus surface impressions of infants. The study disclosed enhanced and sustained nostril symmetry, an elongated columella length, and the absence of alar cartilage displacement in patients incorporating the nasal component. These attributes collectively contribute to improved facial aesthetics in infants. Analysing facial development through cephalometric analysis in the Dutch cleft sample did not reveal significant effects attributed to passive PSIO appliances, although uncertainties exist regarding potential influences on outcomes due to difficulties in accurately identifying landmarks. Measurement inaccuracies may arise in young cleft individuals due to maligned incisors within an atrophic and displaced premaxilla, as well as common challenges encountered in cephalometric assessments. Concerning toddlers affected by unilateral cleft lip and palate, alternative radiographic points such as A, ANS, and PNS have been explored, but conclusive evidence supporting their superiority over traditional landmarks is currently lacking. In general, the degree of measurement errors within the study conducted by Bongaarts et al. [2008]was deemed acceptable. The assessment of orofacial region growth using study casts did not show any significant effects of passive PSIO appliances during the longest follow-up period available. The PSIO appliances did not demonstrate effectiveness in preventing the collapse of the maxillary arch or influencing maxillary arch dimensions. Furthermore, when using the modified Huddart/Bodenham system to assess occlusal relationships at 12 years of age, there were no differences observed between the treatment and control groups. This finding is consistent with the results of a non-randomised controlled trial that investigated the impact of an active PSIO appliance using the GOSLON yardstick in younger children. The modified Huddart/Bodenham system, used for evaluating dental arch relationships in the transverse plane of space, is widely regarded as a strong, valid, and dependable method for assessing treatment outcomes in children with cleft lip and palate [Noverraz et al., 2015]. A similar study by Adali et al [2012] studied the effect of PNAM on the arch circumference and arch form in transverse, anteroposterior, and vertical dimensions and concluded that pre-surgical orthopaedics did not produce any significant effect on the arch form. Upon conducting subjective assessment and evaluation, it became evident that, in contrast to the control group, 2.5-year-old children in the intervention cohort received notably improved assessments regarding speech and language development intelligibility [Konst et al., 2000]. Nonetheless, the achieved scores were considerably favorable, supporting the cost-effectiveness of the overall intervention from a societal economic perspective. However, no statistically significant results were observed in relation to psychosocial aspects relevant to caregivers, including maternal satisfaction [Prahl et al., 2008].

Quality of the evidence available

Overall, the GRADE methodology [Guyatt et al., 2011] indicated that the quality of evidence was of a lower level, creating uncertainties about the strength of the associated recommendations. Most of the evaluated outcomes were predominantly drawn from a singular randomised controlled trial, specifically the Dutchcleft study sample. This underscores the scarcity of evidence-based data for a condition that profoundly impacts patients and their families throughout their lives.

Strengths and limitations of the study

This systematic review has several strengths, including adoption of a methodology that adheres to accepted principles and the exclusive focus on Randomised Controlled Trials (RCTs), which are generally acknowledged to produce the highest quality data. Furthermore, the search strategy implemented in this present analysis was comprehensive and all-encompassing, encompassing both grey literature and electronic sources up until April 2023. It encompassed all accessible randomised controlled trials that compared PSIO with no treatment, irrespective of language or publication status. Rigorous measures were taken to minimise methodological bias. Screening, eligibility validation, data extraction, evaluation of bias risk, and assessment of evidence quality were all conducted by two individuals independently, and any disparities were resolved through discussions or consultations with the co-supervisor of the thesis until a consensus was established, and a collaborative decision was pursued. Moreover, certain constraints within this review stem primarily from the attributes and nature of the collected data during the review process. These limitations led to the evaluation of the available evidence as possessing a high potential for bias, alongside the absence of data homogeneity that prevents the execution of a meta-analysis. Another drawback of the data found in this study is the small number of patients who were ultimately examined, which increased the likelihood of bias and, in some cases, caused challenges with the accuracy of the effect estimates.

Conclusion

The results of this present systematic review, carried out in accordance with established criteria, do not support the rejection of the null hypothesis. The examined protocols of passive presurgical infant orthopaedics (PSIO) in individuals with CLP typically do not exhibit noteworthy treatment effects when compared to the absence of treatment across diverse dimensions. These dimensions encompass aspects such as feeding patterns, facial aesthetics, maxillary dentoalveolar measurements, cephalometric assessments, speech and language-related parameters, dental arch alignments, economic evaluation-related results, and potential adverse effects and complications linked to the employed appliances or procedures. Given the array of variables that could have influenced the outcomes of the incorporated trials, it is advisable that further investigations be conducted in the relevant field. This will help establish a more extensive collection of high-quality evidence and lead to stronger and more reliable recommendations for management decisions in the specific case.

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