UNIVERSIDADE FERNANDO PESSOA

ROUTINE ORAL HEALTH CARE FOR PATIENTS WITH CEREBRAL PALSY- SYSTEMATIC REVIEW

[Cuidados de saúde oral de rotina em pacientes com paralisia cerebral - revisão sistemática]

Dissertação de Mestrado

[Mestrado Integrado em Medicina Dentária]

Eugenia Maria Petitto

Orientadores:

Professora Doutora Otilia Lopes

Mestre Filipa Pinto de Oliveira

Junho, 2024

ROUTINE ORAL HEALTH CARE FOR PATIENTS WITH CEREBRAL PALSY- SYSTEMATIC REVIEW

[Cuidados de saúde oral de rotina em pacientes com paralisia cerebral - revisão sistemática]

Dissertação de Mestrado

[Mestrado Integrado em Medicina Dentária]

Eugenia Maria Petitto

Orientadores:

Professora Doutora Otília Lopes

Mestre Filipa Pinto de Oliveira

Junho, 2024

DEDICATION

A Maya, per sempre al mio fianco.

ACKNOWLEDGEMENTS

Gostaria de expressar a minha mais sincera gratidão a todas as pessoas que contribuíram para a realização desta tese.

Em primeiro lugar, meu mais profundo agradecimento vai para a Professora Otilia Lopez, minha orientadora, pela sua orientação constante, conselhos valiosos e infinita paciência demonstrada durante todo o percurso. Sua dedicação e apoio foram fundamentais para a conclusão deste trabalho.

Um agradecimento especial também vai para a Professora Filipa de Oliveira, minha coorientadora, por sua contribuição insubstituível, sua disponibilidade e suas competências, que enriqueceram enormemente este projeto. Sua colaboração e entusiasmo foram uma fonte de grande inspiração.

Não posso esquecer de agradecer aos meus pais, que com o seu amor, apoio incondicional e confiança em mim, me deram a força para enfrentar cada desafio. Sem o seu encorajamento e compreensão, este marco não teria sido possível.

Um agradecimento afetuoso vai para Maya, meu cão, pela sua presença constante e o conforto que me deu nos momentos de estresse e dificuldade.

De coração, agradeço à Giorgia, minha amiga, pelo seu apoio incondicional, paciência e capacidade de ouvir. Sua amizade tornou os momentos difíceis mais suportáveis e adicionou alegria e significado a esta jornada.

Finalmente, um sincero agradecimento aos meus colegas, pelo apoio moral e pelos momentos de partilha e confronto que tornaram este percurso mais agradável e estimulante. A amizade e ajuda deles foram preciosas e de grande valor.

Obrigado a todos por terem tornado possível este importante marco na minha vida.

RESUMO

Uma rotina clara e correta de cuidados de saúde oral em pacientes com Paralisia Cerebral, e uma correta instrução dos pais/cuidadores, é fundamental para garantir boa saúde oral. objetivo da presente revisão sistemática é produzir uma recomendação baseada na evidência científica atual sobre qual é o método mais eficaz para o controle da higiene oral em indivíduos com paralisia cerebral (PC). Realizou-se uma pesquisa bibliográfica em bases de dados eletrônicas: PubMed, EBSCO, B-ON e Web of Science. A identificação e seleção dos artigos foi realizada através da aplicação de critérios previamente selecionados de inclusão e exclusão. A triagem dos artigos encontrados foi realizada pelo método PRISMA. A avaliação da qualidade metodológica foi realizada por meio do uso da ferramenta do Instituto Joanna Briggs para Estudos Transversais Analíticos, Ensaios Controlados Randomizados e Estudos Quase-Experimentais. Foram identificados 487 artigos. A partir da aplicação dos critérios de inclusão e exclusão, 9 artigos foram incluídos nesta revisão. 3 Estudos Transversais Analíticos, 5 Estudos de Ensaios Controlados Randomizados e 1 estudos quase-experimentais. O protocolo mais adequado para manter uma boa saúde oral em indivíduos com Paralisia Cerebral é realizar a técnica de escovagem com esfregaço horizontal duas vezes por dia, durante dois minutos com o uso de um dentífrico contendo flúor com concentrações de 1000 ppm que são ajustadas com base na idade do paciente. O controle químico do biofilme é realizado usando clorohexidina (0,12% - 0,2%) duas vezes por dia durante apenas 1 semana. Para a realização da escovagem dentária, dependendo do nível de limitação motora dos pacientes com Paralisia Cerebral propõe-se a utilização de uma escova de dentes motorizada ou o uso de escovas manuais de tripla cabeça se for realizada para os pais/cuidadores, ou as escovas de dentes personalizadas se for realizado pelo próprio indivíduo.

Palavras-chave: paralisia cerebral, saúde oral, cuidados

ABSTRACT

A clear and correct oral health care routine in patients with Cerebral Palsy, and a correct instruction from parents/caregivers, is essential to ensure good oral health. objective of this systematic review is to produce a recommendation based on current scientific evidence on which is the most effective method for the control of oral hygiene in individuals with cerebral palsy (CP). A bibliographic research was carried out in electronic databases: PubMed, EBSCO, B-ON and Web of Science. The identification and selection of articles was performed by applying previously selected inclusion and exclusion criteria. The screening of the articles found was performed by the PRISMA method. The evaluation of methodological quality was performed using the tool of the Joanna Briggs Institute for Analytical Cross-Sectional Studies, Randomized Controlled Trials and Quasi-experimental Studies. 487 articles were identified. From the application of the inclusion and exclusion criteria, 9 articles were included in this review. 3 Cross-Sectional Analytical Studies, 5 Randomized Controlled Trials Studies and 1 quasi-experimental studies. The most appropriate protocol to maintain good oral health in individuals with Cerebral Palsy is to perform the brushing technique with horizontal smear twice a day, for two minutes with the use of a fluoride-containing toothpaste with concentrations of 1000 ppm that are adjusted based on the patient's age. Chemical biofilm control is performed using chlorhexidine (0.12% - 0.2%) twice a day for only 1 week. To perform tooth brushing, depending on the level of motor limitation of patients with Cerebral Palsy it is proposed the use of a motorized toothbrush or the use of manual brushes of triple head if it is performed for parents/ caregivers, or personalized toothbrushes if it is carried out by the individual himself.

Keywords: cerebral palsy, oral health, care

GENERAL INDEX

INDEX OF FIGURES

INDEX OF TABLES

INDEX OF ANNEXES

LIST OF ACRONYMS AND ABBREVIATIONS

AVC: apple cider vinegar

CG: control group

CHX: chlorhexidine

CP: Cerebral palsy

CVR: content validity ratio

df-t: Decayed and Filled Teeth index for the deciduous dentition

DHE: dental health education

DI: Debris Index

DMF-T: Decayed and Filled Teeth index for the permanent dentition

GERD: gastroesophageal reflux disease

GI: gingival index

GMFCS: Gross Motor Function Classification System

IG: intervention group

MACS: Manual Ability Classifications System

MGI: modified gingival index

OHI (S): oral hygiene index simplified

PEG: percutaneous endoscopic gastrostomy

PI: plaque index

PICO: Population; Interventions; Comparison e *Outcome*

PRISMA: Preferred Reporting Items Systematic review and Meta-Analyses

PVL: periventricular leukomalacia

RI: The restorative index

SD: mean

SPSS: Statistical Package for Social Sciences

TB-PS-I: tooth brushing performance skill index

TQHPI: Turesky of the Quigley-Hein plaque index

1. INTRODUCTION

Cerebral palsy, a collection of non-progressive conditions, is characterized by abnormalities in voluntary movement or posture due to defects in the central nervous system. These defects can develop during pregnancy, the perinatal period, or after birth. While the exact etiology of cerebral palsy remains unknown, several risk factors are under investigation, including perinatal hypoxia, intrauterine infection, low birth weight, prematurity, and genetic disorders.

Clinical manifestations of cerebral palsy vary based on the severity of the damage and the neurological area affected. Classification is based on the type of impairment (diplegia, quadriplegia, hemiplegia, or tetraplegia) and motor symptoms (spastic, dyskinetic, or ataxic).

For individuals with cerebral palsy, oral health represents a significant concern. Oral and dental problems are more prevalent among those with special needs. The inherent neuromuscular disorders associated with cerebral palsy can negatively impact oral health in multiple ways, including anatomical changes in the orofacial region, an increase in parafunctional habits, difficulties maintaining oral hygiene, challenges in eating, and barriers to receiving dental care. Consequently, patients with cerebral palsy often exhibit poorer oral health, characterized by a high prevalence of caries, periodontal disease, malocclusion, bruxism, and increased dental plaque.

1.1. Definition

Cerebral palsy (CP) is characterized as a group of permanent developmental and postural disorders arising from a non-progressive impairment during fetal or infant brain development. This disorder can lead to limitations in functionality, impacting motor skills along with potential sensory, cognitive, communicative, and behavioral disturbances, as well as epilepsy and secondary musculoskeletal issues (Aguiar et al., 2000; Rosenbaum et al., 2007).

1.2. History

The condition was first documented in 1843 by William John Little, an English

orthopedist. He observed clinical signs of spasticity in 47 children who had experienced difficult births, including issues such as pelvic presentation, prematurity, labor complications, delayed crying or breathing, and early life seizures or comas (Morris, 2007; Piovesana, 2002). Later, in 1893, Sigmund Freud proposed the terminology and identified maternal (prenatal), perinatal, and postnatal factors as primary causes (Morris, 2007).

1.3. Etiology

Various factors increase CP risk during different developmental stages:

Prenatal risks include hypoxia, genetic disorders, multiple gestations, infections, exposure to teratogens (e.g., alcohol, tobacco), and maternal illnesses (Marwaha et al., 2014).

Perinatal risks encompass complications such as asphyxia, prematurity, placental issues, and the use of delivery instruments (Marwaha et al., 2014).

Postnatal risks include factors such as asphyxia post-birth, seizures, cerebral infarctions, and infections like meningitis, which contribute to conditions like chronic lung disease and periventricular leukomalacia (Marwaha et al., 2014).

1.4. Prevalence

Recent increases in multiple births and premature, low birth weight deliveries have coincided with a rise in CP diagnoses, affecting approximately 2-2.5 per 1,000 live births (Jan, 2006).

1.5. Classification of cerebral palsy

1.5.1. Movement Characteristics

Cerebral palsy (CP) can be classified based on the type of motor dysfunction into four categories: Spastic, Dyskinetic or Athetoid, Ataxic, and Mixed Form (Rosenbaum et al., 2007).

Spastic CP is primarily caused by damage to the cerebral motor cortex, affecting the pyramidal tracts. Symptoms include hypertonia, rigidity, muscle and joint contractures,

and abnormal gait (Rosenbaum et al., 2007).

Dyskinetic or Athetoid CP results from damage to the basal ganglia in the extrapyramidal system, leading to involuntary movements that are incomplete and erratic. This form is characterized by varying muscle tone from very tight to very loose, issues with posture, and difficulties with feeding (Rosenbaum et al., 2007).

Ataxic CP involves damage to the cerebellar tracts and is marked by disturbances in balance and coordination, imprecise movements, and challenges in walking, often accompanied by tremors and perceptual problems (Rosenbaum et al., 2007).

Mixed CP features symptoms that are a combination of the above types, typically due to multiple areas of brain damage (Rosenbaum et al., 2007).

1.5.2. Topographical Classification

CP is also classified according to the topographical distribution of muscle spasticity:

Hemiplegic: Affects one side of the body, typically with the arm more impaired than the leg (Wasnik et al., 2020).

Diplegic: Mainly affects the legs more than the arms, associated with brain damage in the areas around the ventricles, often seen in premature infants with periventricular leukomalacia (PVL) (Wasnik et al., 2020).

Quadriplegic: Involves all four limbs and the trunk, often due to severe brain injury such as from intrapartum asphyxia (Wasnik et al., 2020).

Other classifications include monoplegia, paraplegia, triplegia, double hemiplegia, and tetraplegia, each indicating different patterns of involvement (Wasnik et al., 2020).

1.5.3. Gross Motor Function Classification System

The GMFCS categorizes CP based on mobility needs:

Level I: Walks independently, including climbing stairs without support.

Level II: Walks in most settings; uses handrails for stairs; may need assistive mobility devices for long distances.

Level III: Uses hand-held mobility aids in indoor settings; may use wheeled devices for

longer travels.

Level IV: Often requires powered mobility or extensive physical assistance in most settings.

Level V: Relies on a manual wheelchair in all settings with significant limitations in motor control (Palisano et al., 1997).

1.5.4. Manual Ability Classifications System

The MACS assesses how children with CP use their hands to manipulate objects in daily activities:

Level I: Handles objects easily and successfully.

Level II: Manages most objects with some decreased quality or speed.

Level III: Experiences difficulty with handling; often requires assistance.

Level IV: Uses a limited range of objects in adapted situations.

Level V: Severely limited ability to perform even simple actions (Eliasson et al., 2006).

These classifications help in understanding the diverse presentations of CP and guide the development of personalized treatment plans.

1.6. Oral manifestations in cerebral palsy

1.6.1. General Impact on Oral Health

Cerebral palsy (CP) significantly affects neuromuscular function, which in turn impacts oral health. This includes alterations in oral and facial structure, the emergence of parafunctional habits, feeding challenges, difficulties in maintaining oral hygiene, and barriers to accessing dental care (Dougherty, 2009).

1.6.2. Gingival and Periodontal Health

The main challenge in maintaining gingival and periodontal health in individuals with CP is the effective removal of plaque due to neuromuscular and coordination difficulties. These challenges, coupled with a limited understanding of oral hygiene practices, foster

the progression of periodontal diseases (Maiya et al., 2015).

1.6.3. Dental Caries

The development of dental caries in CP is influenced by a complex interplay of biological, socioeconomic, and environmental factors (Beck et al., 2014). Studies show mixed findings: Ferreira de Camargo et al. (2011) report a high incidence of caries in this population, whereas Quintela and Alfredo (2011) suggest a lower incidence compared to peers without CP (Ferreira de Camargo et al., 2011; Quintela & Alfredo, 2011).

1.6.4. Malocclusion

Malocclusion affects 59-92% of CP patients, predominantly presenting as Angle's Class II, often accompanied by an increased open bite in spastic forms of CP (Dougherty, 2009; Oliveira et al., 2011; Winter et al., 2008). Risk factors for severe malocclusion include mouth breathing, lip incompetence, and elongated facial structure (Miamoto et al., 2010). These structural issues, combined with uncontrolled head movements and seizure activity, increase the risk of dental trauma.

1.6.5. Bruxism and Sleep Disorders

Bruxism is common in CP, potentially severe and chronic, leading to significant tooth wear (Wasnik et al., 2020). Sleep disorders may exacerbate nocturnal bruxism, posing challenges in the use of mouth guards or bite splints due to potential gagging or difficulty in fitting (Jan, 2000).

1.6.6. Sialorrhea and Dental Erosion

Dysfunction in swallowing mechanics often causes sialorrhea, marked by excessive saliva accumulation and drooling, which adversely affects health and quality of life (Meningaud et al., 2006). Furthermore, a high prevalence of dental erosion in CP patients correlates strongly with gastroesophageal reflux disease (GERD), typically manifesting as enamel erosion predominantly in the molars (Gonçalves et al., 2008; Su et al., 2003).

These oral health challenges necessitate comprehensive dental care strategies tailored to

the needs of individuals with cerebral palsy, emphasizing prevention, routine monitoring, and adaptations to enhance accessibility and effectiveness of dental treatments.

1.7. Objective

The aim of the present systematic review is to produce a recommendation based on current scientific evidence to verify which is the most effective method for the control of oral hygiene in individuals with cerebral palsy (CP).By identifying the optimal oral hygiene technique allows patients with CP to improve their quality of life, reduce the incidence of dental caries, periodontal disease, other pathologies and simplify the tasks for caregivers and family members who often assist individuals with CP in oral care due to their motor and neurological challenges.

2. METHODOLOGY

The protocol on the methodology of this systematic review is registered under number **CRD42024537331** on the PROSPERO platform.

A systematic review protocol was used according to the PRISMA (Preferred Reporting Items Systematic review and Meta-Analyses) Statement.

The focus question was: "What is the most appropriate protocol for maintaining good oral health in individuals with cerebral palsy? The focus question was developed according to the PICO parameters (Population; Interventions; Comparison e *Outcome*) (cf. Table 1):

Table 1.

Strategy PICO

Criteria	Determinants
P (Population)	Patients with cerebral palsy
I (Intervention)	oral health care
C (Comparision)	Patients without cerebral palsy
O (Outcome)	protocol for routine oral health care depending on the level of disability

The electronic search of the literature was performed on PubMed, EBSCO, B-ON and Web of Science up to February 7, 2024.

The combination of keywords for the research has been: "((cerebral palsy) AND ((oral health) AND (care)".

Articles to be included in the systematic review should have met the following inclusion criteria: studies in humans, last 10 years (2013-2023); and exclusion criteria: in vitro studies, clinical studies not performed on humans.

Studies were selected using a screening procedure: first the keywords were searched in the following databases selected for the systematic review and were found as results a total of 487 articles in the databases, respectively: 114 on Pub Med, 71 on EBSCO, 160 on B-ON and 142 on Web of science. Then records removed *before screening for the reason:* Duplicate records removed (n = 209), Records removed for other reasons(n=13) such as records marked as ineligible by automation tools. The articles selected for the

screening were so 265.

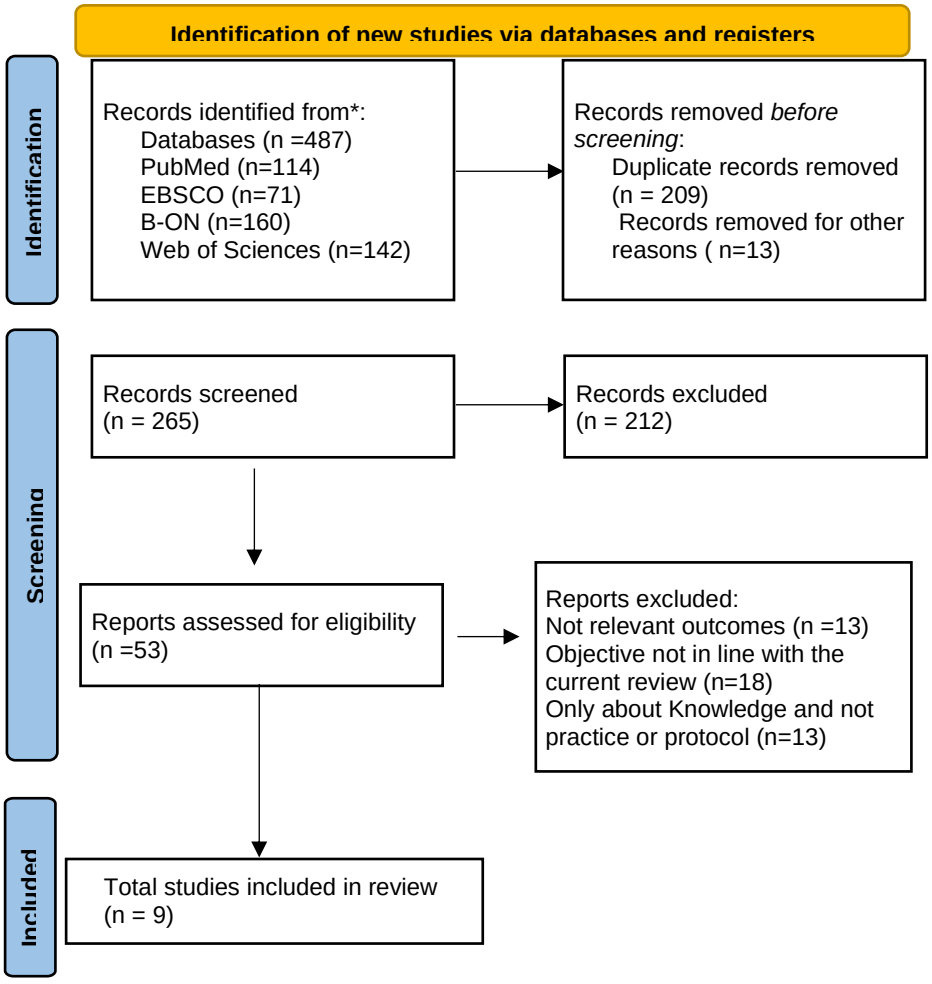
At first stage, titles and abstracts were screened to eliminate irrelevant articles or articles that didn't meet the inclusion criteria, being removed 212 articles, remaining 53 articles.

The second-stage screening of full-texts verified the study eligibility, the articles being removed respectfully for: not relevant outcomes (n =13), objective not in line with the current review (n=18), only about Knowledge and not practice or protocol (n=13).

Remaining a total of 9 articles included in the review, in which 1 selected from the bibliography of an article searched in the following databases "Navigating Oral Hygiene Challenges in Spastic Cerebral Palsy Patients: A Narrative Review for Management Strategies for Optimal Dental Care" (Palanisamy et al., 2023). The screening process is defined in the following PRISMA diagram:

Figure 1.

PRISMA flowchart (Preferred report items for systematic reviews and meta-analysis)



Subtitles: n- number

A critical evaluation of the methodological quality of all included articles was performed using three tools developed by the Joanna Briggs Institute: "Checklist for Analytical Cross-Sectional Studies", "Checklist for Randomized Controlled Trials Studies" and "Checklist for Quasi-Experimental studies" (Moola et al., 2017). The tools consist of 8, 13 and 9 parameters respectively. Which lead the examiners to go through all the articles, in order to fill each of the parameters with "Yes", in cases where the article has all the information evaluation; "No", when the article does not have any references to the information under evaluation, "Unclear", in cases where the information under evaluation is only mentioned in part and, finally, "Not applicable", when the parameter is not applicable to the article under evaluation by methodological determinants. The result of this assessment is shown in the following table (cf. Table 2):

Table 2.

Methodological Critical Evaluation of Included Studies

Autores	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	%yes	Risk of Bias
(Orsós et al., 2021)	yes	yes	yes	yes	yes	no	yes	un	(-)	(-)	(-)	(-)	(-)	75%	Moderate risk
(VPK et al., 2020)	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	92%	Low risk
(Bizarra & Ribeiro Graça, 2020)	yes	no	yes	yes	yes	yes	yes	un	yes	(-)	(-)	(-)	(-)	78%	Low risk
(Cardona-Soria et al., 2020)	yes	yes	un	yes	yes	no	yes	yes	(-)	(-)	(-)	(-)	(-)	75%	Moderate risk
(Rai et al., 2018)	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	un	76,92%	Low risk
(Ferraz et al., 2015)	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	yes	85%	Low risk
(Maiya et al., 2015)	yes	yes	yes	no	no	yes	un	yes	yes	yes	yes	yes	yes	76,92%	Low risk
(Ashkenazi et al., 2013)	yes	yes	un	yes	yes	no	yes	yes	(-)	(-)	(-)	(-)	(-)	75%	Moderate risk
(Yitzhak et al., 2013)	yes	no	un	un	no	yes	Un	yes	un	yes	yes	yes	no	46,16%	Moderate risk
Subtitles: Q-questions; %-percentage; un-unclear; (-)-missing question.															

3. RESULTS

Table 3.

Study Characterazion and sociodemografic data in each study

Authors Year Country	Study design	follow-up	Groups	N	SEX (M:F)	Age (years)
(Orsós et al., 2021) / Hungary	Descriptive Study/ Cross-Sectional	(-)	**5 IG** motor disabilities caused by CP (GMFCS I-V **2 CG:** -CG1 normal education method; -CG2 conductive education method.	199	101: 98	mean (SD) 9.06 (±3.69)
(Bizarra and Graça et al.,2020) / Portugal	Interventional Study	2-6 month	**IG**: - instruction and training of caregivers; -pratical instruction and supervision on CP individuals **CG**	62	male gender (53.2%)	mean SD)45.7 (±11.5) y
(Cardona-Soria et al., 2020) / Spain	Cross-Sectional	(-)	2 IG: -**G1**: either oral (NON- PEG group); -**G2**: enteral route (PEG group).	116	45 (16 PEG group; 29 NON-PEG group) 71(34 PEG group; 37 NON-PEG group)	under 18
(VPK et al., 2020) / India	Randomized Controlled Trial	3 month	**IG**: video- based dental health education (DHE); **CG:** conventional DHE	60	(19:11); (20:10)	4-12

Table 3. Continues

Authors Year Country	Study design	follow-up	Groups	N	SEX (M:F)	Age
(Rai et al., 2018) / India	Randomized Controlled Trial	3 weeks	2 IG: **G1:** normal toothbrush **G2:** customized toothbrush	30	(-)	6-18
(Ferraz et al., 2015) / Brasil	Randomized Controlled Trial	1 month	3 IG: **G1**: manual brushing **G2**: electric toothbrush on **G3:** electric toothbrush of	40	52.5% were female	4-16
(Maiya *et al*., 2015) / India	Randomized Controlled Trial	6 weeks	4 IG: **G1**: Manual toothbrush with fluoridated toothpaste **G2**: Manual toothbrush with fluoridated toothpaste and CHX spray **G3**: Powered toothbrush with fluoridated toothpaste **G4:**Powered toothbrush with fluoridated toothpaste and CHX spray.	64	42: 22	6-18
(Ashkenazi et al., 2013) / Israel	Prospective Study/ Coss-Sectional	(-)	**G1**:Individuals with CP **G2:** Nurse	43 CP 44 Nurse	28: 15 0: 44	4-31 19-61
(Yitzhak *et al*., 2013) / Israel	Randomized Controlled Trial	1 month	2 IG: **G1:** single-headed-toothbrush **G2**: triple-headed-toothbrush	43	28: 15	4-31 years

Subtitles: CG: control group; G1: group one; G2: group two; G3: group three; G4: group four; IG: interventional group F: Feminine M: male N: numbers; (-) : without reference for the follow up

Table 4.

Table of Results

Author, year,	Routine health care	*Valor p*	Main results
(Orsós et al., 2021)	20 questions to asked about OH practices: -tooth brushing frequency, - toothbrushing performance (independent or helped), -last visit to a dentist, -eating habits, -addictions/ bad oral habits, -social background.	($p \leq 0.05$)** significance level. The interaction of tooth brushing performance shows that age has a significant effect on gingivitis (p=0.3072)**. Age and the tooth brushing performance has a significant effect on DMF-T (p = 0.2384)**.	- **Mean df-t** (deciduous teeth): 1.87 - **Mean DMF-T** (permanent teeth):1.15 - Worst Groups by GMFCS Level: Level II: df-t = 3.00, DMF-T = 2.00; Level III: df-t = 2.42, DMF-T = 1.68 **Restorative Index (RI):** - Deciduous Teeth: 18.12% - Permanent Teeth: 27% **Dental Visits:** - Consultation Only: 68.7% - Urgent or Total Dental Care: 46.2% **Caries Experience** (Untreated Dental Caries): Highest GMFCS Classification Groups: I and IV **Toothbrushing Frequency:** - Twice a Day: 76.9% of children - Brushing with help: 29.65% - Brushed by parents/caregivers: 19.6% **Gingivitis Prevalence:** - Overall Prevalence in GMFCS Groups IV-V: 66.7% - Highest Prevalence Areas: Upper and lower incisors, lower canines (above 31% in the whole group) **Effect of Toothbrushing on Gingivitis:** - Significant Difference: Brushing alone vs. brushing with help significantly affects age-related changes in gingivitis. **Effect of Age:** DMF-T values increase with age across different toothbrushing performance groups.

Table 4. Continues

Author, year,	Routine health care	*Valor p*	Main results
(Bizarra and Graça et al.,2020)	**Tooth brush technique demonstrated in giant models:** -type of movements: from midline to posterior teeth -tooth brush inclination: towards gum line **Using positioning and assited retraction techniques:** - head and body control - bite block **Individualized instrutions for unable to rinse and spit:** - amount of toothpaste - dipping toothbrush in solution	No significant differences between study group: -**gender** (p = 0.799)*, -**age** (p = 0.203)*, -**type of CP** (p = 0.155)*, and -**topography distribution (**p = 0.130)*. -**Intellectual disability:** (p = 0.003)**. -**Frequency toothbrushing:** (p= 0.802)*. -**Autonomy in toothbrushing:** (p = 0.799)*. **OHI-S:** IG at 2 months (p = 0.001)** and 6 months (p = 0.001)**, compared to CG. **Differences of DI:** IG p= 0.01** CG p= 0.753*. **Gingival index:** differences were statistically significant between groups at the end of 2 (p < 0,001)** and 6 months (p < 0.001)**.	**Cerebral Palsy (CP) Characteristics:** Type and Topography: -Spastic CP: 80.6% -Topographic Distribution: Tetraplegia, 79% **Intellectual Disability:** - Comparison between Groups: -Control Group (CG): 32.3% - Intervention Group (IG): 3.2% **Oral Hygiene Practices:** Frequency of Toothbrushing: - Two or more times per day: - IG: 80.6%; - CG: 77.4% -Use of Manual Toothbrush: - IG: 83.9%; - CG: 80% Autonomy in Toothbrushing: - IG: 45.2%; - CG: 51.6% Use of Toothpaste: - IG: 90.9%; - CG: 71% Use of Mouthwash: 16.1% **Difficulties in Performing Toothbrushing:** - Opening the Mouth: 84.6% - Swallowing Toothpaste: 61.5% **Oral Hygiene Index - Simplified (OHI-S):** IG: - Independent: - Baseline: 2.15 (±1.1) - 2 Months: 1.21 (±0.87) - 6 Months: 1.44 (±0.71) - Dependent: - Baseline: 3.0 (±1.35) - 2 Months: 1.46 (±1.53) - 6 Months: 1.60 (±0.93) CG: - Independent: - Baseline: 2.91 (±1.3) - 2 Months: 2.40 (±1.23) - 6 Months: 2.58 (±1.1) - Dependent: - Baseline: 2.74 (±1.08) - 2 Months: 2.47 (±1.06) - 6 Months: 2.34 (±1.05) **Differences in Decay Index (DI):** - Highest Reduction at 2 Months: - Dependent Individuals of IG: –0.67 - Dependent Individuals of CG: –0.02 **Gingival Index (GI)**: Comparison Between Groups: - IG had a lower GI compared to CG. - At 6 months, the IG decreased by 0.35, and the CG decreased by 0.06. Trends Over Time: - All groups showed a decrease in GI mean between baseline and 2 months, with a slight increase between 2 and 6 months. - The decrease in GI was higher in the dependents (p = 0.024 at 2 months and p = 0.047 at 6 months) and independents (p = 0.006 at both periods) of IG.

Table 4. Continues

Author, year,	Routine health care	*Valor p*	Main results
(Cardona-Soria et al., 2020)	OH measures: -twice-daily brushing introduced with the eruption of the first tooth. -Toothbrush size and shape of the brush: adapted to the needs and characteristics of the patient. - fluoridated toothpaste (starting at 1000 ppm).	Use of fluoride toothpaste: significant differences were obtained in PEG group and non-PEG group(P < .0005)**. Carie score: (P < .001)**.	**Type of Diet:** - PEG Group: 82% on an enteral diet alone - Non-PEG Group: 63.6% on a no-chew diet **Oral Hygiene Practices:** - Conventional Manual Toothbrush: 60.6% - Electric Toothbrush: 30.3% - Gauze Moistened with Water: 9.2% **Frequency of Toothbrushing:** - Twice a Day: 36.5% (44% in PEG group, 30.8% in non-PEG group) - Never Brushed: 5.2% **Use of Fluoride Toothpaste:** - Non-PEG Group: 71.7% - PEG Group: 28.6% **Type of Dentition:** - Permanent: 47.4% - Mixed: 41.4% - Temporary:11.2% **Dental Health Metrics:** - **dft Index Scores**: 5.4 in the non-PEG group, 0.6 in the PEG group - **DMFT Scores:** 2.81 in the non-PEG group, 1.09 in the PEG group (differences not significant) **- Caries Score:** Non-PEG group had significantly more caries than the PEG group **Periodontal Status:** - Moderate-Severe Gingivitis: 79.1% **Plaque Index:** - Severe Accumulation of Calculus or Soft Plaque: 69.8% - PEG Patients: 86% - Non-PEG Patients: 57.6% **Types of Malocclusion:** - Class II: 75% - Class III: 10.3% - Class I:10.3% - Anterior Open Bite: 64.6% - Marked Overjet with Protruding Front Teeth: 23%

Table 4. Continues

Author, year,	Routine health care	*Valor p*	Main results
(VPK et al., 2020)	Video-based dental heath education (DHE): -significance of oral health, -brushing technique (horizontal brushing method), -importance of rinsing/wiping the child's tooth after every meal, -healthy diet, -oral preventive procedures, - improving access to oral health care services along with necessary reinforcement.	statistical significance was set at 5% level of significance (P < .05)**. changes in the scores were statistically significant in both the groups (P-value < .005, S)** except for the Gingival index score in Group 2 (P-value = .6)*.	**Study Groups:** -IG: 28 children -CG: 25 children **Oral Hygiene Practice Post-Intervention:** -IG: - Never brushed: Decreased from 3 (10.71%) to 0 - Occasional brushing: Decreased from 5 (17.86%) to 1 (3.57%) - Once a day: Increased from 17 (60.71%) to 22 (78.57%) - Twice a day: Increased from 3 (10.71%) to 5 (17.86%) - CG: - Never brushed: Decreased from 6 (24%) to 3 (12%) - Occasional brushing: Decreased from 3 (12%) to 2 (8%) - Once a day: Increased from 15 (60%) to 18 (72%) - Twice a day: Increased from 1 (4%) to 2 (8%) **Oral Hygiene Index - Simplified (OHI-S):** -IG: - Reduced from 0.86 ± 0.79 to 0.596 ± 0.59 after 12 weeks -CG: - Reduced from 1.108 ± 0.65 to 1.083 ± 1.16 after 12 weeks **Plaque Index (PI):** - IG: - Reduced from 0.641 ± 0.53 to 0.472 ± 0.35 after 12 weeks - CG: - Reduced from 0.962 ± 0.58 to 0.827 ± 0.34 after 12 weeks **Gingival Index (GI):** -IG: - Reduced from 0.172 ± 0.36 to 0.079 ± 0.18 after 12 weeks -CG: - Reduced from 0.212 ± 0.29 to 0.171 ± 0.24 after 12 weeks **Mean Reductions:** -IG: - OHI-S: 0.27 - PI: 0.17 - GI: 0.09 -CG: - OHI-S: 0.03 - PI: 0.14 - GI: 0.04 ~

Table 4. Continues

Author, year,	Routine health care	*Valor p*	Main results
(Rai et al., 2018)	G1 and G2 instructed to perform OH procedures with the assistance of caregivers: -Brushing technique horizontal scrub method. -twice daily rinse using 0.2% chlorhexidine mouthwashwas	**PI:** group I (p = 0.32)*; group II (p = 0.01)**. **MGI:** group I (p = 0.24)*; group II (p = 0.04)**. The difference in the PI and gingival index (GI) was not statistically different between group I and group II with p value of 0.17* and 0.49*.	**Plaque Index (PI) Before and After Intervention:** - GII: 31.55% reduction - GI: 8.34% reduction Modified Gingival Index (MGI) Before and After **Brushing:** - GII: 30.23% drop - GI: 14.51% drop I**ntraclass Correlation Coefficient (ICC):** - ICC Coefficient: >0.8
(Ferraz et al., 2015)	Strategies for biofilm control: -the adaptation of manual brushes - addition of chlorhexidine to toothpaste	Biofilm reduction with 3 brushing methods (P < 0.001)**. Significant differences between G1 and G3 (P < 0.001)** and between G2 and G3 (P = 0.007)**. No significant difference between G1 and G2 (P = 0.06)*.	**Study Participation:** - 40 participants completed the first cycle of brushing. - 39 participants completed the second cycle. - 38 participants completed the third cycle. **Biofilm Reduction:** - Mean Reductions in Biofilm: - G1: 47.6% - G2: 47.4% - G3: 44.5% **Comparison of Brushing Methods:** - When comparing the capacity to decrease biofilm accumulation by 70%, no statistically significant reductions were found between the different brushing methods. **Effectiveness of Brushing Methods:** - Manual brushing and the electric toothbrush (when switched on) showed similar effectiveness. - Both manual brushing and the electric toothbrush (switched on) achieved better results compared to the electric toothbrush when it was switched off.

Table 4. Continues

Author, year,	Routine health care	*Valor p*	Main results
(Maiya *et al*., 2015)	**Instruction given to parents/ caretakers:** - horizontal tooth brush with manual and powered toothbrush with pea-size fluoride toothpaste - Twice daily (morning /after dinner) - 2 min - application of 0,2%CHX spay (buccal and ligual surfaces of each arch) - Twice daily 30 minutes after brushing - Caretakers instruted to brush for 2min	**The results of OHI (S)**: were statistically very highly significant (P < 0.001)**. **The MGI score:** highly significant between baseline and 1 week (P < 0.05)**, and statistically very highly significant between 1 and 2 weeks (P < 0.001)**, not statistically significant between 2 and 6 weeks (P > 0.05)*.	**Oral Hygiene Index (OHI-S) Scores:** -Comparison Intervals: Baseline, 1 week, 2 weeks, 6 weeks - G4: Reduction observed from baseline to 6 weeks **Modified Gingival Index (MGI) Scores:** - Comparison Intervals:Baseline, 1 week, 2 weeks, 6 weeks - G4: Reduction observed from baseline to 6 weeks - Overall Trend: Gradual decrease in MGI score from baseline to 6 weeks

Table 4. Continues

Author, year,	Routine health care	*Valor p*	Main results
(Ashkenazi et al., 2013)	44 Nurses instructed to brush twice a day (morning and evening after meals). Instruction for brushing: -**single-headed toothbrush:** - horizontal scrub technique: brush buccally each arch in five segments (anterior, two canines, and two posterior segments) and lingual/palatal in three segments (anterior and two posterior segments) -place the toothbrush partially on the gingiva and partially on the teeth, and to perform 10 back and forth brushing strokes on each segment. -**triple-headed toothbrush:** - brushing each arch in 5 segments (anterior, two canines, and two	**Correlations Between Nurses'Knowledge and Other Factors** 1. Seniority: Positive correlation between nurses' knowledge of preventive oral measures and their seniority (R = 0.432, p = .003)**. 2. Self Oral Hygiene Compliance: Positive correlation between nurses' knowledge of preventive oral measures and their compliance to self oral hygiene (R = 0.372, p = .013)**. 3. Receiving Instruction for Brushing: Positive correlation between nurses' knowledge of preventive oral measures and whether they have ever received instruction for brushing their own teeth (R = 0.288, p = .058)*. 4.Instruction for CP Patients: - Positive correlation between nurses' knowledge of preventive oral measures and whether they have ever received instruction for brushing their CP patients' teeth (R = 0.303, p = .046)**. 5. Commitment to CP Patients' Oral Hygiene: Positive correlation between nurses' knowledge of preventive oral measures and their commitment to maintaining good oral hygiene of their CP patients (R = 0.314, p = .038)**. 6.Receiving Previous Instruction and Commitment: Positive correlation between receiving previous instruction for correct	**Nurses' Oral Hygiene Practices:** Tooth Brushing Frequency: - Morning: 72.7% - Evening: 40.9% Toothpaste Selection: - Based on dentists' recommendations. - Using toothpaste with fluoride concentration (1,250-1,450 ppm). Toothbrush Replacement: -86.4% replace their toothbrush at least once every 8 months or acording to fiber wear. Flossing: - 73% do not floss. **Dental Check-ups and Treatment:** - More than 50% of nurses visit their dentist only when experiencing pain. **Tooth Brushing for CP Patients:** Frequency and Awareness: - More than 50% believe CP patients' teeth should be brushed twice daily. - 88.6% are aware that tooth brushing is important for preventing periodontal disease. - 56.8% know it is important for preventing caries. Flossing: - 54.6% think flossing is important for preventing periodontal disease. - 63.7% believe flossing prevents caries. - 45.5% consider it moderately or not important for periodontal disease prevention. Awareness of CP Patients' Susceptibility to Oral Diseases: - 38.6% believe periodontal disease is most prevalent. - 22.7% think caries is most prevalent. - 15.9% think CP patients is comparable to the healthy population. **Receiving Tooth Brushing Instructions**: Personal Hygiene Instructions: - 29.5% have not received tooth brushing instruction. - 63.6% have not received flossing instruction. Frequency of Instruction:

	posterior segments); -place the toothbrush on the occlusal surfaces, perform 10 back and forth brushing strokes one each segment.	oral hygiene and commitment to maintaining good oral hygiene for CP patients (R = 0.345, p = .022)**. **TB-PS-I Score Analysis:** 1. <u>One Month Assessment:</u> - Single-headed toothbrush group: Decreased by 10% (p < .001)**. - Triple-headed toothbrush group: Scores remained the same (p = not significant). 2.<u>Deterioration Observed</u>: Main deterioration was in the "stay" component 20.2% (p < .001)**. 3.<u>No Correlations Found:</u> between TB-PS-I scores (conventional or triple-headed toothbrush) at baseline or at one month assessment and age or seniority of the nurses. **Additional Correlations** 1. <u>Knowledge and Baseline TB-PS-I Score</u>: Positive correlation in the conventional toothbrush group (R = 0.424, p = .004)**. 2. <u>Reach" Component</u>: Positive correlation between knowledge and the "reach" component.(R = 0.349, p = .02)**. 3.<u>"Stay" Component:</u> Positive correlation between knowledge and the "stay" component (R = 0.443, p = .003)**. - No significant correlations found in the triple-headed toothbrush group.	- 25% received instruction more than once in their life. - 43.2% never received instructions for brushing patients' teeth. - 34% received instructions only once. **Commitment to CP Patients' Oral Health:.** **Brushing** **Practices:** - 65.9% believe it is possible to brush only the front teeth. - 91% always try to brush even if the patients do not cooperate. - 77.3% never miss brushing a patient's teeth due to workload. - 40.9% brush their patients' tongues. - 9% do not clean due to difficulty. - 32% were not instructed to clean the tongue. **Flossing:** - All nurses reported not flossing their patients' teeth. - 18% due to difficulty. - 82% due to lack of instruction. **Challenges with Brushing CP Patients' Teeth:** - 90% believe CP patients do not suffer from increased gag reflex or excessive tongue movement during tooth brushing. - Only 16% believe their patients can open their mouth wide enough. **Tooth Brushing Performance Scores (TB-PS-I):** - Conventional toothbrush: 92.7% - Triple-headed toothbrush: 92.2%

Table 4. Continues

Author, year,	Routine health care	*Valor p*	Main results
(Yitzhak *et al*., 2013)	**Brushing instruction for the single- headed toothbrush:** -horizontal scrub technique (brush buccally each arch in five segments (right molars and premolars, right canines, anterior teeth, left canines and left molars and premolars) and the lingual/palatal aspect in three segments (right molars and premolars, anterior including the canines, left molars and premolars), - place the toothbrush partially on the gingiva and partially on the teeth, and to perform 8–10 back and forth brushing strokes on each segment; for a total of eight segments in each arch. **Brushing instruction with the triple- headed**	**Plaque Index (PI):** -Higher PI in Lingual and Mandibular Segments: Compared to Buccal Segments ($p < .001$); Compared to Maxillary Segments ($p < .001$)**. - PI and Severity of CP at Baseline: Patients with very high severity of CP had higher mean PI than those with high or medium severity CP ($p < .015$)**. - After one month of brushing, the mean PI of patients with very high severity of CP significantly decreased ($p < .001$)**. **Gingival Index (GI):** - Higher GI in Lingual and Maxillary Segments: - Compared to Buccal and Mandibular Segments ($p < .001$)**. - Comparison Between Institutionalized and External Patients: - No statistically significant difference in GI after brushing with either single or triple-headed toothbrush ($p < .105$)*. - **GI and Severity of CP at Baseline:** - Correlated with the severity of CP ($p < .015$)**. - No significant difference in GI between individuals with high and medium severity CP ($p < .105$)*. - **Effect of Triple-Headed Toothbrush on Children with Very High Severity of CP:** - Significant improvement in GI after using the triple-headed toothbrush ($p < .001$)**.	**Plaque Index (PI):** - Baseline PI: 1.97 to 2.37 (Mean 2.14 ± 0.6). - Mandibular teeth: 2.28 - Maxillary teeth: 1.97 - Lingual: 2.37 - Buccal: 1.98 - After One Month: - Reduction in PI was more than twice as high with the triple-headed toothbrush compared to the single-headed toothbrush. **Gingival Index (GI):** - Baseline GI:2.14 to 2.43 (Mean 2.24 ± 0.52). - Mandibular arch: 5% - Lingual aspects: 13.6% - After One Month: - Triple-headed toothbrush: Reduction by 34.11-40% in gingival inflammation. - Single-headed toothbrush: Reduction by 16.35%-19.3%. - Gingival inflammation with the triple-headed toothbrush was: - Buccal: 2.12 times higher - Lingual: 2.09 times higher - Upper arch: 1.36 times higher - Lower arch: 1.93 times higher GI in Institutionalized vs. External Patients: - Baseline: - Lingual: 2.45 (institutionalized) vs. 2.44 (extern) - Buccal: 2.15 (institutionalized) vs. 2.13 (extern) - After One Month: - Institutionalized patients using the triple-headed toothbrush: - Buccal: 1.68 times - Lingual: 1.4 times **GI Severity in Children with Cerebral Palsy (CP):** - Baseline: - Very high severity: 2.71 - High severity: 2.18 - Medium severity: 2.08 - After One Month: - Single-headed toothbrush: Reduction by 13.5% -17%

	technique: performing 8–10 horizontal strokes in five segments in each arch (anterior, two canines, and two posterior segments), to place the toothbrush on the occlusal surfaces, and to perform about 8–10 back and forth brushing strokes on each segment.	Toothbrushing Performance and Satisfaction Index **(TB-PS-I)** - One Month After Instruction: - Single-headed toothbrush showed significant improvement ($p < .001$)**. - "Stay component" showed significant improvement ($p < .001$)**. - Nurses required additional instruction ($p < .002$)**.	- Triple-headed toothbrush: Reduction by 25% -41.7% - In children with very high severity of CP, the improvement with the triple-headed toothbrush was 1.74 times higher than with the single-headed toothbrush. **TB-PS-I / Ashkenazi Index:** - Baseline: Comparable between both types of toothbrushes. - After One Month: - Single-headed toothbrush: 10% decrease in both arches, 20.2% decrease in the "stay" component. - Triple-headed toothbrush: No change. **Additional Instruction Required by Nurses:** - After one month: - 15% of nurses using the single-headed toothbrush required additional instruction. - 7.6% of nurses using the triple-headed toothbrush required additional instruction. **Nurses' Preference:** - 75.5% preferred the triple-headed toothbrush. - 22.6% preferred the single-headed toothbrush.

Subtitles: CG: control group; G1: group one; G2: group two; G3: group three; G4: group four; IG: interventional group; (-)=without reference for the follow up; * $p > 0.05$; ** $p < 0.005$

The article by Orsós *et al*. is a descriptive study conducted in Budapest, Hungary. The aim of the study is to describe a dental program that allows obtaining comprehensive information on the oral health of patients with cerebral palsy (CP), their health behavior, and monitoring of dental care. They investigate how dental treatments could be tailored for children with CP, how their dental treatment can be optimized, and how the severity of motor deficiencies affects their oral hygiene and dental status. The study population consists of 199 children (101 boys and 98 girls) with a mean (SD) age of 9.06 (±3.69) (149 children at the Pető Institute/Practice Kindergarten, Conductive Practice School, and Dorm, and 50 children at a school center as a healthy control group), divided into 7 groups, including 5 groups of children with motor disabilities caused by CP, categorized using the Gross Motor Function Classification System (GMFCS) into levels I-V, and 2 control groups of children without motor dysfunction (Orsós et al., 2021). As observed in the Table 3.

The GMFCS is valuable because it offers families and healthcare professionals a clear understanding of a child's current motor abilities and insight into potential future needs for equipment or mobility aids, such as crutches, walking frames, or wheelchairs (Palisano et al., 1997). They used a 20-question questionnaire to inquire about oral hygiene practices, frequency of tooth brushing, brushing performance (whether done independently or assisted), last dental visit, dietary habits, oral dependencies/bad habits, and social background. This allowed them to analyze demographic characteristics, dental care, (carie experience, gingivitis prevalence, frequency toothbrushing) dietary habits, and consumption relative to the median df-t (Decayed and Filled Teeth index for the deciduous dentition) and the DMF-T index for the permanent dentition. In the study a $p \leq 0.05$ significance level was used for the interferential statistics. Regarding dental care, caries experiences among children with CP predominantly involved untreated dental caries with the highest prevalence observed in GMFCS classification groups I and IV. The proportion of CP / healthy children with caries that never received dental restorative treatment was higher in younger children with primary dentition than in older children with permanent dentition. The periodontal condition of patients with PC, especially in the GMFCS IV-V groups, was 66.7%, this value being influenced by the fact that brushing was carried out by parents, carers or teachers due to the severe motor dysfunction. The tooth surfaces with the highest prevalence of gingivitis were the upper and lower incisors and the lower canines. The restorative index (RI): was 18.12% for deciduous and 27%

for permanent teeth. The frequency of toothbrushing is characterized by 76.9% of children clean their teeth twice a day, 29.65% brush with help, and the teeth of 19.6% are brushed by parents and caregivers or conductive teachers. The last dental visit for the 68.7 % was only a consultation, and 46.2% was urgent or total dental care. The mean df-t and DMF-T were 1.87 and 1.15, respectively, in the total of 199. The worse groups were the GMFCS level II and III classification of children with CP, with df-t scores 3.00 and 2.42, and DMF-T scores 2.00 and 1.68 (Orsós et al., 2021). The study by Orsós et al. highlighted that age has a significant effect on gingivitis (p- value was 0.3072). The DMF-score can be significantly affected by toothbrushing performance and age (p-value was 0.2384), the values of DMF-T are higher when we increase the age in different toothbrushing performance groups (Orsós et al., 2021). As observed in the table 4.

The study realized by Bizarra and Ribeiro Graça is an interventional study and the research aims is to investigate the impact of a dental care promotion initiative, on people with Cerebral Palsy (CP) residing in care facilities and their caregivers. Their theory suggests that offering tailored support, to both caregivers and CP individuals will result in improved health and reduced gum disease indicators. The population of the studies was selected, focused on individuals residing in the APCL institution (Lisbon Cerebral Palsy Association) due to its significant population of individuals with CP and all of the 69 homes beings dependent or independent into realized the oral care and their 47 caregivers were invited to take part of the study. The patients without natural teeth, those unable of taking part in oral exams, and those who failed to give informed consent were also considered exclusion criteria. For this reason of the 64 individuals with CP, were out of the study, 5 patients because were edentulous, 1 because is uncooperative and another died, and resulted in the final 62 participants. The residences in the institution were randomly separated into intervention group (IG) of 31 participants and a control group (CG) of 31 participants, with the mean age of 45.7 (±11.5) years old and were predominantly male gender (53.2%). The (79.5%) of caregivers were women, with a mean age of 35.7 years [22-61 years] and having working experience with the persons with disability of 6.7 years [1-30 years] (Bizarra & Ribeiro Graça, 2020). As observed in the the Table 3.

To understand difficulties in performing oral hygiene and oral hygiene routines, was created an opened questionnaire to be answered by nurses (Bizarra & Ribeiro Graça, 2020).

Educational interventions were conducted in all assisted care homes, targeting health workers and individuals with cerebral palsy (CP). These sessions, of 90 minutes, supervised by the principal investigator, in a first part were discussed topics such as oral diseases and prevention strategies for the general population, as well as specific oral problems faced by CP individuals. In the second part the caregivers received training on brushing techniques using models before practicing on themselves while individuals with CP engaged in awareness activities and practical demonstrations using models for 30 minutes. The technique of brushing explained by the investigator had as its primary theme the sequence and type of movement to be realized during the brushing, starting from the middle line and heading back and giving particular importance to the inclination of the toothbrush in the direction of the gingival margin (Bizarra & Ribeiro Graça, 2020).During the third part of the session, role playing techniques were utilized to help caregivers tackle obstacles encountered during oral hygiene routines such as limited mouth opening, biting on the brush, heightened gag reflexes, tongue thrusting, difficulty in rinsing and swallowing toothpaste. Problem solving strategies such as head and body control, using bite-blocks, and providing individualized instructions like using less toothpaste or dipping the toothbrush in a solution for those who couldn't rinse and spit were discussed (Bizarra & Ribeiro Graça, 2020).

For two months, the intervention group received personalized follow-up, which involved tooth brushing sessions and adjustments based on individual requirements. The evaluation took place after breakfast, without interrupting the institutions' routines (Bizarra & Ribeiro Graça, 2020).

In the oral examination were analyzed, the Gingival Index (GI) and Simplified Oral Hygiene Index (OHI-S),that have been compared at baseline, two, and six months in the intervention (Bizarra & Ribeiro Graça, 2020).

Regarding the statistical analysis, in the study was used the SPSS® software version 25, with the level of significance of 5%. The Kolmogorov- Smirnov test was used for checking the sample normality, and after that nonparametric tests were used. The differences between IG and CG were verified with the Mann-Whitney U test and The Friedman test analyzed the overall changes in the indices in each group, followed by the Wilcoxon test to compare the average index differences between each assessment period (Bizarra & Ribeiro Graça, 2020).

The results highlighted by the article of Bizarra and Ribeiro Graça was that concerning

the most common type of CP was spastic (80.6%), and the most common topographic distribution was tetraplegia (79%) (Bizarra & Ribeiro Graça, 2020). There were no significant differences between gender (p = 0.799), age (p = 0.203), type of CP (p = 0.155), and topography distribution (p = 0.130) between the IG and CG. Regarding the intellectual disability, the CG had an increased number of individuals with severe intellectual disabilities (32.3%) when compared to the IG (3.2%) (p = 0.003) (Bizarra & Ribeiro Graça, 2020). Regarding the toothbrushing, the study found that, the (80.6%) of the IG and the (77.4%) performed toothbrushing two or more times per day (p = 0.802) with a manual toothbrush (IG = 83.9%; CG = 80%). During the toothbrushing, the main difficulties encountered was trouble opening the mouth (84.6%) and swallowing toothpaste (61.5%). Toothpaste was used by the majority in both groups (90.9% for IG and 71% for CG), while the (16.1%) in the CG used mouthwash. The groups were similar in autonomy in toothbrushing (IG = 45.2% and CG = 51.6%; p = 0.799) (Bizarra & Ribeiro Graça, 2020). Analysis of the OHI-S revealed that the IG presented lower values at 2 months (p = 0.001) and 6 months (p = 0.001), when compared to the CG. In both groups the OHI- S) values decreased, significant variances were only noticed in the intervention group. It is worth mentioning that there were no differences, between independent individuals, in either group (Bizarra & Ribeiro Graça, 2020). Regarding the Gingiva index (GI), the IG had a lower GI compared to the CG and there was a difference statistically significant between groups at the end of 2 (p < 0,001) and 6 months (p < 0.001).During the 6 month checkup it was observed that the group receiving the intervention showed a reduction of 0.35, in GI whereas the control group only saw a decrease of 0.06. Both groups initially saw a decrease in the GI from baseline to 2 months followed by an increase between 2 and 6 months. Furthermore, significant differences were found when comparing GI levels between individuals who were dependent and those who were independent in both groups. The reduction in GI was more pronounced among dependents (with p values of 0.024 at 2 months and 0.047 at 6 months) and the independents (with p values of 0.006 at both time points), in the IG (Bizarra & Ribeiro Graça, 2020). The research investigated the variations, in the Debris Index (DI) depending on dependency status in each group. The results showed a decrease in averages across all groups with an uptick at the 6 month point. The significant decrease in averages was noted at 2 months among individuals in the IG (0.67; p = 0.01) while the smallest decrease was seen among dependent individuals, in the CG (0.02; p = 0.753) (Bizarra & Ribeiro Graça, 2020). As observed in the table 4.

The article of Cardona-Soria et al. is a cross-sectional observational clinical study realized in Barcelona in 2017. The population in study was 116 patients (45 boys, 71 girls) affected by CP under 18 years of age (mean age was 12.09 ±3.89 years), dividend into two groups according the type of feeding: enteral route or PEG group (PEG), and the oral route or non-PEG group (non-PEG). 50 patients (43.1%) were fed via PEG (the PEG group), and the remaining 66 (56.9%) received oral nutrition (the non-PEG group). As observed in the Table 3.

The objective of the study was to examine the oral health condition of children with CP who receive oral feeding and compare it to those who are solely fed through a percutaneous endoscopic gastrostomy (PEG) tube. The study suggests specific guidelines for oral hygiene tailored to each feeding method. The data was collected from a health questionnaire, clinical history and an oral clinical examination. In the health questionnaire the collection of the data was the tipe of food, oral hygiene and the complementary product for and tipe of food. In the oral examination the researchers recorded the following variables: the type of dentition, the gingival health with the Löe & Silness index, the Silness & Löe plaque index, the type of malocclusion according to Angle's classification, the df-t index and the DMF-T index (Cardona-Soria et al., 2020).

In the study a $p \leq 0.05$ significance level was used for the interferential statistics. The study feud that regarding the type of food, 82% of the patients of the PEG group received an enteral diet alone and in the non-PEG group the 63.6% received a soft diet. The oral hygiene of this patients is characterized for using a conventional manual toothbrush by 60.6%, an electric toothbrush by 30.3%, and only 9.2% used a gauze moistened with water to remove plaque and in 95.5% of cases, parents or caregivers assisted with oral hygiene. The fluoride toothpaste was used by most of the non-PEG group (71.7%) but by only 28.6% of the PEG group. As concerns the frequency of toothbrushing, the 36.5% brushed their teeth twice a day (44% PEG and 30.8% non-PEG); while 5.2% never brushed their teeth. In the PEG group, 12.2% used gauze moistened with water, while in the non-PEG group only 6.7% used this method (Cardona-Soria et al., 2020). In the context of type of dentition the study related that 47.4% of the patient have a permanent dentition, 41.4% have a mixed dentition and the 11.2% have a temporary dentition. Referring to types of malocclusion: 87 children (75% had Angle class II malocclusion), 12 children (10.3% had Angle class III) and 12 children (10.3% had Angle class I). Commonly, this type of malocclusion is associated with anterior open bite that had 73

children (64.6%) and marked overjet with clearly protruding front teeth that had 26 children (23%). The study collected the following values for the df-t index and the DMF-T index, 5.4 in the non-PEG group and 0.6 in the PEG group for the df-t index and 2.81 in the non-PEG group and 1.09 in the PEG group, though the differences were not significant. The oral clinical examination revealed that the non-PEG group had significantly more caries than the PEG group (p-value < .001). The study showed up regarding the periodontal condition that most of the patients (79.1%) had moderate-severe gingivitis, and (69.8%) of the patients shows signs of severe accumulation of calculus or soft plaque ((PEG group were affected more than their non-PEG group (86 vs 57.6%)) (Cardona-Soria et al., 2020). As observed in the Table 4.

The article realized by VPK et al. describe a randomized double-blind controlled parallel time series trial study. The objective of the research was to assess the comparative effectiveness of various parenting interventions such as using a video to improving the oral hygiene of cerebral palsy children visiting a tertiary care center in New Delhi, in which the study population is a total of 60 children with CP among 4-12 years old. The exclusion criteria to identify the participants for the investigation was children who have a documented medical history of other conditions that can affect their oral health, as well as those who have received dental treatment within the past six months, and those who are unwilling to take part or are uncooperative. The patients with CP were randomly assigned by flipping a coin method–simple into two groups, such as Interventional Group (IG) which has been subjected to an intervention with video-based in the dental health education (DHE) and the Control Group (CG) has been subjected to an conventional DHE, and the complete session in both the groups lasted 20 min. The parents and participants were not informed about the other group's methodology, and section of reforming was realized in both of the groups at the fourth and eighth week (VPK et al., 2020).

After 3 mouth of follow-up have been analyzed the OHI-S index, the PI and the GI. The OHI-S index was given for the permanent teeth by Greene and Vermillion ((Greene & Vermillion, 1964), got he primary teeth was using Miglani's modification of OHI-S (Miglani et al., 1973), PI was given by Sillness and Loe, the modified gingival index given by Lobene (Löe, 1967) and the carie experience was assessed using DMF-T index given by (Klein et al., 1938).

Before starting the study the researcher received a four-week training program in a

medical facility, in New Delhi, and in this training the researcher received instruction and calibration on health assessment using indices from an expert of the Department of Public Health Dentistry. Both inter and intra investigator agreement, for all evaluations showed results (k value 0.78 0.84) (VPK et al., 2020).

The DHE-based video provides oral hygiene instructions for children with cerebral palsy (CP) to improve their oral hygiene efficiency and reduce the incidence of oral diseases. It covers proper brushing techniques (using the horizontal brushing method), the importance of rinsing or wiping the child's teeth after meals, promoting a healthy diet, implementing oral preventive procedures, and enhancing access to oral healthcare services (VPK et al., 2020).

The study included a questionnaire to gather data on oral hygiene practices, medical history, familial variables, and sociodemographic characteristics. It was discovered that the overall content validity ratio (CVR) was 0.84 (VPK et al., 2020).

For the analysis statistical was used the SPSS (Statistical Package for Social Sciences) Version 26.0, and the connection, between variables and dental care routines among groups was examined both before and after the treatments using a range of statistical analyses such as the chi square test, Fischer exact test, Student paired, unpaired t-tests and the Mann Whitney test (VPK et al., 2020).

The statistical significance was set at 5% level of significance ($P < .05$) (VPK et al., 2020). The investigation results from VPK et al. revealed changes, in hygiene practices among parents in IG after the follow up period. The percentage of parents who reported never brushing their childs teeth decreased from 3(10.71%) to 0 while those who brushed occasionally decreased from 5 (17.86%) to 1 (3.57%). Parents who brushed their childs teeth a day increased from 17 (60.71%) to 22 (78.57%). Those who brushed twice a day increased from 3 (10.71%) to 5 (17.86%). In CG the percentage of parents who reported never brushing their childs teeth decreased from 6 (24%) to 3 (12%) while those who brushed occasionally decreased from 3 (12%) to 2 (8%). Parents who brushed their childs teeth a day increased from 15 (60%) to 18(72%). And those who brushed twice a day increased from 1 (4%), to 2 (8%) (VPK et al., 2020). Regarding the OHI-S, in the IG, OHI-S scores reduced from 0.86 ±0.79 to 0.596 ±0.59 after 12 weeks. In CG, the scores for OHI-S reduced from 1.108 ±0.65 to 1.083 ±1.16 (VPK et al., 2020). The score for Plaque index (PI) in IG, at the start of the study was 0.641 ±0.53, which reduced to 0.472 ±0.35 after 12 weeks, and in the CG the PI scores reduced from 0.962 ±0.58 to 0.827 ±

0.34 (VPK et al., 2020). The scores for Gingival index(GI) in IG reduced from 0.172 ± 0.36 to 0.079 ±0.18, and 0.212 ±0.29 to 0.171 ±0.24 in CG (VPK et al., 2020). The mean reduction in OHI-S, PI, and GI scores was 0.27, 0.17, and 0.09, respectively, in IG and in CG were 0.03 in OHI-S, 0.14 in PI, and 0.04 in GI index (VPK et al., 2020).The changes in the scores were statistically significant in both the groups (*P*-value < .005, S) except for the GI score in CG (*P*-value = .6) (VPK et al., 2020). As observed in the Table 4.

The article of Rai et al. is a randomized controlled trial, and the study commenced after receiving approval, from the Institutional Ethics Committee (Protocol reference number 17005) and was carried out in accordance with the guidelines specified in the Helsinki Declaration of 1975 (updated in 2000). It was a single-blinded trial, where the individuals recording the data were unaware of the group allocations. The study aim was to evaluate how customized toothbrushes compete with the conventional ones in keeping the mouth clean and periodontal healthy, for individuals with CP. The null hypothesis being tested that there wouldn't be a difference in the effectiveness of personalized toothbrushes, versus ones when it comes to maintaining oral hygiene and gum health in CP patients (Rai et al., 2018).

For the research was included 30 patients with CP aged 6 to 18 from a disability center, Bangalore, India, divided in two groups:

-16 patients in Group I that received guidance on hygiene along with tooth brushing whereas

-14 patients in Group II received instructions, on oral hygiene along with using a personalized toothbrush (Rai et al., 2018). As observed in the Table 3.

In the study were excluded patients with severe CP who were unable to cooperate. All participants were directed to carry out oral hygiene procedures with the help of their caregivers, regardless of their assigned group. The brushing technique utilized was the horizontal scrub method and both groups were advised to brush tour teeth twice daily with 0.2% chlorhexidine mouthwash (Rai et al., 2018).

Customized toothbrushes were created using self-cure acrylic over a wax spacer on commercially available toothbrush handles. Children held the brushes while the acrylic set. After the acrylic hardened, the brushes and wax spacer were removed. The custom acrylic handle was then inserted into the toothbrush handle, allowing easy removal,

rotation, and reinsertion for thorough brushing. Soft reliners were added to the toothbrush heads to assist with oral muscle exercises (Rai et al., 2018).

All the participants included in the study received an oral inspection during the first visit and after 3 weeks for a second appointment for collecting the Plaque index (PI) and the modified gingival index (MGI). The method that the author used for statistical analysis was the t-test for comparison the value before and after for the PI and MGI index, and the Student's t-test for comparison of conventional and customized toothbrush (Rai et al., 2018).

The study showed that when comparing the PI before and after the intervention group II experienced a decrease of 31.55% ($p = 0.01$) while group I only saw an 8.34% decline ($p = 0.32$). The MGI exhibited a pattern pre and post brushing with a 30.23% decrease in group II ($p = 0.04$) and a 14.51% reduction in group I ($p = 0.24$). There were no differences between group I and group II in terms of PI and GI as indicated by (p values of 0.17 and 0.49 respectively). The ICC coefficient showed interobserver agreement, with a coefficient exceeding 0.8 (Rai et al., 2018). As observed in the Table 4.

The article realized by Ferraz et al. is a clinical randomized, crossover, blind study realized in Brazil. The purpose of this study was to evaluate the efficacy of an electric toothbrush, in removing plaque from individuals with cerebral palsy both, in active and inactive states and to compare its performance with that of a manual toothbrush. The population that taking part, was 40 children with CP (52.5% were female),between 4-16 year old (mean age 8.93 years (SD = 3.8 years), randomly divided in 3 groups using two different envelopes for each participant (G1 = manual brushing; G2 = electric toothbrush turned on; G3 = electric toothbrush turned off). Each brushing technique was performed at least 7 days apart (Ferraz et al., 2015). As observed in the Table 3.

The researcher team was composed of: the appraiser, who handled recruitment and biofilm assessment; the supervisor, responsible for drawing envelopes, selecting brushing methods, and escorting patients to the brushing room; and the coordinator, in charge of research oversight and data analysis (Ferraz et al., 2015).

Before the start of the study was told to the caregivers to don't brush the teeth's patient's for 23-25 h, and it was realized an oral examination before and after the realization of each brush technique, for analyzing the Quigley–Hein biofilm index, modified by Turkey et al., ranged from 0 to 5 (Quigley & Hein, 1962; Turesky et al., 1970).

Following the first biofilm assessment, participants were taken to the brushing room where they were given the designated toothbrush and caregivers then conducted brushing sessions lasting 3 minutes each, with a minimum 7-minute interval between sessions. While caregivers were trained in using the electric toothbrush, no specific instructions were given regarding brushing technique (Ferraz et al., 2015).

The statistical analysis used was the Statistical Package for Social Sciences (SPSS for Windows, version 20.0, SPSS Inc. Chicago, IL, USA) for analyzing the data; the Shapiro–Wilk test for describing the analysis; the Wilcoxon and Kruskal–Wallis tests for proven the distribution of the variables; The chi-squared test was utilized to determine the decrease in the percentage of total biofilm among the groups.

The significance level for all tests was set at $P \leq 0.05$, but the statistical analysis was only conducted for the participants that completed the cycle of three brushings (Ferraz et al., 2015). The results of the study by Ferraz et al. showed statistically significant differences between the accumulation of biofilm before and after the three methods of brushing ($P < 0.001$). Across the groups there were consistent biofilm levels pre and post brushing along with comparable percentage decreases in biofilm. However, when evaluating the efficacy of halving biofilm accumulation marked distinctions were noted between using the toothbrush powered on versus off ($p = 0.007$) well as, between the electric toothbrush turned off and manual brushing ($p < 0.001$). No significant variances were identified when comparing the ability to reduce biofilm accumulation by 70% among the brushing methods (Ferraz et al., 2015). As observed in the Table 4.

The study made by Maiya et al. is a randomized, open-blinded study realized in two special schools in the city of Bangalore, India. The aim of this study was to educate parents, caretakers, institution staff, and children with CP on various preventive home care strategies and assess the oral hygiene and gingival health status of these children beforehand and after implementing various preventive home care strategies (Maiya et al., 2015).

The participant included in the study were 64 children diagnosed with CP, 42 participants (65.2%) were males and 22 participants (34.8%) were females, between the ages of 6 and 18 years. The children who were part of the study of Maiya et al., were randomly divided into four groups of 16 children each as follows:

Group 1: Manual toothbrush with fluoridated toothpaste; Group 2: Manual toothbrush

with fluoridated toothpaste and CHX spray; Group 3: Powered toothbrush with fluoridated toothpaste; Group 4: Powered toothbrush with fluoridated toothpaste and CHX spray (Maiya et al., 2015). As observed on the Table 3.

Due to the motor implications that patients with CP present, oral hygiene is carried out by caregivers, and in the study the parents or caregivers were encouraged by the conduction of the study to brush their children's teeth twice a day, in the morning and after dinner, using a horizontal motion with a manual toothbrush or correctly using a powered toothbrush with a pea-sized amount of fluoride toothpaste. They were advised to complete the brushing activity within 2 minutes each time. After brushing, the caregivers were instructed to apply the custom-made 0.2% chlorhexidine (CHX) spray on both the outer and inner surfaces of each tooth arch, twice a day, with a half-hour gap after brushing (Maiya et al., 2015).

During the oral examination were recorded the oral hygiene index simplified [OHI (S)] and the modified gingival index (MGI) in a period of 6 weeks. The OHI-S and MGI were recorded and compared at baseline and the end of 1 week, 2 weeks, and 6 weeks. For the statistical analysis were used: SPSS 19, ANOVA ad the t-test (Maiya et al., 2015).

The study highlighted that regarding the OHI(S) index the Group 4 exhibited a significant decrease in measurements from the initial baseline to the 6-week mark, with a results that were statistically very highly significant ($p < 0.001$). The MGI score marked that the Group 4 showed a reduction from the baseline to the 6 week when compared to the other three groups. When comparing the mean MGI score over this period (baseline to 6 weeks) there was a gradual reduction, which was statistically highly significant between baseline and 1 week ($p < 0.05$) and statistically very highly significant between 1 and 2 weeks ($p < 0.001$). However, the improvement between 2 and 6 weeks did not reach statistical significance ($p > 0.05$) (Maiya et al., 2015). As observed in the Table 4.

The article mede by Ashkenazi et al. is a cross-sectional prospective study. The objective is to examine whether there's a correlation between the oral hygiene practices of nurses and their dedication and ability to adhere to instructions for brushing teeth with conventional and triple-headed toothbrushes when caring for children with CP. The population including for the study: was 43 individuals with CP, 28 (65%) males and 15 (35%) females with an aged between 4–31 (mean age was 11.65, median 11 years) out of them, 19 were externs who stayed at the facility until late afternoon and went home to sleep, and 24 (55.8%) were institutionalized; and their 44 nurses all women aged 19–61

years (mean age 42.04 ±13.34 years) who worked in the institution for 0.4–20 years (mean 8 years), their mean number of years of education was 13.5 (range 12–17) (Ashkenazi et al., 2013). As observed the Table 3.

At the beginning a structured questionnaire was created to collect the information from nurses. It focusing in three main areas: 1) information such as age, gender, years of experience and education level; 2) their knowledge and commitment to maintaining oral hygiene for themselves and their cerebral palsy (CP) patients; and 3) the difficulties encountered while assisting CP patients with teeth brushing. The questionnaire included sections on measures oral care routines, commitment to maintaining oral health for CP patients past dental guidance received and previous instructions on brushing the teeth of CP patients. Responses were rated on a scale from 0, to 3 where 0 indicated a level of understanding and 3 indicated a response (Ashkenazi et al., 2013).

After the nurse responds at its questionnaire were divided in two groups, the nurses, in Group A, consisting of 26 individuals were initially trained to brush the teeth using a single-headed toothbrush (Paro M27, Paro, Switzerland) for the first month and then transitioned to a triple-headed manual toothbrush (Dr. Barman's Superbrush, DENTACO, AS, Haukeland, Norway) for the second month; The nurses in Group B totaling 27 participants were trained in the opposite order, with the same toothbrushes. The instruction to brush the teeth of the patient with CP was realized for 2 dentist, and involved to explaining the importance of brushing and demonstrating the proper technique using plastic models and actual patients' teeth. Nurses were instructed to brush the residents' teeth twice daily, after breakfast and dinner (Ashkenazi et al., 2013).

Instruction for brushing with a single-headed toothbrush was according to the horizontal scrubs technique: to brush the buccal aspect in each arch in five segments (anterior, two canines, and two posterior segments) and the lingual/palatal aspect in three segments (anterior and two posterior segments), to place the toothbrush partially on the gingiva and partially on the teeth, and to perform 10 back and forth brushing strokes on each segment (Levin et al., 2012; Telishevesky et al., 2012; Wei & Lang, 1982).

Instruction for brushing with the triple-headed toothbrush entailed brushing each arch in 5 separate segments (anterior, two canines, and two posterior segments), to place the toothbrush on the occlusal surfaces, and to perform about 10 back and forth brushing strokes on each segment (Levin et al., 2012; Telishevesky et al., 2012).

For verifying the Nurses 'ability to follow tooth brushing instructions, was evaluated using the tooth brushing performance skill index (TB-PS-I/ Ashkenazi index).

For the statistical analysis were used descriptive analysis for the questionnaire realized to the nurses, the Chi-square test and Fisher's exact test were used to evaluate the correlation between the variables and was using the paired *t*-test to compare TB-PS- I data post brushing, with triple headed toothbrushes.

The level of significance was realized at 5% (Ashkenazi et al., 2013). The study of Ashkenazi et al. has evidenced regarding to maintaining the oral hygiene of the nurse that a higher proportion of them mentioned that they usually brush their teeth in the morning compared to the evening (72.7%, versus 40.9%). 20% indicated brushing their teeth in the evening three times a week or less. The majority of nurses (86.4%) claimed to replace their toothbrush every 8 months or as needed based on bristle condition. A significant number (73%) mentioned they do not regularly floss or only use floss occasionally to remove food particles, and 5% said they flossed daily or every day. However, only a quarter of them (25%) reported experiencing gum bleeding while brushing their teeth. Most nurses stated they choose toothpaste based on their dentists advice and opt, for toothpaste containing the recommended concentration of 1,250–1,450 ppm, but 9% confessed to selecting toothpaste based on price. An equal percentage reported using toothpaste with a fluoride concentration of 250–500 ppm. A majority of the nurses mentioned that they only visit their dentist when they experience pain (Ashkenazi et al., 2013). Concerning the the nurses' knowledge of oral disease prevention it was revealed that a significant portion, 63.6% never received training, on using floss and only 25% received instructions on proper tooth brushing more than once in their career. Moreover 43.2% of the nurses never learned how to brush their patients teeth while 34% were taught once (Ashkenazi et al., 2013). In terms of hygiene practices more than half of the nurses believed that brushing their patients teeth twice a day was essential for those with palsy (CP) and 88.6% acknowledged the importance of tooth brushing in preventing periodontal disease. Nevertheless 56.8% recognized the significance of toothpaste in preventing cavities. Furthermore, over half (54.6%) understood that flossing plays a role in preventing gum disease with a percentage (63.7%) considering it important for cavity prevention. However 45.5% viewed flossing as important or not important all in preventing gum disease. Moreover 38.6% of the nurses were aware that periodontal disease is the common oral condition among CP patients and 22.7% believed cavities

were more prevalent among CP patients while 15.9% thought CP patients vulnerability to diseases was similar, to that of healthy individuals (Ashkenazi et al., 2013). The dedication of nurses to ensuring the health of their patients, with palsy was evident in various ways. A majority of nurses (77.3%) claimed they never missed brushing a patients teeth due to their workload with one nurse admitting oversights for this reason. Despite a number (65.9%) believing it's sufficient to brush the front teeth of patients with cerebral palsy 91% of the nurses stated that they always make an effort to brush their patients teeth even if the patients resist. In terms of tongue cleaning 40.9% of nurses mentioned that they perform it regularly while 9% cited difficulty as the reason for not doing and 32% pointed to a lack of guidance. Notably none of the nurses reported flossing their patients teeth with 18% attributing this omission to difficulty and 82% to a lack of instruction. The majority (90%) of nurses believe that CP patients don't experience an exaggerated gag reflex or excessive tongue movements during tooth brushing. However, only 16% believe that their patients are able to open their mouths sufficiently for proper tooth brushing. Regarding replacing patients toothbrushes one third of the nurses stated that they replace them, at once every eight months or based on the condition of the brush fibers. Moreover, over half of the nurses indicated that either the institution or the patients parents determine how often toothbrushes are replaced (Ashkenazi et al., 2013). During the evaluation both groups of nurses showed rates of following tooth brushing instructions with 92.7%, for the conventional toothbrush and 92.2% for the triple headed toothbrush. However, after a month there was a decrease of around 10% in the headed toothbrush groups adherence to instructions ($p < .001$) mainly due to a decline in the "stay" aspect by 20.2% ($p < .001$). In opposition there were no changes in the components of TB-PS-I observed in the triple-headed toothbrush group (p= not significant). There were no correlations between when using the conventional or triple-headed toothbrush and between age of the nurses, at baseline or at one month for the TB-PS-I scores except for a correlation between experience and the "stay component" scores using the triple headed toothbrush, at baseline ($R = -0.32$, $p = .034$). A link was identified between knowledge and the initial TB PS I score in the toothbrush group showing a correlation ($R = 0.424$ $p = .004$) well as, between the aspects of "reach" and "stay" ($R = 0.349$, $p = .02$ and $R = 0.443$ $p = .003$ respectively). However, no such connections were evident in the triple-headed toothbrush group (Ashkenazi et al., 2013). Positive associations were noted between nurses understanding of practices and their experience level ($R = 0.432$ $p = .003$) adherence to personal oral care ($R = 0.372$, $p = .013$) receipt of prior guidance on brushing

their teeth (R= 0.288 p=.058) or for their CP patients (R= 0.303 p=.046) and dedication to maintaining good oral health for their CP patients (R= 0.314 p=.038). Similarly, there was a relationship found between receiving previous instructions on proper oral hygiene and the commitment to ensuring good oral health, for CP patients under their care (R= 0.345 p=.022) (Ashkenazi et al., 2013). As observed in the Table 4.

The research by Yitzhak et al. is an prospettive crossover study, and had four goals: 1. To gauge the effectiveness of nurses, in following tooth brushing instructions for individuals with palsy (CP) using single headed and triple headed toothbrushes assessed by the Ashkenazi index both at the initial instruction and one month later; 2. To compare plaque and gingival indices after a month of using two types of toothbrushes; 3. To analyze the changes in plaque index and gingival index among institutionalized individuals with CP based on the severity of their condition; 4. To explore the difficulties encountered in tooth brushing for individuals, with CP (Yitzhak et al., 2013).

The study included: 43 individuals with CP, were 28 (65%) males and 15 (35%) females, aged 4–31 (mean age was 11.65, median 11 years) and of them, 24 (55.8%) were institutionalized and 19 sleep at home; 53 of their nurses that were all women with 19–61 years old (mean age 42.04 ±13.34 years) with mean work experience of 8 years and authorized with a written consent to participate in the study. The participant with CP were randomly divided with a coin in Group A of 21 participant and Group B of 23 participant in line to gender, age, institutionalized or living at home and the severity of CP (group A: medium severity-13 patients, high severity-3 patients, very high severity-5 patients. Group B: medium severity-16 patients, high severity-4 patients, very high severity-2 patients) (Yitzhak et al., 2013). As observed in the Table 3.

The nurses were also divided into two groups; Group 1 comprised of 26 nurses who received training on tooth brushing using a manual single-headed toothbrush (Paro M27 Paro, Switzerland) while Group 2 included 27 nurses who used a manual triple-headed toothbrush from (Dr. Barman's Superbrush Dentaco AS, Haukeland, Norway) and after one month the groups swapped their brushing techniques. The tooth brushing instructions included explanations on its importance and demonstrations on how to perform it using models and the patients own teeth. The nurses were directed to brush the teeth of residents twice daily, once in the morning and once in the evening, immediately after eating (Yitzhak et al., 2013).

With a single-headed toothbrush the method involved using a horizontal scrub technique

was motion dividing the vestibular of the teeth into five parts (right molars and premolars, right canines, anterior teeth, left canines and left molars and premolars) and dividing the lingual of the teeth into three parts (right molars and premolars, anterior including the canines, left molars and premolars) (Fischman, 1988; Levin et al., 2012; Telishevesky et al., 2012; Wei & Lang, 1982). The toothbrush was placed partly on the gums and partly on the teeth with 8-10 brushing strokes done back and forth on each part totaling eight parts in each side of the mouth. For the triple-headed toothbrush the technique included doing 8-10 strokes in five parts on each side of the arch (anterior, two canines, and two posterior segments), to place the toothbrush on the occlusal surfaces, and to perform about 8–10 back and forth brushing strokes on each segment (Telishevesky et al., 2012).

An oral examination was realized by two dentists at the start of the study and after each month of tooth brushing with each type of toothbrush, for evaluated the plaque index (PI) according to the OHI-S realized by Greene and Vermilion (0–3 degrees) (Fischman, 1988; Wei & Lang, 1982), the Gingival index (GI) of Lobene *et al*. and Fischman (0–4 degrees) (Fischman, 1988; Lobene et al., 1986; Wei & Lang, 1982), and the tooth brushing performance skill index (TB-PS-I/ Ashkenazi index) for to evaluate the nurses' ability to effectively brush the patient’s teeth (Levin et al., 2012; Telishevesky et al., 2012).

Statistical analysis involved ANOVA to compare PI and GI before and after brushing, the Pearson Chi Square test for assessing the relationship between PI and GI in patients with varying levels of CP severity, the t test for comparing TB PS I scores between the two groups and the Pearson Correlation test for analyzing the relationship, between GI, PI and TB-PS-I. The level of significance was set at 5% (Yitzhak et al., 2013).

The results by Yitzhak et al., indicated that at the beginning of the study of the PI ranged from 1.97 to 2.37 across different tooth segments, with a mean of 2.14 ±0.6 with no significant difference between groups 1 and 2 according to the ANOVA analysis. Mandibular teeth had a higher mean PI by 13.6% compared to maxillary teeth (2.28 vs. 1.97, $p < .001$), and the lingual side had a 16.5% higher mean PI compared to the buccal side (2.37 vs. 1.98, $p < .001$). Following one month brushing with a single or triple headed toothbrush, the mean total PI and mean PI for all segments decreased, and were significantly greater after using the triple-headed toothbrush, and were more than double that seen after using the single headed brush. The improvement of the PI was higher in the lingual and in the mandibular segments than in the buccal segments or maxillary segments ($p < .001$). Initially, patients with very high severity CP had a higher mean PI

than those with high or medium severity CP ($p < .015$). However, after one month of brushing, the mean PI decreased for all levels of CP severity, with no statistical differences between groups. Patients with very high severity CP showed greater improvement in PI following one month of brushing with the triple-headed toothbrush ($p < .001$), eliminating the significant differences observed among groups at baseline. Residency status did not significantly affect PI at baseline or after one month of brushing with single-headed or triple-headed toothbrushes (Yitzhak et al., 2013). At the start of the study, the GI varied from 2.14 to 2.43 (mean 2.24 ±0.52) in different segments and the mean GI of the mandibular and the lingual aspects was higher than that of the maxillary and buccal aspect by 5% and 13.6%. After one month a decrease in the GI was greater with the triple-headed than with the single-headed toothbrush (34.11%–40% vs. 16.35%–19.3%, $p < .001$). An advance in the GI has been shown after brushing with the triple-headed tooth-brush in the total, buccal, lingual, upper and lower arch with values 2.12, 2.09, 1.36, 1.93, 1.91 times higher compared to using the single-headed toothbrush with an improvement of the GI that was more pronounced in the lingual and in the maxillary segments than in the buccal and mandibular segments ($p < .001$) (Yitzhak et al., 2013). At the beginning, there were no differences in GI between institutionalized and extern patients (2.45 vs. 2.44 for lingual; 2.15 vs. 2.13 for buccal). However, after one month of using the triple-headed toothbrush, the mean GI in the buccal aspect improved by 1.68 times in institutionalized individuals and by 1.4 times in the lingual aspect compared to extern individuals, though these differences were not statistically significant. There was no significant difference in the GI between institutionalized and extern patients after brushing with the single-headed or triple-headed toothbrush ($p < 105$) (Yitzhak et al., 2013). Initially, the GI was correlated with the severity of CP (mean values of 2.71, 2.18, and 2.08 for very high, high and medium severity of CP, respectively, $p < .015$). After one month, progress in the GI was observed for all grades of severity of CP, and ranged from 13.5–17% for the single-headed and 25–41.7% for the triple- headed toothbrush. The most advance was obtained in the children with very high severity of CP, after using the triple-headed toothbrush with a value of 1.74 times higher than after using the single-headed toothbrush ($p < .001$). There was no significant difference in the GI between individuals with high and medium severity CP ($p < .105$) (Yitzhak et al., 2013). Regarding the mean total TB-PS-I scores at baseline, were similar between triple-headed and the single-headed toothbrushes. After one month brushing with the triple-headed toothbrush, the value of TB-PS-I scores rest the same, in opposition with the single-headed

toothbrush, mean total TB-PS-I and TB-PS-I for both arches were decreased by about 10% ($p < .001$). The main decay was observed in the "stay" component (20.2%, $p < .001$). When questioned at the nurses about their preference for a type of toothbrush 75.5% of the nurses leaned towards the headed one while 22.6% favored the single-headed option. Nurses pointed out benefits of the triple-headed toothbrush such, as improved plaque removal, reduced bleeding during brushing, less gag reflex sensitivity and shorter brushing duration based on their observations and experiences. Initially the percentage of nurses who correctly brushed the residents teeth following TB-PS-I guidelines was similar, however one month later a higher proportion of nurses required guidance after using the single-headed toothbrush (15%) compared to those, in the triple headed toothbrush group (7.6%; p <.002) (Yitzhak et al., 2013). As observed in the Table 4.

4. DISCUSSION

Our findings recommend adopting the horizontal scrub brushing technique for tooth brushing. This technique should be applied twice daily—once in the morning and once at night after dinner, with each session lasting two minutes. To mitigate the high risk of dental caries in CP patients, it is advisable to use fluoride toothpaste with concentrations starting at 1000 ppm, tailored according to the patient's age. For plaque control, chlorhexidine (CHX) at concentrations of 0.12% to 0.2% is effective. However, due to potential side effects, its use should be limited to a one-week period, followed by a suspension, under the supervision of parents or caregivers. In terms of brushing devices, powered toothbrushes are recommended for ease of use, especially if a caregiver performs the brushing. Alternatively, triple-head manual brushes can provide comprehensive coverage and are preferable when used by caregivers. For patients capable of brushing independently, custom-made toothbrushes tailored to their specific motor abilities are suggested to enhance efficiency and autonomy in maintaining oral hygiene. These recommendations are designed to provide a structured oral hygiene regimen that accommodates the unique needs of individuals with CP, promoting optimal dental health and reducing the risk of dental diseases.

Patients with cerebral palsy (CP) generally exhibit poorer oral health compared to healthy individuals, with a notably higher incidence of dental caries as demonstrated by Somani et al. (Somani et al., 2019). The compromised functionality of their chewing system often necessitates a diet consisting mainly of soft foods, which diminishes natural self-cleansing processes in the mouth and leads to poor oral hygiene. This, in turn, increases their susceptibility to tooth decay. According to Orsós et al., oral health declines as motor impairments worsen, particularly evident in the higher GMFCS levels (IV and V), where there is a greater prevalence of gingivitis and untreated caries, and lower decayed, filled teeth (df-t) and Decayed, Missing, and Filled Teeth (DMF-T) scores. This deterioration can be attributed to reduced self-sufficiency, necessitating reliance on caregivers for oral hygiene practices (Orsós et al., 2021).

Furthermore, the consumption of high-risk, cariogenic foods exacerbates oral health issues; hence, monitoring and managing the intake of such foods are critical for preventing dental caries while ensuring adequate nutritional intake for growth.

In CP patients with severe dysphagia, the need for prolonged mastication can complicate feeding, potentially leading to bronchoscopic incidents during meals and increasing the risk of respiratory conditions such as chronic lung disease and respiratory tract infections. To manage these risks and ensure proper nutrition, many patients transition from oral to enteral feeding using techniques such as percutaneous endoscopic gastrostomy (PEG), a procedure that involves the surgical insertion of a feeding tube directly into the stomach (Hidas et al., 2010; Jiménez et al., 2010).

Cardona-Soria et al. highlighted that CP patients who are enterally fed via PEG are at an increased risk for gingivitis and periodontitis compared to those who are orally fed. This distinction underscores the necessity of implementing effective oral hygiene practices, such as assisted brushing or the application of moistened gauze with antimicrobial agents like 0.12% chlorhexidine or 0.05% fluoride. This is crucial not only to maintain dental health but also to prevent the aspiration of toothpaste, which can be a risk factor for bronchial complications (Cardona-Soria et al., 2020).

Orally fed patients face a heightened risk of developing dental caries due to their soft, carbohydrate-rich diets. Both the American and Spanish Associations of Pediatric Dentistry recommend supervised tooth brushing twice daily with fluoride toothpaste to mitigate this risk, adjusting fluoride concentration based on the patient's age and specific needs. This approach helps in managing the dual challenges of dietary preferences and the inherent difficulties in performing daily oral care tasks, thereby enhancing overall oral health outcomes for individuals with cerebral palsy.

This systematic review analyzes various studies, including those by Maiya et al. and Ferraz et al., to determine the effectiveness of electric (activated) versus manual toothbrushes in managing oral hygiene for individuals with cerebral palsy (CP). The findings suggest that electric toothbrushes, when used with 0.12% chlorhexidine (CHX), are more effective, as indicated by improvements in the Oral Hygiene Index (OHI-S) and the Modified Gingival Index (MGI) (Ferraz et al., 2015; Maiya et al., 2015). This is attributed to the smaller size and user-friendliness of electric toothbrushes for caregivers. However, both toothbrush types show comparable efficacy in biofilm reduction, with the electric toothbrush’s rotating bristles mimicking the manual toothbrush’s actions to remove plaque effectively without substantial physical effort (Goyal et al., 2011).

Haffajee et al. (2001) further support the superiority of powered toothbrushes in plaque control over a six-week period, as evidenced by significant reductions in the Plaque Index

(PI) (Haffajee et al., 2001). Conversely, the study by Ferraz et al. using the Quigley–Hein biofilm index, modified by Turkey et al., found no significant difference between the two types of brushes in biofilm reduction. This study, however, noted limitations such as the non-assessment of lingual tooth surfaces and a lack of detailed classification of CP severity among participants (Ferraz et al., 2015).

Orsós et al. observed no significant improvement in gingivitis and dental caries indices with electric toothbrushes, potentially due to inadequate user education on the optimal use of these devices. Research underscores that CP patients often depend on caregivers for oral hygiene, facilitated by using triple-head brushes which cover larger areas per stroke compared to single-head brushes, thus reducing the time and effort required for effective cleaning (Ashkenazi et al., 2013; Orsós et al., 2021; Yitzhak et al., 2013).

Custom-made toothbrushes have shown promise in enhancing manual dexterity among CP patients, leading to better plaque control as demonstrated in a study by Rai et al. These toothbrushes allow patients to brush more independently, though the study calls for further research with a larger cohort over a longer period to validate these findings conclusively (Rai et al., 2018).

Furthermore, the review discusses the use of alternative therapeutic resources such as finger cots and adapted toothbrush handles, which cater to varying severities of CP and improve the effectiveness of oral hygiene practices (Zito et al., 2021). The predominant brushing technique recommended across studies is the horizontal scrub, which has proven effective irrespective of the toothbrush model used.

From an instructional perspective, the American Academy of Pediatric Dentistry (AAPD) and the Spanish Society of Pediatric Dentistry (SEOP) advocate starting dental care routines early, with twice-daily brushing upon the emergence of the first tooth. Studies highlight that while caregivers recognize the importance of twice-daily brushing, consistent implementation remains challenging (Orsós et al., 2021; VPK et al., 2020).

Chemical plaque control using chlorhexidine gluconate (CHX) is recommended as a supplementary measure to mechanical brushing, especially given its efficacy in reducing plaque and gingivitis with minimal side effects when used short-term (Balagopal & Arjunkumar, 2013; Bozkurt et al., 2004). However, its potential adverse effects, such as staining and taste alteration, necessitate cautious use.

The CP individuals have physical limitations, motor coordination problems, muscular

limitation and oral characteristics that may hinder the implementation of oral hygiene and that is why health professionals should be trained in plaque control and trained to provide adequate care for this especialy patients (Shah et al., 2017). Training is necessary for caregivers to provide adequate care, which is not something that comes naturally.

The studies realized by (Pradhan et al., 2009; Waldron et al., 2017) have highlighted that many caregivers encounter greater challenges in completing this task when the resident refuses to open their mouth, bites the toothbrush, or rejects oral hygiene care altogether. Similarly, difficulties arise when the resident present the bleeding during toothbrushing.

In a study, by Bizarra and Ribeiro Graça, they looked into how an oral health initiative influenced individuals with CP living in care facilities and their caregivers. They evaluated the results after 2 and 6 months showing effects on outcomes. The education on health was successful in boosting knowledge, however the improvements in plaque control and periodontal health tended to be short lived after these interventions. Participants seemed motivated and dedicated to continuing the program post intervention, sadly during the follow up period without assistance there was an increase, in markers. This showed that without continuous monitoring and reinforcement of the motivation of caregivers, the various programs of implementation of proper oral hygiene for patients with CP are not continued by caregivers (Bizarra & Ribeiro Graça, 2020).

The study by Pradhan et al. highlighted that the caregivers tend to neglect daily the oral hygiene care when they have limited time, which highlights the fact that oral health is not a priority in caregivers' daily activities (Pradhan et al., 2009).

The research realized by VPK et al. has showed that based on the results obtained, it was found that the post-intervention scores of OHI-S, PI, and GI was lower for the parents/caregivers that received video-based in dental health education (DHE), proposing that video-based oral health education was an effective technique for enhancing the parents/caregivers knowledge and thereby their child’s oral health. This aligns with the research conducted by Alsada et al. (Alsada et al., 2005). Since parents could access health education videos on their smartphones it's likely that this not improved their understanding but also made them more inclined to watch the videos thus reinforcing the health lessons provided. Moreover, using video-based methods is beneficial especially considering how technological advancements have made educational content readily available. These discoveries have the potential to improve the health of children, with palsy and could help in creating tailored oral health promotion strategies for this specific

group. This study opens up possibilities, for research to investigate how technology can effectively address oral health issues (VPK et al., 2020).

This discussion underscores the complex interplay of factors influencing oral hygiene in CP patients, emphasizing the need for tailored approaches that accommodate the unique challenges faced by this population. Training and continuous education for caregivers are crucial to ensure the effective and consistent application of oral hygiene practices.

4.1. Limitation of the study

The main limitations of this review concern the small number of participants included in the various studies with a higher prevalence of participants aged between 6 and 18 years old thus reducing studies with adult patients, and the possible discrepancy of the various levels of severity of motor dysfunction of patients with cerebral palsy present in the various groups examined for review, as there may be a greater or lesser presence of patients with a high or low severity of motor disability. Another limitation was the short-term follow-up of the studies.

4.2. Future Prospects

More in-depth studies are needed, with more individuals with CP with different levels of motor disability and with various age groups, to instill a routine protocol of oral hygiene adapted to various levels of motor disability.

5. CONCLUSION

The most appropriate protocol for maintaining a good oral health in individuals with Cerebral Palsy is to realize the horizontal scrub brushing technique twice a day, for two minutes with the use a toothpaste containing fluoride with concentrations beginning at 1000 ppm and adjusting based on the patient's age. The chemical control of plaque is realized using CHX (0.12% - 0.2%) twice a day for only 1 week. For realizing the tooth brushing, depending on the level of motor limitation of patients with CP it is proposed to use a powered toothbrush or the use of triple-head manual brushes if its realized for the parents/caregivers, or the custom-made toothbrushes if it’s realized by the CP.

6.BIBLIOGRAPHY

Aguiar, S. M. H. C. A. de, Barbieri, C. M. L., Saito, L. P. A., & Eyko, T. (2000). Eficiência de um programa para a educação e a motivação da higiene buco-dental direcionado a excepcionais com deficiência mental e disfunção motoras. *Revista Da Faculdade de Odontologia de Lins*, *12*(1/2), 16–23.

Alsada, L. H., Sigal, M. J., Limeback, H., Fiege, J., & Kulkarni, G. V. (2005). Development and testing of an audio-visual aid for improving infant oral health through primary caregiver education. *Journal of the Canadian Dental Association*, *71*(4), 241.

Asaad, N., & Laflouf, M. (2022). Effectiveness of Apple Cider Vinegar and Mechanical Removal on Dental Plaque and Gingival Inflammation of Children With Cerebral Palsy. *Cureus*, *14*(7). https://doi.org/10.7759/cureus.26874

Ashkenazi, M., Yaish, Y., Yitzhak, M., Sarnat, H., & Rakocz, M. (2013). The relationship between nurses' oral hygiene and the mouth care of their patients. *Special Care in Dentistry*, *33*(6), 280–285.

Balagopal, S., & Arjunkumar, R. (2013). Chlorhexidine: The gold standard antiplaque agent. *Journal of Pharmaceutical Sciences and Research*, *5*(12), 270–274.

Beck, J. D., Youngblood Jr, M., Atkinson, J. C., Mauriello, S., Kaste, L. M., Badner, V. M., Beaver, S., Becerra, K., & Singer, R. (2014). The prevalence of caries and tooth loss among participants in the Hispanic Community Health Study/Study of Latinos. *The Journal of the American Dental Association*, *145*(6), 531–540.

Bizarra, M. de F., & Ribeiro Graça, S. (2020). Short-term impact of an oral health program for adults with cerebral palsy. *Special Care in Dentistry*, *40*(1), 26–34. https://doi.org/https://doi.org/10.1111/scd.12431

Bozkurt, F. Y., Fentoğlu, Ö., & Yetkin, Z. (2004). The comparison of various oral hygiene strategies in neuromusculary disabled individuals. *Journal of Contemporary Dental Practice*, *5*(4), 23–31. https://doi.org/10.5005/jcdp-5-4-23

Cardona-Soria, S., Cahuana-Cárdenas, A., Rivera-Baró, A., Miranda-Rius, J., Martín de Carpi, J., & Brunet-Llobet, L. (2020). Oral health status in pediatric patients with cerebral palsy fed by oral versus enteral route. *Special Care in Dentistry*, *40*(1), 35–40. https://doi.org/https://doi.org/10.1111/scd.12429

Dougherty, N. J. (2009). A review of cerebral palsy for the oral health professional. *Dental Clinics of North America*, *53*(2), 329–338.

Eliasson, A. C., Krumlinde-Sundholm, L., Rösblad, B., Beckung, E., Arner, M., Öhrvall, A. M., & Rosenbaum, P. (2006). The Manual Ability Classification System (MACS) for children with cerebral palsy: Scale development and evidence of validity and reliability. *Developmental Medicine and Child Neurology*, *48*(7), 549–554. https://doi.org/10.1017/S0012162206001162

Ferraz, N. K. L., Tataounoff, J., Nogueira, L. C., Ramos-Jorge, J., Ramos-Jorge, M. L., & Pimenta Pinheiro, M. L. (2015). Mechanical control of biofilm in children with cerebral palsy: A randomized clinical trial. *International Journal of Paediatric Dentistry*, *25*(3), 213–220. https://doi.org/10.1111/ipd.12132

Ferreira de Camargo, M. A., Frias, A. C., & Antunes, J. L. F. (2011). The incidence of dental caries in children and adolescents who have cerebral palsy and are participating in a dental program in Brazil. *Special Care in Dentistry*, *31*(6), 210–215.

Fischman, S. L. (1988). Clinical index systems used to assess the efficacy of mouth-rinses on plaque and gingivitis. *Journal of Clinical Periodontology*, *15*(8), 506–510.

Gonçalves, G. K. M., Carmagnani, F. G., Corrêa, M. S. N. P., Duarte, D. A., & Santos, M. T. B. R. (2008). Dental erosion in cerebral palsy patients. *Journal of Dentistry for Children*, *75*(2), 117–120.

Goyal, S., Thomas, B. S., Bhat, K. M., & Subraya Bhat, G. (2011). Manual toothbrushing reinforced with audiovisual instruction versus powered toothbrushing among institutionalized mentally challenged subjects-A randomized cross-over clinical trial. *Medicina Oral, Patologia Oral y Cirugia Bucal*, *16*(3), 359–364. https://doi.org/10.4317/medoral.16.e359

Greene, J. G., & Vermillion, J. R. (1964). The simplified oral hygiene index. *The Journal of the American Dental Association*, *68*(1), 7–13.

Haffajee, A. D., Thompson, M., Torresyap, G., Guerrero, D., & Socransky, S. S. (2001). Efficacy of manual and powered toothbrushes (I). Effect on clinical parameters. *Journal of Clinical Periodontology*, *28*(10), 937–946.

Hidas, A., Cohen, J., Beeri, M., Shapira, J., Steinberg, D., & Moskovitz, M. (2010). Salivary bacteria and oral health status in children with disabilities fed through gastrostomy. *International Journal of Paediatric Dentistry*, *20*(3), 179–185.

Jan, M. M. S. (2000). Melatonin for the treatment of handicapped children with severe sleep disorders. *Pediatric Neurology*, *23*(3), 229–232. https://doi.org/10.1016/S0887-8994(00)00188-0

Jan, M. M. S. (2006). Cerebral palsy: comprehensive review and update. *Annals of Saudi Medicine*, *26*(2), 123–132.

Jiménez, D. G., Martin, J. J. D., García, C. B., & Treviño, S. J. (2010). Patología gastrointestinal en niños con parálisis cerebral infantil y otras discapacidades neurológicas. *Anales de Pediatría*, *73*(6), 361-e1.

Klein, H., Palmer, C. E., & Knutson, J. W. (1938). Studies on Dental Caries: I. Dental Status and Dental Needs of Elementary School Children. *Public Health Reports (1896-1970)*, *53*(19), 751. https://doi.org/10.2307/4582532

Levin, L., Marom, Y., & Ashkenazi, M. (2012). Brushing skills and plaque reduction using single-and triple-headed toothbrushes. *Quintessence International-Journal of Practical Dentistry-English Edition*, 525.

Lobene, R. R., Weatherford, T., Ross, N. M., Lamm, R. A., & Menaker, L. (1986). A modified gingival index for use in clinical trials. *Clinical Preventive Dentistry*, *8*(1), 3–6.

Löe, H. (1967). The gingival index, the plaque index and the retention index systems. *The Journal of Periodontology*, *38*(6), 610–616.

Maiya, A., Shetty, Y. R., Rai, K., Padmanabhan, V., & Hegde, A. M. (2015). Use of different oral hygiene strategies in children with cerebral palsy: A comparative study. *Journal of International Society of Preventive and Community Dentistry*, *5*(5), 389–393.

Marwaha, M., Bansal, K., Sehrawat, N., & Chopra, R. (2014). Cerebral Palsy: A Dental Update. *International Journal of Clinical Pediatric Dentistry*, *7*(2), 109–118. https://doi.org/10.5005/jp-journals-10005-1247

Meningaud, J.-P., Pitak-Arnnop, P., Chikhani, L., & Bertrand, J.-C. (2006). Drooling of saliva: a review of the etiology and management options. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, *101*(1), 48–57.

Miamoto, C. B., Ramos-Jorge, M. L., Pereira, L. J., Paiva, S. M., Pordeus, I. A., & Marques, L. S. (2010). Severity of malocclusion in patients with cerebral palsy: determinant factors. *American Journal of Orthodontics and Dentofacial Orthopedics*, *138*(4), 394-e1.

Miglani, D. C., Beal, J. F., James, P. M., & Behari, S. A. (1973). The assessment of dental cleanliness status of the primary dentition using a modification of the simplified oral hygiene index (OHIS-M). *Journal of the Indian Dental Association*, *45*(12), 385–388.

Moola, S., Munn, Z., Tufanaru, C., Aromataris, E., Sears, K., Sfetcu, R., Currie, M., Qureshi, R., Mattis, P., & Lisy, K. (2017). Systematic reviews of etiology and risk. In *Joanna Briggs Institute reviewer's manual* (Vol. 5, pp. 217–269). The Joanna Briggs Institute Adelaide, Australia.

Morris, C. (2007). Definition and classification of cerebral palsy: a historical perspective. *Developmental Medicine & Child Neurology*, *49*, 3–7.

Oliveira, A. C., Paiva, S. M., Martins, M. T., Torres, C. S., & Pordeus, I. A. (2011). Prevalence and determinant factors of malocclusion in children with special needs. *The European Journal of Orthodontics*, *33*(4), 413–418.

Orsós, M., Antal, D., Veres, D. S., Nagy, K., & Németh, O. (2021). Oral health, dental care and nutritional habits of children with cerebral palsy during conductive education. *Journal of Clinical Pediatric Dentistry*, *45*(4), 239–246.

Palanisamy, S., Cholan, P., Ramachandran, L., Tadepalli, A., Parthasarsthy, H., & Umesh, S. G. (2023). Navigating Oral Hygiene Challenges in Spastic Cerebral Palsy Patients: A Narrative Review for Management Strategies for Optimal Dental Care. *Cureus*, *15*(12).

Palisano, R., Rosenbaum, P., Walter, S., Russell, D., Wood, E., & Galuppi, B. (1997). Development and reliability of a system to classify gross motor function in children with cerebral palsy. *Developmental Medicine and Child Neurology*, *39*(4), 214–223.

Piovesana, A. M. S. G. (2002). Encefalopatia crônica, paralisia cerebral. In L. Fonseca, G. Pianetti, & C. Xavier (Eds.), *Compêndio de neurologia infantil*. Medsi.

Pradhan, A., Slade, G. D., & Spencer, A. J. (2009). Factors influencing caries experience among adults with physical and intellectual disabilities. *Community Dentistry and Oral Epidemiology*, *37*(2), 143–154.

Quigley, G. A., & Hein, J. W. (1962). Comparative cleansing efficiency of manual and power brushing. *The Journal of the American Dental Association*, *65*(1), 26–29.

Quintela, L. M., & Alfredo, L. C. (2011). Experience of caries in patients with cerebral palsy. *Revista Gaúcha Odontologia*, *59*, 387–395.

Rai, T., Karuna, Y. M., Rao, A., Anupama Nayak, P., Natarajan, S., & Joseph, R. M. (2018). Evaluation of the effectiveness of a custom-made toothbrush in maintaining oral hygiene and gingival health in cerebral palsy patients. *Special Care in Dentistry*, *38*(6), 367–372. https://doi.org/10.1111/scd.12334

Ramfjord, S. P. (1959). Indices for Prevalence and Incidence of Periodontal Disease. *The Journal of Periodontology*, *30*(1), 51–59. https://doi.org/10.1902/jop.1959.30.1.51

Rosenbaum, P., Paneth, N., Leviton, A., Goldstein, M., & Bax, M. (2007). A report: The definition and classification of cerebral palsy April 2006. *Developmental Medicine and Child Neurology*, *49*(SUPPL. 2), 8–14. https://doi.org/10.1111/j.1469-8749.2007.tb12610.x

Shah, A. H., Naseem, M., Khan, M. S., Asiri, F. Y. I., AlQarni, I., Gulzar, S., & Nagarajappa, R. (2017). Oral health knowledge and attitude among caregivers of special needs patients at a Comprehensive Rehabilitation Centre: an analytical study. *Annali Di Stomatologia*, *8*(3), 110.

Somani, R., Gupta, M. P., Jaidka, S., Singh, D. J., Puri, V., & Kumar, D. (2019). Dermatoglyphics as a Noninvasive Tool for Predicting Dental Caries in Cerebral Palsy and Healthy Children: An In Vivo Study. *International Journal of Clinical Pediatric Dentistry*, *12*(3), 237–242. https://doi.org/10.5005/jp-journals-10005-1630

Su, J.-M., Tsamtsouris, A., & Laskou, M. (2003). Gastroesophageal reflux in children with cerebral palsy and its relationship to erosion of primary and permanent teeth. *Journal of the Massachusetts Dental Society*, *52*(2), 20–24.

Telishevesky, Y. S., Levin, L., & Ashkenaz, M. (2012). Assessment of parental tooth-brushing following instruction with single-headed and triple-headed toothbrushes. *Pediatric Dentistry*, *34*(4), 331–336.

Turesky, S., Gilmore, N. D., & Glickman, I. (1970). Reduced Plaque Formation by the Chloromethyl Analogue of Victamine C. *Journal of Periodontology*, *41*(41), 41–43. https://doi.org/10.1902/jop.1970.41.41.41

VPK, V., Mohanty, V. R., Balappanavar, A. Y., Juneja, M., Gupta, V., & Kapoor, S. (2020). Effectiveness of different parenting interventions on oral hygiene of cerebral palsy children: A randomized controlled trial. *Special Care in Dentistry*, *40*(4), 335–343. https://doi.org/https://doi.org/10.1111/scd.12481

Waldron, C., Phadraig, C. M., Nunn, J., Comiskey, C., Donnelly-Swift, E., Guerin, S., & Clarke, M. J. (2017). Oral hygiene programmes for people with intellectual disabilities. *The Cochrane Database of Systematic Reviews*, *2017*(4).

Wasnik, M., Chandak, S., Kumar, S., George, M., Gahold, N., & Bhattad, D. (2020). Dental management of children with cerebral palsy-a review. *Journal of Oral Research and Review*, *12*(1), 52–58.

Wei, S. H., & Lang, N. P. (1982). Periodontal epidemiological indices for children and adolescents: II. Evaluation of oral hygiene; III. Clinical applications. *Pediatric Dentistry*, *4*(1), 64–73.

Winter, K., Baccaglini, L., & Tomar, S. (2008). A review of malocclusion among individuals with mental and physical disabilities. *Special Care in Dentistry, 28*(1), 19–26.

Yitzhak, M., Sarnat, H., Rakocz, M., Yaish, Y., & Ashkenazi, M. (2013). The effect of toothbrush design on the ability of nurses to brush the teeth of institutionalized cerebral palsy patients. *Special Care in Dentistry*, *33*(1), 20–27.

Zito, A. R. A., Ferreira, N. dos S. P., dos Santos, M. O., Furtado, B. A., & Theodoro, L. H. (2021). Impacto do uso de recursos terapêuticos para higiene bucal em pacientes com paralisia cerebral. *RSBO*, *18*(2), 348–357.

7. ANNEXES

Annex A.

The Joanna Briggs Institute Critical Appraisal tools for use in JBI Systematic Reviews Checklist for Quasi-experimental studies

JBI CRITICAL APPRAISAL CHECKLIST FOR QUASI-EXPERIMENTAL STUDIES

Reviewer_____
Date_____

Author_____Year_____ Record Number_____

		Yes	No	Unclear	Not applicable
1.	Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☐	☐	☐	☐
2.	Were the participants included in any comparisons similar?	☐	☐	☐	☐
3.	Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	☐	☐	☐	☐
4.	Was there a control group?	☐	☐	☐	☐
5.	Were there multiple measurements of the outcome both pre and post the intervention/exposure?	☐	☐	☐	☐
6.	Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☐	☐
7.	Were the outcomes of participants included in any comparisons measured in the same way?	☐	☐	☐	☐
8.	Were outcomes measured in a reliable way?	☐	☐	☐	☐
9.	Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)_____

_____

_____

_____

Annex B.

The Joanna Briggs Institute Critical Appraisal tools for use in JBI Systematic Reviews Checklist for Analytical Cross-Sectional Studies

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS SECTIONAL STUDIES

Reviewer_____

Date_____

Author_____Year_____ Record Number_____

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	☐	☐	☐	☐
2. Were the study subjects and the setting described in detail?	☐	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	☐	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	☐	☐	☐	☐
5. Were confounding factors identified?	☐	☐	☐	☐
6. Were strategies to deal with confounding factors stated?	☐	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	☐	☐	☐	☐
8. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

_____

_____

_____

_____

Annex C.

The Joanna Briggs Institute Critical Appraisal tools for use in JBI Systematic Reviews Checklist for Randomized Controlled Trials

Assessor:	**Date of Appraisal:**	**Record Number:**
Study Author:	**Study Title:**	**Study Year:**

	Internal Validity	Choice - Comments/Justification	Yes	No	Unclear	N/A
Bias related to selection and allocation						
1	**Was true randomization used for assignment of participants to treatment groups?**		☐	☐	☐	☐
2	**Was allocation to treatment groups concealed?**		☐	☐	☐	☐
3	**Were treatment groups similar at the baseline?**		☐	☐	☐	☐
Bias related to administration of intervention/exposure						
4	**Were participants blind to treatment assignment?**		☐	☐	☐	☐
5	**Were those delivering the treatment blind to treatment assignment?**		☐	☐	☐	☐
6	**Were treatment groups treated identically other than the intervention of interest?**		☐	☐	☐	☐
Bias related to assessment, detection and measurement of the outcome						
7	**Were outcome assessors blind to treatment assignment?**		**Yes**	**No**	**Unclear**	**N/A**

	Outcome 1		☐	☐	☐	☐
	Outcome 2		☐	☐	☐	☐
	Outcome 3		☐	☐	☐	☐
	Outcome 4		☐	☐	☐	☐
	Outcome 5		☐	☐	☐	☐
	Outcome 6		☐	☐	☐	☐
	Outcome 7		☐	☐	☐	☐
8	**Were outcomes measured in the same way for treatment groups?**		**Yes**	**No**	**Unclear**	**N/A**
	Outcome 1		☐	☐	☐	☐
	Outcome 2		☐	☐	☐	☐
	Outcome 3		☐	☐	☐	☐
	Outcome 4		☐	☐	☐	☐
	Outcome 5		☐	☐	☐	☐
	Outcome 6		☐	☐	☐	☐
	Outcome 7		☐	☐	☐	☐
9	**Were outcomes measured in a reliable way**		**Yes**	**No**	**Unclear**	**N/A**

	Outcome 1		☐	☐	☐	☐
	Outcome 2		☐	☐	☐	☐
	Outcome 3		☐	☐	☐	☐
	Outcome 4		☐	☐	☐	☐
	Outcome 5		☐	☐	☐	☐
	Outcome 6		☐	☐	☐	☐
	Outcome 7		☐	☐	☐	☐

Bias related to participant retention

10	**Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?**					
	Outcome 1		**Yes**	**No**	**Unclear**	**N/A**
	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐
	Result 3		☐	☐	☐	☐
	Outcome 2		**Yes**	**No**	**Unclear**	**N/A**
	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐

Result 3		☐	☐	☐	☐
Outcome 3		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
Outcome 4		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
Outcome 5		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
Outcome 6		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
Outcome 7		**Yes**	**No**	**Unclear**	**N/A**

	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐
	Result 3		☐	☐	☐	☐

Statistical Conclusion Validity

11	**Were participants analysed in the groups to which they were randomized?**					
	Outcome 1		**Yes**	**No**	**Unclear**	**N/A**
	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐
	Result 3		☐	☐	☐	☐
	Outcome 2		**Yes**	**No**	**Unclear**	**N/A**
	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐
	Result 3		☐	☐	☐	☐
	Outcome 3		**Yes**	**No**	**Unclear**	**N/A**
	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐

Result 3		☐	☐	☐	☐
Outcome 4		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
Outcome 5		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
Outcome 6		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
Outcome 7		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐

12	**Was appropriate statistical analysis used?**					
	Outcome 1		**Yes**	**No**	**Unclear**	**N/A**
	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐
	Result 3		☐	☐	☐	☐
	Outcome 2		**Yes**	**No**	**Unclear**	**N/A**
	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐
	Result 3		☐	☐	☐	☐
	Outcome 3		**Yes**	**No**	**Unclear**	**N/A**
	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐
	Result 3		☐	☐	☐	☐
	Outcome 4		**Yes**	**No**	**Unclear**	**N/A**
	Result 1		☐	☐	☐	☐
	Result 2		☐	☐	☐	☐
	Result 3		☐	☐	☐	☐
	Outcome 5		**Yes**	**No**	**Unclear**	**N/A**

Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
Outcome 6		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
Outcome 7		**Yes**	**No**	**Unclear**	**N/A**
Result 1		☐	☐	☐	☐
Result 2		☐	☐	☐	☐
Result 3		☐	☐	☐	☐
		Yes	**No**	**Unclear**	**N/A**
13	**Was the trial design appropriate and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?**	☐	☐	☐	☐

Overall appraisal: **Include:** ☐ **Exclude:** ☐ **Seek Further Info:** ☐

Comments:

Table 3 – The JBI Critical Appraisal Tool for RCTs