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An Extended Concept of Dental Caries and Update of Cariology Terminology

By Ana María Acevedo, Alejandra Garcia-Quintana,
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Abstract- Recent terminology explains dental caries through an understanding of factors that interplay in its etiology; however, the focus is still overpowered by the disease at advanced stages. The aims: (1) extend the concept of dental caries, through the Dental Caries Integrated Ecological Hypothesis (DCIEH), to one that includes the complexity of the disease with its conjoint elements during development and progression, and (2) update cariology terminology. The term: dental caries corresponds to the disease, and dental caries lesion corresponds to the expression of the disease. Dental caries follows a sequence of progressive phases (mild to severe), characterized by microbiome dysbiosis of the dental biofilm, including the disturbance of the metabolic activity of its commensal microbiota, producing an acid-base imbalance. Dysbiosis is determined by the complex relationship of influential factors regulated by biological features, modulated by behavior, and conditioned by the environment. A severe chronic imbalance leads to complete oral homeostasis disruption echoed in a dynamic interaction between the tooth surface and the dental biofilm with subsequent mineral loss.

Keywords: cariology, terminology, dental caries, dental caries lesion.

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An Extended Concept of Dental Caries and Update of Cariology Terminology

Ana María Acevedo ^α, Alejandra Garcia-Quintana ^σ, Annabella Frattaroli-Pericchi ^ρ & Sonia, Feldman ^ω

Abstract- Recent terminology explains dental caries through an understanding of factors that interplay in its etiology; however, the focus is still overpowered by the disease at advanced stages. The aims: (1) extend the concept of dental caries, through the Dental Caries Integrated Ecological Hypothesis (DCIEH), to one that includes the complexity of the disease with its conjoint elements during development and progression, and (2) update cariology terminology. The term: dental caries corresponds to the disease, and dental caries lesion corresponds to the expression of the disease. Dental caries follows a sequence of progressive phases (mild to severe), characterized by microbiome dysbiosis of the dental biofilm, including the disturbance of the metabolic activity of its commensal microbiota, producing an acid-base imbalance. Dysbiosis is determined by the complex relationship of influential factors regulated by biological features, modulated by behavior, and conditioned by the environment. A severe chronic imbalance leads to complete oral homeostasis disruption echoed in a dynamic interaction between the tooth surface and the dental biofilm with subsequent mineral loss. An individual dental caries free should imply that the disease is not present. Instead, dental caries lesion free suggests the absence, after thorough evaluation, of a visible clinical expression at any lesion stages (from non-cavitated to cavitated lesion). This extended concept allows for a broader understanding of the complexity of the disease. It provides a basis for knowledge to develop tailored strategies that may address the existing condition of the disease and its progression.

Keywords: cariology, terminology, dental caries, dental caries lesion.

I. INTRODUCTION

For the most part, throughout history, there has been no clear separation between the terminologies used for dental caries disease and dental caries lesion. Although the set of agreed concepts¹ attempting to explain dental caries disease has included a more comprehensive understanding of the factors that interplay in its complex etiology, the focus is still overpowered by the disease at advanced stages; hence an extended concept is needed.

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II. DISCUSSION

The current definition of dental caries as a disease states that it is a “biofilm-mediated, diet modulated, multifactorial, non-communicable, dynamic disease resulting in net mineral loss of dental hard tissues. It is determined by biological, behavioral, psychosocial, and environmental factors. As a consequence of this process, a caries lesion develops”.¹ Extending this idea, a concept that communicates the complexity of the disease with its conjoint elements during development and progression, is immersed in the Dental Caries Integrated Ecological Hypothesis (DCIEH).²

The DCIEH integrates Microbial-Biochemical-Environmental-Behavioral (MBEB) factors in a 4-phased process, which ranges from mild to severe, to understand the complexity of the early establishment of health and comprehend decisive factors involved in the onset and progression of dental caries. The phases (dynamic stability, mild, moderate, and severe dysbiosis) follow a logical order of event occurrence and consider MBEB factors and processes including: homeostatic mechanisms in the dental biofilm, the relationship between dental biofilm and microbiota, acid and base metabolic pathways, saliva composition and functions, the role of the salivary pellicle, epigenetic modifiers, dietary and nutritional influences, the importance of maternal psychosocial and behavioral modulators, and predisposing, reinforcing and enabling environmental conditions.²

Under the scope of the DCIEH, the term dental caries corresponds to the disease characterized by microbiome dysbiosis of the dental biofilm, including the disturbance of the metabolic activity of its normal, commensal, and resident microbiota. Such alteration is reflected in the quantity and type of organic acid production and the insufficient generation of alkaline substances. Dysbiosis is determined by the complex relationship of a series of influential factors, regulated by biological features, modulated by behavior, and conditioned by the environment.²

The term dental caries lesion corresponds to the expression of the disease. The chronic persistence of microbiome imbalance and altered dental biofilm conditions leads to the disruption of oral health homeostasis echoed in a dynamic interaction (demineralization-remineralization) between the tooth

surface and the dental biofilm. Once the disease reaches a moderate phase (under uncontrolled conditions), a mineral loss occurs in the tooth structure (initial lesion) at a subclinical stage. The initial lesion could be completely reversed if the environment of the dental microbiome shift towards a healthy state. As unfavorable conditions prevail, a severe phase of the disease is then expressed as a clinically detectable lesion.²

It is essential to emphasize the difference between dental caries and its expression understood as dental caries lesion. The combined usage of disease and lesion in the simple term "caries" has created confusion when distinguishing that the disease pertains to the individual. In contrast, the lesion relates to the hard tissues of the tooth.³⁻⁸ Under this extended concept, dental caries disease shares common risk factors with other non-communicable diseases (e.g., obesity, diabetes, cardiovascular disease, cancer, autoimmune disease).^{9,10} Despite the efforts to manage such conditions, the complexity they convey has not allowed their effective management, possibly due to the limited understanding of the upstream etiology.¹¹⁻¹⁴ In contrast, most research and clinical action have been evoked to treat their signs and symptoms, as non-communicable diseases remain the leading causes of death and disability globally.^{15,16}

As is the case in dentistry, little to none has been proposed to understand dental caries from its origin to its management. Meanwhile, all efforts have been directed to detect and treat dental caries lesions.¹⁷⁻²⁴ However, poor outcomes and no success are evident given that the severe disease, masked by lesions, continues to be a public health problem worldwide.¹¹ No scientific evidence is yet comprehensive enough to depict the effectiveness of dental treatments as measures to address the disease; instead, these actions are procedures to mitigate lesion progression.²⁵ Hence, based on evidence, wide-ranging strategies and policies are necessary to jointly manage the disease and its impact.¹¹⁻¹³

Based on this rationale, the term "caries free" and "cavity free" needs to be clarified. As previously mentioned, *the term "caries" alone is subject to confusion*; thus, it is necessary to expand the concept to one that differentiates the *disease (dental caries) and its clinical expression (dental caries lesion)*. By recent consensus, "caries free implies that there are no detectable signs of dental caries," and "cavity free implies that there are no detected cavities in dentine."¹ However, these concepts analyzed under the DCIEH suggest that an individual "*dental caries free*" should imply that the disease is not present. Instead, "*dental caries lesion free*" indicates the absence, after thorough evaluation, of a visible clinical expression at any lesion stages (from non-cavitated to cavitated lesion).² The term "cavity free" is dispensable

given that it is immersed in the latest stage of dental caries lesion.

From this understanding, it is essential to acknowledge that determining an individual as dental caries free is very difficult. The only approximation we have to obtain information about the presence of the disease is the risk assessment.^{26,27} However, no clear indication of its degree of severity can be concluded with the existing tools. Therefore, clinical research must focus on developing methods to detect the presence and severity of the disease accurately.

Historically, what has been developed are criteria and indexes to detect and quantify dental caries lesions, mainly assessing the late stages of lesion progression (cavitation).²⁸ Until recently, the status of dental caries in its different phases at the population level (from local to national) remains unknown. Generally, epidemiological profiles reported the prevalence of dental caries lesion with criteria that only reflected its severe stage.²⁹⁻³⁰ In 2005, the International Caries Detection and Assessment System (ICDAS)³¹ developed a more accurate clinical scoring system to detect and assess dental caries lesions before cavitation at various tooth surfaces.^{32,33}

This last system allows the detection of the disease at a severe phase but at an earlier stage of its expression (non-cavitated dental caries lesion). However, no system is available to detect the early phases of the disease (mild and moderate) because the clinical expression is not yet evident on the tooth surface during these phases.² Detecting a dental caries lesion during the early stages of expression indicates that the individual has the disease; however, the absence of a dental caries lesion does not mean that the individual is free of the disease. Hence, it is essential to highlight that the detection of dental caries lesion alone generates a sub-registry of dental caries as a disease in the entire population.³⁴ Prevalence results of dental caries lesions are not an accurate parameter to assess the condition; thus, under the DCIEH, it becomes necessary to include the analysis of all the factors (MBEB) that indicate an individual suffers the disease but does not manifest it.² Such an approach paves the way to design, plan and implement overarching strategies that address the onset and progression of the disease.³⁵

Most of the research has focused on the secondary and tertiary management (e.g., dental material and instrument technology, non and minimally invasive treatment) of dental caries lesions. As for disease management, scarce scientific evidence has been published regarding a comprehensive approach to health and disease prevention; moreover, sugar intake and dental hygiene have been the focus.^{11,12}

This extended concept of dental caries (Figure 1) allows for a broader understanding of the complexity of the disease. This approach provides a basis for knowledge applicable to develop tailored strategies that

may address the existing condition of the disease and its progression. Such an approach should cover public health policies, health promotion programs, environmental change, behavioral and biological interventions, patient-centered practices, and clinical management.

III. CONCLUSION

Finally, we encourage academies, associations, and researchers to join consensus on the terminology used to define dental caries and all it encompasses. Also, we recommend that research advancement focuses on developing instruments and methods for disease identification (from its onset to progression). Lastly, a comprehensive approach should lead to effective promotion and prevention strategies to manage dental caries.

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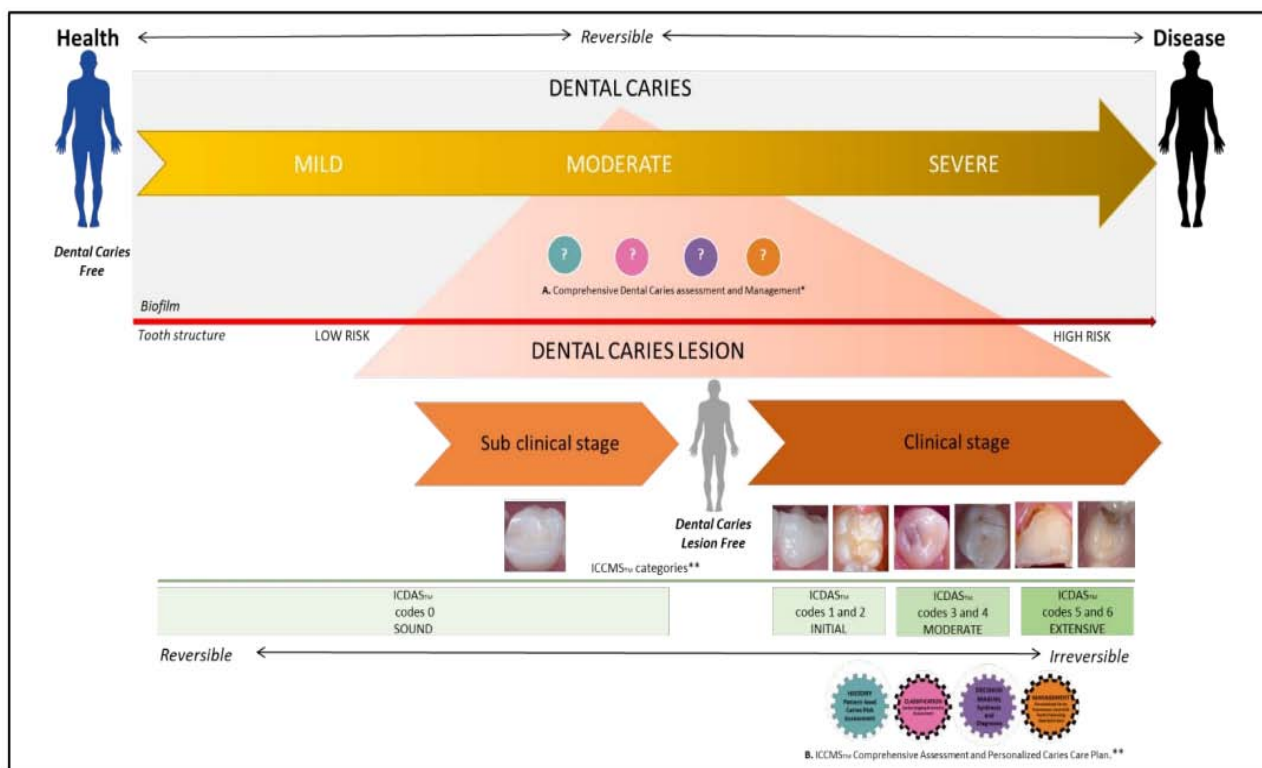


Figura 1: A schematic representation of the extended concept of dental caries.

A. Comprehensive Dental Caries assessment and Management correspond to evaluation, classification, diagnosis and management for dental caries (current research proposal).

*Acevedo AM, Garcia-Quintana A, Frattaroli-Pericchi, Feldman S. 2022.

B. The International Caries Classification and Management System - ICCMS™ as key elements for dental caries lesion management.

**Ismail AI et al. 2015.

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Comparative Study between Endoscopic Assisted Microdebrider Adenoidectomy (EAMA) and Endoscopic Assisted Coblation Adenoidectomy (EACA): Analyzing the Intraoperative Parameters & Post-Operative Recovery

By Dr. Shrinivas S. Chavan, Dr. Naveen Kumar Singh, Dr. Vitthal D. Kale,
Dr. Abhishek D. Khond, Dr. Elton C. Mendonca & Dr. Priyanka Singh

Abstract- Background: Adenoid hypertrophy is one of the most common causes of nasal blockage in children to seek an otorhinolaryngologist, which is often presented as recurrent acute otitis media, sleep disordered breathing including obstructive sleep apnea (OSA), hypo apnea syndrome and chronic rhinosinusitis. Surgical adenoidectomy is a common Otolaryngology procedure recommended in children with adenoid hypertrophy not responding to medical line of management. Conventional adenoidectomy is performed blindly without visualizing the nasopharynx; which leads to complications like inadequate adenoid tissue removal, eustachian tube scarring, bleeding. This has led to development of alternate surgical methods with visualization of nasopharynx via nasal endoscopes. With the recent introduction of microdebrider and coblation in rhino surgery many surgeons prefer endoscopic guided microdebrider adenoidectomy and endoscopic guided coblation adenoidectomy.

Keywords: nasal obstruction, adenoid hypertrophy, adenoidectomy, microdebrider, coblation.

GJMR-J Classification: DDC Code: E LCC Code: RF484.5



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Comparative Study between Endoscopic Assisted Microdebrider Adenoidectomy (EAMA) and Endoscopic Assisted Coblation Adenoidectomy (EACA): Analyzing the Intraoperative Parameters & Post-Operative Recovery

Dr. Shrinivas S. Chavan ^α, Dr. Naveen Kumar Singh ^σ, Dr. Vitthal D. Kale ^ρ, Dr. Abhishek D. Khond ^ω,
Dr. Elton C. Mendonca [¥] & Dr. Priyanka Singh [§]

Abstract- Background: Adenoid hypertrophy is one of the most common causes of nasal blockage in children to seek an otorhinolaryngologist, which is often presented as recurrent acute otitis media, sleep disordered breathing including obstructive sleep apnea (OSA), hypo apnea syndrome and chronic rhinosinusitis. Surgical adenoidectomy is a common Otolaryngology procedure recommended in children with adenoid hypertrophy not responding to medical line of management. Conventional adenoidectomy is performed blindly without visualizing the nasopharynx; which leads to complications like inadequate adenoid tissue removal, eustachian tube scarring, bleeding. This has led to development of alternate surgical methods with visualization of nasopharynx via nasal endoscopes. With the recent introduction of microdebrider and coblation in rhino surgery many surgeons prefer endoscopic guided microdebrider adenoidectomy and endoscopic guided coblation adenoidectomy.

Aim: To compare intra operative parameters and post operative recovery in patients undergoing endoscopic assisted microdebrider adenoidectomy (EAMA) and endoscopic assisted coblation adenoidectomy (EACA).

Methods and results: A prospective interventional comparative clinical study between endoscopic assisted microdebrider adenoidectomy (EAMA) and endoscopic assisted coblation adenoidectomy (EACA) was conducted. A total of 30 patients were included in the study. Patients were randomized in pool A and pool B by random number allocation technique. Patients in pool A underwent EAMA and in pool B underwent EACA. Comparisons were made between pre and post operative endoscopic grades of adenoids, pre and post operative relief of associated symptoms of adenoid hypertrophy, intra operative time, intra operative blood loss along and post operative pain, results were statistically significant for EACA.

Conclusion: Even though the comfort and adequate training of surgeon as well as cost affordability by the patients would determine the choice of technique to be used for endoscopic guided adenoidectomy over conventional method as both the procedures compared in our study do justice in the completeness of removal as well as in rate of complications

still we can conclude that endoscopic assisted coblation adenoidectomy (EACA) produce better results in treatment of adenoid hypertrophy not relieved with medical line of management both in intra operative and post operative parameters as compared to endoscopic assisted microdebrider adenoidectomy (EAMA). Limitations of this study was that different causes of adenoid hypertrophy were not taken into consideration and adenoid hypertrophy with associated symptoms not responding to medical line of management between the age group of 5 to 15 years were included in this study. Another limitation of this study was that objective method of nasal patency assessment like rhinomanometry was not used due to cost restraints and instead subjective method of visual analog scale of 10-point scale was used for the same. A more elaborate larger randomized studies with use of rhinomanometry would definitely be helpful to confirm or refute the same.

Keywords: nasal obstruction, adenoid hypertrophy, adenoidectomy, microdebrider, coblation.

I. INTRODUCTION

In today's era adenoidectomy & tonsillectomy are the two most commonly performed pediatric otorhinolaryngological procedures and are associated with variety of potential complications [1-3] As we all know adenoids exist as a rectangular mass of lymphatic tissue in the nasopharynx. Meyer first described this mucosa-associated lymphoid tissue in 1868 [4]. They form part of the Waldeyer's ring. Adenoids with other lymphatic tissue in the nasopharynx act as the first line of defense against ingested or inhaled pathogens.[1][2] Adenoid hypertrophy is more common in children than in adults. In children, the prevalence of adenoid hypertrophy has been estimated at 34.5 percent [5]. Adenoid's hypertrophy occurs physiologically in children between the age of 6–10 years, then later regresses by the age of 16 years [6].

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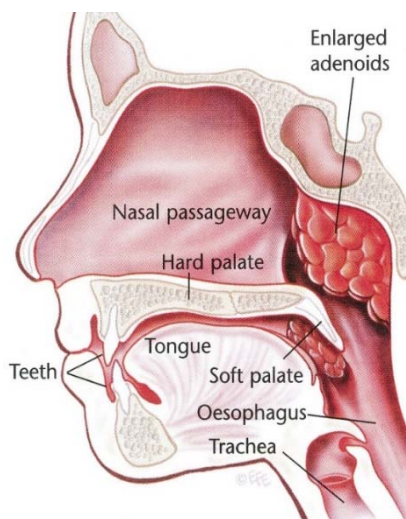


Figure 1: Adenoid hypertrophy

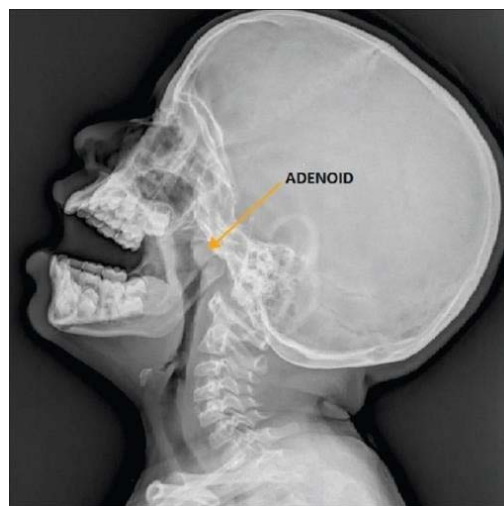


Figure 2: Endoscopic view enlarged adenoids



Figure 3: Lateral soft tissue radiograph X-ray nasopharynx

Adenoid hypertrophy is an obstructive condition, with its symptomatology depending on the obstructed structure. Nasal obstruction by hypertrophic adenoid tissue can cause rhinorrhea, difficulty breathing through the nose, post-nasal drip, snoring, and/or sleep-disordered breathing in children like Obstructive Sleep Apnea (OSA) and hypo apnea syndrome. If the nasal obstruction is significant, the patient can suffer from sinusitis as a result and may complain of facial pain. Obstruction of the Eustachian tube can lead to symptoms consistent with Eustachian tube dysfunction such as muffled hearing, otalgia, and/or recurrent middle ear infections [7]. Although in many cases, the adenoid hypertrophy regresses with age but some cases require active intervention. Initially, these cases are managed medically but sometimes surgical intervention in form of adenoidectomy becomes mandatory in patients not responding to medical management.

Basic principle of adenoidectomy surgery is to debulk the hypertrophied adenoids and to decrease associated obstructive symptoms. The conventional adenoidectomy using saint claire Thompson adenoid curette was first described in 1885 [6]. This procedure is performed blindly without visualizing the nasopharynx; which leads to uncommon complications such as inadequate adenoid tissue removal, eustachian tube scarring, bleeding and nasopharyngeal stenosis. This has led to development of alternate surgical method where visualized resection of adenoid tissue can be done like endoscopic assisted adenoidectomy.

Canon et al. [1] popularized endoscopic assisted adenoidectomy (EAA) calling it "natural progression of endoscopic technology to allow a more complete adenoidectomy".

With advent of endoscopic assisted adenoidectomy many newer techniques have been used for surgical debulking of adenoid tissue which includes microdebrider, diathermy, coblation. Because

of the availability of varied techniques of surgical debridement under endoscopic guidance there is lack of consensus for optimal endoscopic assisted adenoidectomy (EAA). Hence in this study we would like to compare and contrast endoscopic assisted microdebrider adenoidectomy (EAMA) and endoscopic assisted coblation adenoidectomy (EACA).

II. STUDY DESIGN

This is a prospective interventional and comparative study conducted between December 2020 to December 2021 in Department of Otorhinolaryngology, Grant Government Medical College and Sir J.J. group of Hospitals, Mumbai, India.

a) Inclusion criteria

1. Male and female individuals of age 5 years to 15 years suffering from associated symptoms due to adenoid hypertrophy and not getting relieved with medical line of management.
2. Individuals presenting with symptoms of chronic mouth breathing, snoring, persistent nasal discharge, recurrent upper respiratory tract infection, recurrent acute suppurative otitis media and adenoid facies.
3. Individuals with radiological and endoscopic evidence of adenoid hypertrophy.
4. Individuals willing to enroll in the study meeting the above criteria.

b) Exclusion criteria

1. Individuals with congenital facial anomalies like cleft lip, cleft palate etc.
2. Individuals with other nasal pathology like Sino nasal polyposis, Sino nasal mass etc.
3. Individuals with syndromes like Down's syndrome etc.
4. Previously operated individuals for the similar pathology.
5. Individual with bleeding disorders like sickle cell anemia, abnormal coagulation profile.
6. Individuals not willing to enroll in the study.

c) Methodology and techniques

Patients attending Otorhinolaryngology OPD in Grant Government Medical College and Sir J.J. Group of Hospitals, Mumbai, India with complaints of rhinorrhea, post-nasal drip, mouth breathing, snoring, sleep-disordered breathing, recurrent middle ear infections, recurrent upper respiratory tract infections and adenoid facies were initially screened based on inclusion and exclusion criteria as stated before. After screening, chosen patients were subjected to detailed clinical history followed by thorough clinical ENT examination after taking informed valid written consent. During ENT examination patients showing bulge / soft tissue mass in nasopharynx during posterior rhinoscopy were subjected to X ray nasopharynx lateral view for

radiological evidence of adenoid hypertrophy. Diagnostic nasal endoscopy was done to rule out any other endonasal pathology other than adenoid hypertrophy and grades of adenoid hypertrophy were documented.

A total of 112 patients with above symptoms were screened and examined out of which 69 patients were found to have adenoid hypertrophy. All these patients were subjected to medical line of management in form of topical and oral nasal decongestants along with topical corticosteroids nasal spray. Among these 36 patients responded to medical line of management after 6 weeks. Remaining 33 patients were thoroughly explained about their condition, and were given an option of adenoidectomy under this study design, procedure to be performed, associated risks & need for postoperative follow up. So out of the 33 patients 3 patients gave negative consent for surgery, remaining 30 patients after receiving informed valid written consent were randomized into two pools based on random number allocation technique. Patients with odd number were allocated into POOL-A, where the patients underwent endoscopic assisted microdebrider adenoidectomy (EAMA) with irrigating blades of angle 45 degrees. Patients with even number were allocated into POOL-B, where the patients underwent endoscopic assisted coblation adenoidectomy (EACA) with PROCISE MAX wand. All the patients were operated by the same surgeon who was blinded with respect to study designs and study details.

Diagnostic nasal endoscopies of pool A and pool B along with data analysis for pre-operative and post-operative gradings of adenoid hypertrophy was performed by same investigator. Intra operative time for adenoid excision, along with blood loss was noted and compared. Pre-operative clinical signs and symptoms were compared with post-operative clinical signs and symptoms. All the patients in pool A and pool B received the same post-operative care. Patients were examined on 2nd, 7th, 15th and 30th post-operative day for signs and symptoms with post-operative nasal endoscopy for grading of adenoids. Patients were examined for pre- and post-surgery for nasal patency percentage based on visual analogue scale score (VAS Score)- patients were instructed to indicate the point on the scale (1-10) that best corresponds to their severity of nasal obstruction, higher score indicates worse obstruction.

Visual Analogue Scale (VAS). VAS score out of 10 X10= VAS Score out of 100.

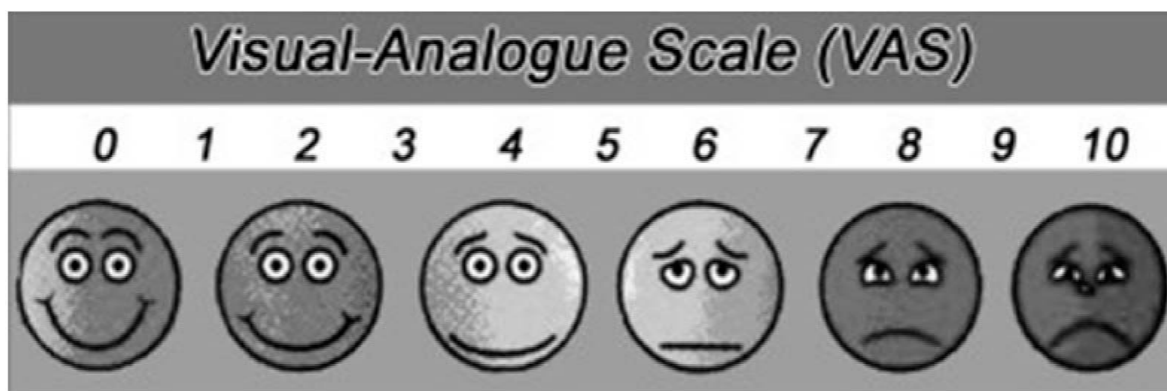


Figure 4: Visual Analogue Scale for nasal patency percentage

Post operative pain was also measured on follow up days i.e. 2nd, 7th, 15th and 30th based on Visual Analogue Scale. It consists of a 10 cm line with two

anchor points of no pain and worst pain imaginable which is self-assessed by patient.

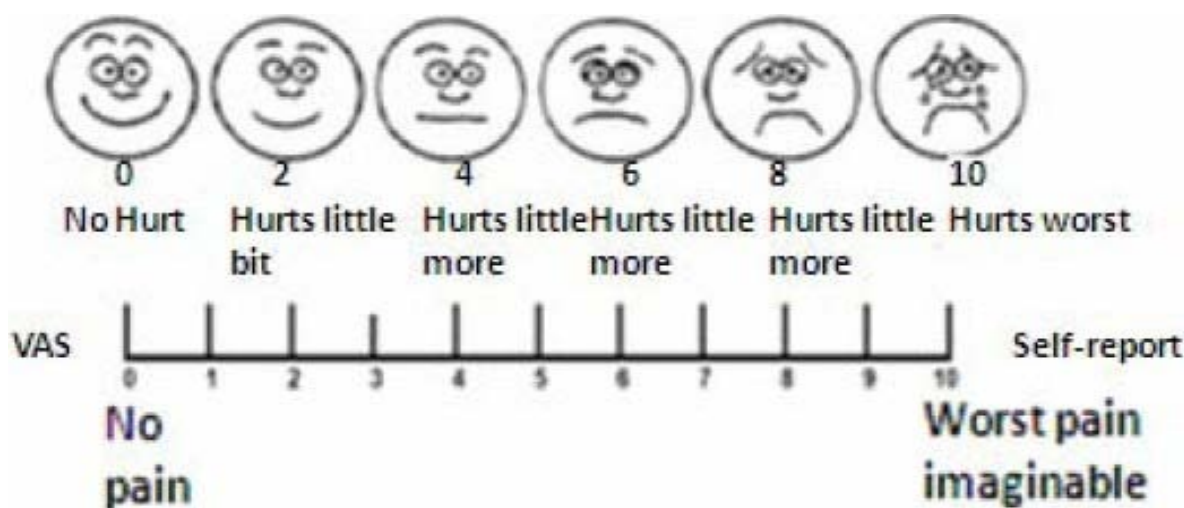


Figure 5: Visual Analogue Scale for post operative pain

d) Procedure

All procedures were performed under general anesthesia. Patients taken in supine position, painted and draped. Zero degree endoscope with a video attachment is introduced through nose and grade of adenoid hypertrophy noted and accordingly.

In Pool A, 0-degree endoscope is introduced through the nose to visualize the nasopharynx, microdebrider with a 45 degrees curved blade with cutting window of which is on the convex side, is also introduced through the mouth. The instrument is connected to an aspirator and is programmed to alternate rotations, with a rotational speed of 1200 rpm. Removal of the adenoid tissue starts from the choanal vegetations and proceeds backwards along the vault towards the posterior wall of the nasopharynx. At the end of the resection, a post nasal pack is placed in that

cavity for 5 minutes. After hemostasis is achieved, post nasal pack is removed under direct vision.



Figure 6: Endoscopic view of microdebrider blade and its position

In Pool B, 0-degree endoscope is introduced along with coblation PROCISE MAX wand, which is connected to the controller with the default settings of 7 and 3 on the coblation and coagulation LEDs respectively. Foot pedal ablation of the adenoid tissue was activated as soon as the wand is close to the inferior edge of the adenoid, avoiding direct contact. It

was made sure that wand is carefully inserted and removed without injury to uvula or soft palate.

Endoscopic check of nasopharynx was performed to ensure removal of all adenoid tissue. And if any bleeding areas were present, then they were coagulated with the wand by pressing directly on the bleeder for 2-3 seconds.



Figure 7: Procise Max Wand

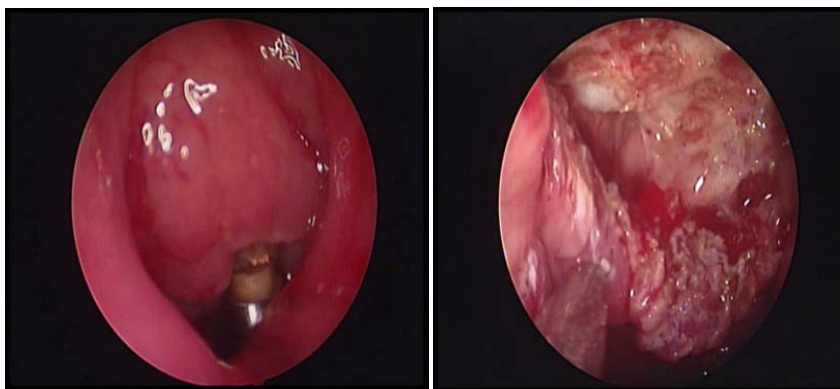


Figure 8: Endoscopic view of coblator during start of adenoidectomy and post adenoidectomy

In both pools A and B, at the end of procedure intra operative time, intra operative blood loss was recorded check nasal endoscopy was done for any residual adenoid tissue and for any bleeding points. There after similar check nasal endoscopy was done on post op day 2 before discharging the patient and on subsequent follow ups that is on 7th, 15th 30th day. Similarly post op pain, post op nasal patency based on VAS score was recorded on same follow-up days.

software for statistical analysis. Quantitative data was presented as mean and standard deviation and comparison of the two study groups was done using unpaired t-Test. Pre-operative and post -operative quantitative data of each surgical technique was compared using paired t-Test. Qualitative data was presented as frequency and percentage and analyzed using chi-square test. A p-value of < 0.05 was considered as statistically significant.

e) Data analysis and statistical tests

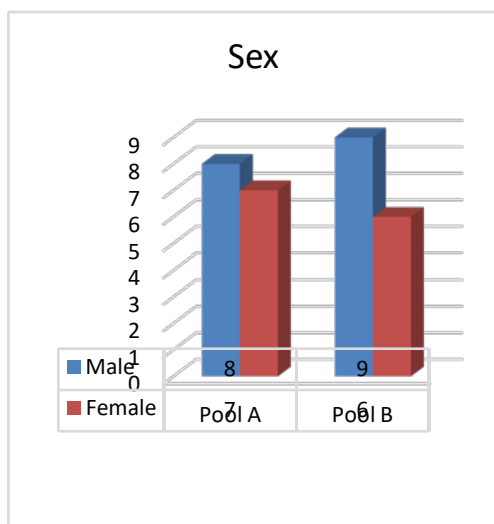
All the collected data was entered in Microsoft Excel sheet. It was then transferred to SPSS ver. 17

III. OBSERVATIONS AND RESULTS

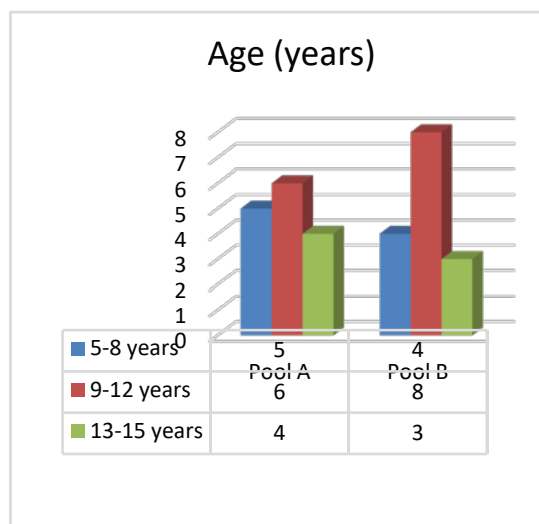
In this study of 11 months duration, 112 patients were assessed in otorhinolaryngology OPD of Grant Medical College and Sir JJ group of Hospitals Mumbai, India, out of which 69 patients were found to have clinical symptoms because of adenoid hypertrophy and thereafter they were subjected to medical line of management. 36 patients responded to medical line of management of 6 weeks. And remaining 33 patients whose symptoms didn't subside with medical line of

management were given the option of adenoidectomy under this study design of which 3 patients gave negative consent for surgery, remaining 30 patients after receiving informed valid written consent were included in this study.

In pool A, 15 patients were operated of which 08 were males and 07 were females. In pool B, 15 patients were operated of which 09 were males and 06 were females.



Graph 1: Distribution of patients



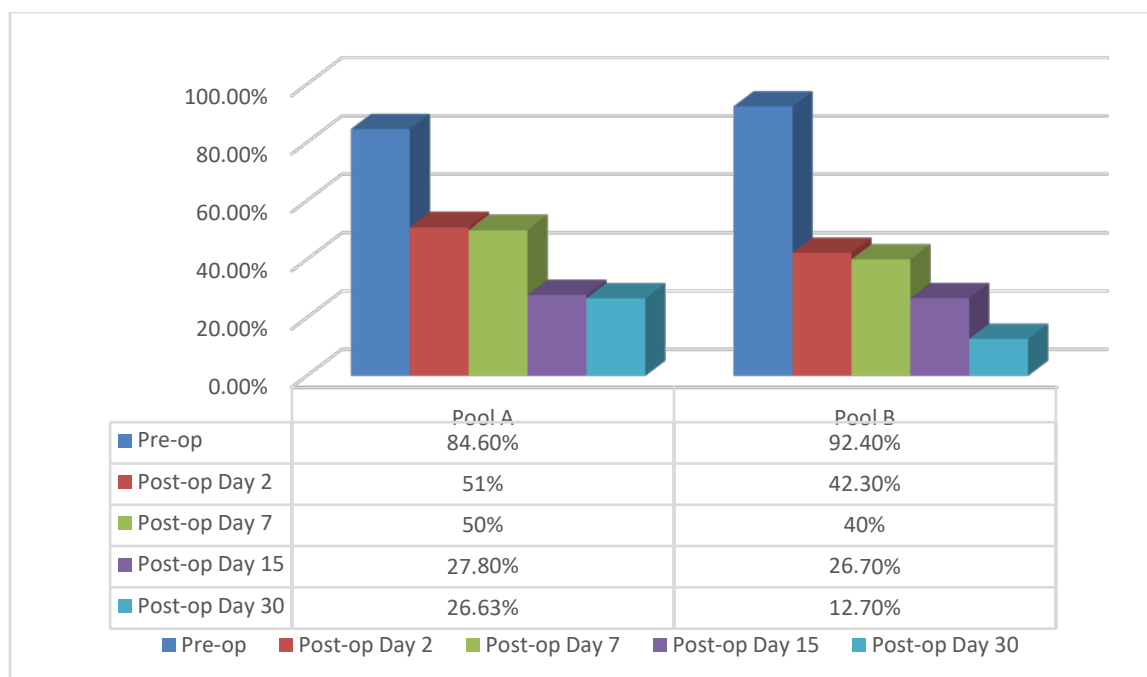
Graph 2: Distribution of patients according to Sex according to Age

Overall, mean age in Pool A was 10.20 ± 3.14 years and in Pool B was 10.27 ± 2.40 years (Graph 2).

a) Visual Analogue Scale (VAS) Score

In this study, VAS score is used for evaluation of Pre and post op nasal patency along with post op pain.

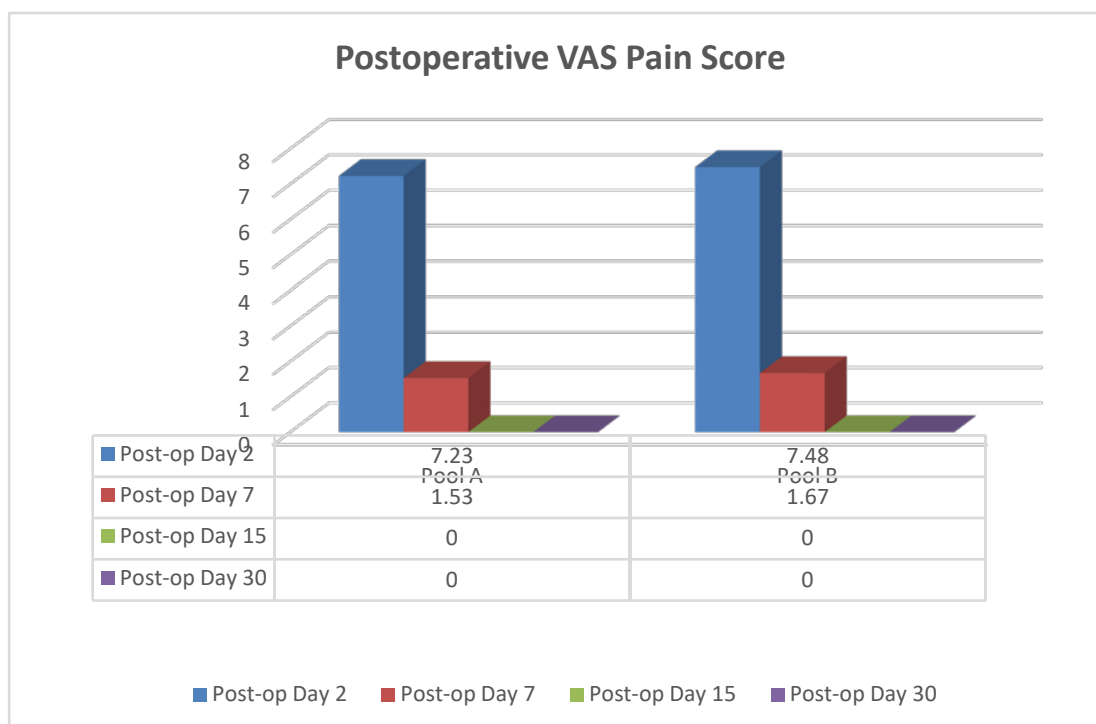
Nasal Patency: The mean pre-operative VAS score percentage in pool A was 84.60% whereas in pool B was 92.4%. During post-operative follow up, VAS score percentage in pool A on day 2nd, 7th, 15th, 30th were 51%, 50%, 27.80% and 26.63% respectively, and in pool B on aforementioned days were 92.4%, 42.30%, 40%, 26.70% and 12.70% respectively (Graph 3). The difference in VAS score percentage between pre-op and post-op values in both the groups was statistically significant as per ANOVA test ($p < 0.05$).



Graph 3: Distribution of patients according to nasal patency of airway based on VAS score for nasal obstruction.

VAS score for post operative pain:- Similarly, the mean VAS score for post operative pain on Post op day 2 in pool A was 7.23 ± 0.51 whereas in pool B was 7.48 ± 0.46 . During post-operative follow ups, VAS score for post op pain in pool A on day 7th was 1.53 ± 0.26 and in pool B was 1.67 ± 0.35 which

reduced to 0 for both the pools on subsequent follow up days i.e., on post op day 15th and 30th. In both the techniques VAS Score for post operative pain were compared using chi square test and the result of the test were statistically not significant with p-value > 0.05.

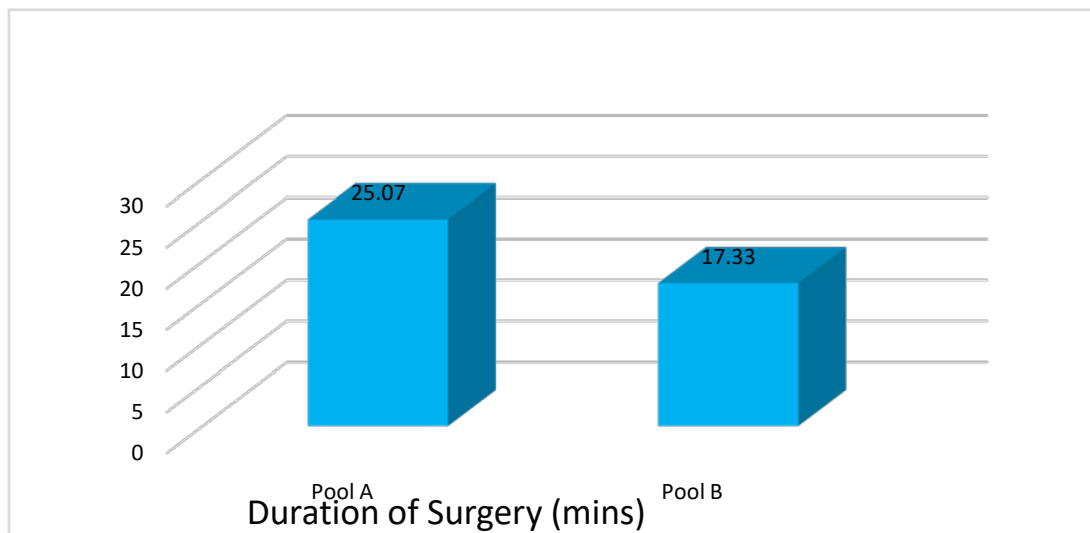


Graph 4: Distribution of patients according to post operative pain based on VAS score.

b) *Duration for surgery*

Intra operative time taken in both surgery were recoded and compared, it was found that mean

duration of surgery was significantly longer in Pool A compared to Pool B as per Student t-test (25.07 ± 3.79 mins vs. 17.33 ± 2.44 min $p < 0.05$).



Graph 5: Comparison of Duration of Surgery in both Groups

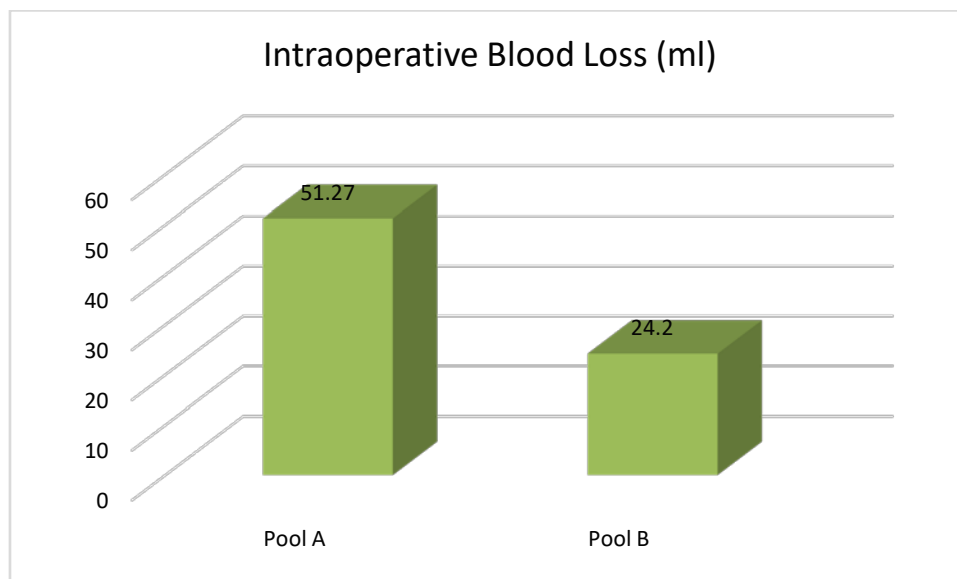
c) *Intra Operative Blood Loss*

Similarly, intra operative blood loss calculated and it was found that mean intraoperative blood loss

was significantly more in Pool A compared to Pool B as per Student t-test (51.27 ± 8.08 ml vs. 24.20 ± 4.74 ml $p < 0.05$).

Table 1: Comparison of Intraoperative Blood Loss in both Groups

	Pool A		Pool B		p value
	Mean	SD	Mean	SD	
Intraoperative Blood Loss (ml)	51.27	8.08	24.20	4.74	<0.05



Graph 6: Comparison of Intraoperative Blood Loss in both Groups

d) *Nasal endoscopic findings*

During nasal endoscopy of each patient on pre-operative and post-operative follow up days, Adenoids were categorized into the following 4 grades according to the percentage of adenoid tissue that causes the blockage of posterior choana

Grade I- adenoid tissue obstructs 0% to 25% of posterior choana

Grade II- adenoid tissue obstructs 26% to 50% of posterior choana

Grade III- adenoid tissue obstructs 51% to 75% of posterior choana

Grade IV- adenoid tissue obstructs 76% to 100% of posterior choana [10]

e) *Grades of adenoid hypertrophy based of nasal endoscopy*

It was observed in our study that Pre operative grading of adenoid hypertrophy in Pool A, by nasal

endoscopy was as following, 5 (33.3%) patients was Grade 2 while it was Grade 3 and Grade 4 in 6 (40%) and 4 (26.7%) patients respectively. In Pool B, the grade of the adenoid hypertrophy in 3 (20%) patients was Grade 2 while it was Grade 3 and Grade 4 in 5 (33.3%) and 7 (46.7%) patients respectively. There was no significant difference between the groups as per Chi-Square test ($p>0.05$).

When compared with Post Op Grading on Day 30 Grade 0 were seen in 5 (33.3%) patients in Pool A and 9 (60%) patients in Pool B, grade 1 was seen in 4 (26.7%) patients in Pool A and 6 (40%) in Pool B. Grade 2 was only seen in pool A that too also in 6 (40%) patients. There was no significant difference between the groups as per Chi-Square test ($p>0.05$).

Table 2: Distribution of patients according to Pre-operative Grading of the Adenoids

Pre-operative Grading of the Adenoids	Pool A		Pool B		p value
	N	%	N	%	
Grade 1	0	-	0	-	>0.05
Grade 2	5	33.3%	3	20%	
Grade 3	6	40%	5	33.3%	
Grade 4	4	26.7%	7	46.7%	

Table 3: Distribution of patients according to Post-operative Grading of the Adenoids on Day 2, 7, 15 and 30

Post-op Grading of the Adenoids on POD 2	Pool A		Pool B		p value
	N	%	N	%	
Grade 0	3	20%	7	46.7%	>0.05
Grade 1	10	66.7%	8	53.3%	
Grade 2	2	13.3%	0	-	
Grade 3	0	-	0	-	
Grade 4	0	-	0	-	

Post-op Grading of the Adenoids on POD 7	Pool A		Pool B		p value
	N	%	N	%	
Grade 0	3	20%	7	46.7%	>0.05
Grade 1	10	66.7%	8	53.3%	
Grade 2	2	13.3%	0	-	
Grade 3	0	-	0	-	
Grade 4	0	-	0	-	

Post-op Grading of the Adenoids on POD 15	Pool A		Pool B		p value
	N	%	N	%	
Grade 0	5	33.3%	9	46.7%	>0.05
Grade 1	4	26.7%	6	53.3%	
Grade 2	6	40%	0	-	
Grade 3	0	-	0	-	
Grade 4	0	-	0	-	

Post-op Grading of the Adenoids on Day 30	Pool A		Pool B		p value
	N	%	N	%	
Grade 0	5	33.3%	9	60%	>0.05
Grade 1	4	26.7%	6	40%	
Grade 2	6	40%	0	-	
Grade 3	0	-	0	-	
Grade 4	0	-	0	-	

f) *Pre-Op evaluation of associated symptoms*

Along with VAS score and nasal endoscopic gradings, patients were also evaluated for preoperative symptoms and relief of those symptoms post operatively. In the present study, pre operatively in Pool A all patients showed symptom of mouth breathing while 10 (66.7%) patients had snoring, 8 (53.3%) patients each had recurrent Upper Respiratory Tract

Infection (URTI) and Acute Suppurative Otitis Media (ASOM) while 7 (46.7%) patients had general features of the adenoid facies. In Pool B, 12 (80%) patients each showed symptom of mouth breathing and snoring while 9 (60%) patients had URTI. 8 (53.3%) patients had facial features while 7 (46.7%) patients had ASOM. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

Table 4: Distribution of patients according to Pre-operative Symptoms

Pre-operative Symptoms	Pool A		Pool B		p value
	N	%	N	%	
Mouth Breathing	15	100%	12	80%	>0.05
Snoring	10	66.7%	12	80%	
URTI	8	53.3%	9	60%	
ASOM	8	53.3%	7	46.7%	
Adenoid facies	7	46.7%	8	53.3%	

g) *Post-Op evaluation of associated symptoms*

Thereafter, post-operatively on Day 2, 5 (33.3%) patients in Pool A and 2 (13.33%) patients in Pool B still showed symptom of mouth breathing while 3 (20%) patients in Pool A and 2 (13.33%) patients in Pool B still had snoring. URTI was only seen in Pool A that too also with 3 (20%) patients. 8 (53.3%) patients in pool A and 7 (46.7%) patients in Pool B still had adenoid facies. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

Post-operatively on Day 7, results were similar to that of Day 2 apart from few differences as shown in the table. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

On post-operative Day 15, results were similar to that of post op day 7 only difference was in pool A, 6

patients (40%) were having complaints of snoring and in pool B, patients complaining of mouth breathing and snoring reduced to 1 that is 6.7%. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

Post-operative Day 30, all patients in Pool B continued to show relief of mouth breathing, snoring, URTI and ASOM, while 7 (46.7%) patients still had general facial features of the adenoid hypertrophy (adenoid facies). On contrary in Pool A still patients were showing symptoms like mouth breathing (20%), snoring (20%), URTI (6.7%), ASOM (6.7%), adenoid facies (53.3%). There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

Table 5: Distribution of patients according to Post-operative Symptoms on Day 2, day 7, day 15, day 30

Post-operative Symptoms on Day 2	Pool A		Pool B		p value
	N	%	N	%	
Mouth Breathing	5	33.3%	2	13.33%	>0.05
Snoring	3	20%	2	13.33%	
URT	3	20%	0	-	
ASOM	0	-	0	-	
Adenoid facies	8	53.3%	7	46.7%	

IV. DISCUSSION

Adenoidectomy pioneered in the 19th century by Hans Wilhelm Meyer, the procedure has radically evolved over the last century [11]. And with the advent of endoscopes, surgeries in the nasal cavities have become much safer as they provide precise a traumatic dissection with lesser complications and faster postoperative healing [12] [13]. Along with many advantages there exist minor disadvantages of EAMA and EACA like the need to have a complete set of endoscopic unit, microdebrider unit and coblator unit which includes setup and maintenance cost along with that there is also longer learning curve as it requires skill and expertise to operate these units in coherence [14]

Yanagisawa and Weaver in 1997 used an endoscope along with a microdebrider through a transnasal approach and concluded that they had a completeness of clearance of adenoid with significantly lesser complications [13]. Costantini et al. in 2008, had used a 70° endoscope with video attachment introduced

and a 40° microdebrider blade through the mouth to remove the adenoid and they realized that the limitation of mobility of instruments through the nasal cavity could be overcome with this approach [15]. Anand et al. in 2014 suggested that this difficulty of maneuvering the instruments can be overcome by passing the endoscope through one nostril and straight blade microdebrider through the other [16].

Even though both endoscopic assisted microdebrider adenoidectomy (EAMA) and endoscopic assisted coblation adenoidectomy (EACA) offer similar advantages over the older curettage technique, there exist subtle differences between the two which set them apart. This present study focusses to compare these two adenoidectomy procedures based on different parameters as stated before.

In this study, males outnumbered females, Pool A constituted of 53.3% male and 46.7% female patients while Pool B had 60% male and 40% female patients. Majority of the patients i.e., 40% in Pool A were in the age group of 9-12 years followed by 33.3% in the age

group of 5-8 years and 26.7% in the age group of 13-15 years. The mean age of the patients in Pool A was 10.20 ± 3.14 years. Majority of the patients i.e., 53.3% in Pool B were in the age group of 9-12 years followed by 26.7% in the age group of 5-8 years and 20% in the age group of 13-15 years. The mean age of the patients was 10.27 ± 2.40 years.

The difference in the groups was statistically not significant as per Student t-test ($p > 0.05$). Our study was comparable to other studies carried out by Abo Elmagd EA et al¹⁷ where the study evaluating micro-debrider-assisted adenoidectomy and conventional curettage method found mean age of the patients was 7.27 ± 2.36 years in group A (micro-debrider-assisted) and 7.43 ± 2.87 years in Group B (conventional) and the M/F ratio was nearly equal in both groups.

In general, both the techniques were well tolerated by the patients the major difference between EAMA and EACA were found in terms of time taken for surgery and blood loss during surgery.

In the present study it was observed that the mean duration of surgery was significantly longer in Pool A compared to Pool B (25.07 ± 3.79 mins vs. 17.33 ± 2.44 mins respectively) as per Student t-test ($p < 0.05$). This was also confirmed in study by Mularczyk C et al¹⁸ which is a prospective, single-blinded, randomized controlled trial, showing mean time for coblation as 5.50 mins was significantly lower than mean time for microdebrider adenoidectomy that was 9.47 mins.

It is observed in our study that the mean intraoperative blood loss was significantly more in Pool A compared to Pool B as per Student t-test (51.27 ± 8.08 ml vs. 24.20 ± 4.74 ml $p < 0.05$) and it is similar to Jaskaran S et al¹⁹ prospective randomised single blind study which showed mean grade of intraoperative bleeding in coblator group was 1.4 ± 1.04 ml and in microdebrider group was 3.5 ± 0.9 ml.

In present study, nasal patency and post operative pain was studied with the help of mean VAS score (visual analogue scale score). Although VAS score is not a standardized test for nasal patency and pain evaluation, this study found that the results of this technique correlate well with the patients' subjective sensation of nasal blockage and pain perception.

The mean pre-operative VAS score percentage for nasal patency in pool A was 84.60% whereas in pool B was 92.4%. During post-operative follow up, VAS score percentage for nasal patency in pool A on day 2nd, 7th, 15th, 30th were 51%, 50%, 27.80% and 26.63% respectively, and in pool B on aforementioned days were 92.4%, 42.30%, 40%, 26.70% and 12.70% respectively. The difference in VAS score percentage between pre-op and post-op values in both the groups was statistically significant as per ANOVA test ($p < 0.05$). Jaskaran S et al¹⁹ prospective randomised single blind study reported coblation group had 69 cases with good-excellent surgical field while only 1 case

demonstrated poor-average surgical field. The microdebrider group reported poor-average surgical field in 37 cases while 33 cases showed good-excellent surgical field.

Similarly mean VAS score for post operative pain on Post op day 2 in pool A was 7.23 ± 0.51 whereas in pool B was 7.48 ± 0.46 . During post-operative follow ups, VAS score for post op pain in pool A on day 7th was 1.53 ± 0.26 and in pool B was 1.67 ± 0.35 which reduced to 0 for both the pools on subsequent follow up days i.e., on post op day 15th and 30th. In both the techniques VAS Score for post operative pain were compared using Student t-test and the result of the test were statistically not significant with p -value > 0.05 . Jaskaran S et al¹⁹ prospective randomised single blind study showed post-operative 24 h mean pain score was 2.6 ± 0.99 and 7.14 ± 0.99 in coblation and microdebrider group respectively. The post-operative 72h mean pain score in coblation group was 1.17 ± 1.1 while in microdebrider group was 4.08 ± 1.42 .

In the present study, Pre operatively in Pool A, all patients showed symptom of mouth breathing i.e., 15 (100%), patients with snoring were 10 (66.7%), patients with recurrent Upper Respiratory Tract Infection (URTI) and Acute Suppurative Otitis Media (ASOM) were 8 (53.3%), patients who had general facial features of adenoid facies were 7 (46.7%). In Pool B, 12 (80%) patients each showed symptom of mouth breathing and snoring while 9 (60%) patients had URTI. 8 (53.3%) patients had adenoid facies while 7 (46.7%) patients had ASOM. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$). As per Abo Elmagd EA et al¹⁷ study evaluating micro-debrider-assisted adenoidectomy and conventional curettage method showed most common presenting symptoms were nasal obstruction and sleep-disordered breathing.

On post-operative evaluation on Day 2, 5 (33.3%) patients in Pool A and 2 (13.33%) patients in Pool B still showed symptom of mouth breathing while 3 (20%) patients in Pool A and 2 (13.33%) patients in Pool B still had snoring. URTI was only seen in Pool A that too also with 3 (20%) patients. 8 (53.3%) patients in pool A and 7 (46.7%) patients in Pool B still had adenoid facies. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

On post-operative Day 7 and 15, results were similar only difference was in pool A, 6 patients (40%) were having complaints of snoring and in pool B, patients complaining of mouth breathing and snoring reduced to 1 that is 6.7%. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

Post-operative Day 30, all patients in Pool B continued to show relief of mouth breathing, snoring, URTI and ASOM, while 7 (46.7%) patients still had general facial features of the adenoid hypertrophy

(adenoid facies). On contrary in Pool A still patients were showing symptoms like mouth breathing (20%), snoring (20%), URTI (6.7%), ASOM (6.7%), adenoid facies (53.3%). There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

This is concordant to the studies of Singh S et al²⁰ which is a randomized study reported at the 3-month follow-up, no residual disease was found in group II. However, in group I, 23 patients (77%) presented with residual disease causing nasopharyngeal symptoms and sleep-disordered breathing and residual disease were significantly higher with the conventional technique compared to the endoscopic procedure.

It was observed in our study that Pre operative grading of adenoid hypertrophy in Pool A, by nasal endoscopy was as following, 5 (33.3%) patients was Grade 2 while it was Grade 3 and Grade 4 in 6 (40%) and 4 (26.7%) patients respectively. In Pool B, the grade of the adenoid hypertrophy in 3 (20%) patients was Grade 2 while it was Grade 3 and Grade 4 in 5 (33.3%) and 7 (46.7%) patients respectively. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

When compared with Post Op Grading on Day 30 Grade 0 were seen in 5 (33.3%) patients in Pool A and 9 (60%) patients in Pool B, grade 1 was seen in 4 (26.7%) patients in Pool A and 6 (40%) in Pool B. Grade 2 was only seen in pool A that too also in 6 (40%) patients. There was no significant difference between the groups as per Chi-Square test ($p > 0.05$).

Jaskaran S et al¹⁹ prospective randomised single blind study showed average adenoid grade in coblation group was 3 ± 0.7 and in microdebrider group was 2.9 ± 0.6 respectively.

V. CONCLUSION

Even though the comfort and adequate training of surgeon as well as cost affordability by the patients would determine the choice of technique to be used for endoscopic guided adenoidectomy over conventional method as both the procedures compared in our study do justice in the completeness of removal as well as in rate of complications still we can conclude that endoscopic assisted coblation adenoidectomy (EACA) produce better results in treatment of adenoid hypertrophy not relieved with medical line of management both in intra operative and post operative parameters as compared to endoscopic assisted microdebrider adenoidectomy (EAMA). Limitations of this study was that different causes of adenoid hypertrophy were not taken into consideration and adenoid hypertrophy with associated symptoms not responding to medical line of management between the age group of 5 to 15 years were included in this study. Another limitation of this study was that objective

method of nasal patency assessment like rhinomanometry was not used due to cost restraints and instead subjective method of visual analog scale of 10-point scale was used for the same. A more elaborate larger randomized studies with use of rhinomanometry would definitely be helpful to confirm or refute the same.

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Authorship contribution

All authors have read and approved the final manuscript. NKS and AK were responsible for investigating and evaluating cases as per inclusion and exclusion criteria. All the cases were operated by SSC. Final drafting of the article was done by NKS and AK under guidance of SSC. Entire research work was co-ordinated and supervised by VDK. Conflict of interest The authors have no conflicts of interest to declare.

Ethics approval and consent to participate

Before starting the study, ethical clearance was taken from the institutional ethical committee. Informed consent was duly taken from patients.

Consent for publication

Not applicable.

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Orthopantomogram as an Assessment Tool for Identifying Growth Pattern- A Radiographic Study

By Dr. Sajin Sam, Dr. Prasanna Turuvekere Ramaiah, Dr. Madhusudhan. V,
Dr. Suhas Setty, Dr. Dakshina CK & Dr. Sangeetha RV

Abstract- Aim: Growth prediction is an estimation of alteration in speed and direction of growth. The ability to predict growth patterns of mandible, maxilla and other craniofacial structures plays an important role in improving the reliability of treatment planning and long term success of orthodontic patients. Bjork suggested structural signs such as inclination of condylar head, curvature of mandibular canal, shape of lower border of mandible, depth of antegonial notch, etc. to find the direction of mandibular growth. The purpose of the present study is to evaluate mandibular growth pattern using various Bjork structural signs on Orthopantomograms.

Material and Methods: An analytical study was done with 84 pretreatment lateral cephalograms (28 average, 28 horizontal, 28 vertical mandibular growth pattern) and 84 orthopantomograms (28 average, 28 horizontal and 28 vertical mandibular growth pattern) of same patients.

Keywords: lateral cephalogram, OPG, mandibular curvature, gonial angle, inclination of condylar head and depth of antegonial notch.

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ORTHOPANTOMOGRAMAS AN ASSESSMENT TOOL FOR IDENTIFYING GROWTH PATTERN A RADIOGRAPHIC STUDY

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Orthopantomogram as an Assessment Tool for Identifying Growth Pattern– A Radiographic Study

Orthopantomogram as an Assessment Tool

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Dr. Dakshina CK [¥] & Dr. Sangeetha RV [§]

Abstract- Aim: Growth prediction is an estimation of alteration in speed and direction of growth. The ability to predict growth patterns of mandible, maxilla and other craniofacial structures plays an important role in improving the reliability of treatment planning and long term success of orthodontic patients. Bjork suggested structural signs such as inclination of condylar head, curvature of mandibular canal, shape of lower border of mandible, depth of antegonial notch, etc. to find the direction of mandibular growth. The purpose of the present study is to evaluate mandibular growth pattern using various Bjork structural signs on Orthopantomograms.

Material and Methods: An analytical study was done with 84 pretreatment lateral cephalograms (28 average, 28 horizontal, 28 vertical mandibular growth pattern) and 84 orthopantomograms (28 average, 28 horizontal and 28 vertical mandibular growth pattern) of same patients. Inclination of condylar head, curvature of mandibular canal, depth of antegonial notch and gonial angles were analyzed both in lateral cephalogram and Orthopantomograms (both right and left side) to check for the growth pattern of an individual.

Results: Results showed significant difference in gonial angle (129.82°) and antegonial notch (1.97mm) when compared among different growth patterns and also reliability of using these parameters when analysed in OPG and lateral cephalogram. Thus the correlation between orthopantomogram (OPG) and lateral cephalogram in evaluating mandibular growth pattern was assessed using various parameters and its reliability is proven.

Conclusion: Orthopantomogram can also be used to analyse the growth pattern of an individual which will reduce the

radiation exposure of the patient by taking an extra lateral cephalogram radiograph.

Clinical Significance: Orthopantomogram can emerge as an assessment tool which can be cost effective and has reduced radiation exposure for diagnosing and prediction of mandibular growth pattern in orthodontic cases.

Keywords: lateral cephalogram, OPG, mandibular curvature, gonial angle, inclination of condylar head and depth of antegonial notch.

I. INTRODUCTION

Growth is defined as the complete series of physiologic and anatomic changes taking place between the prenatal life and the close of senility.¹ Growth prediction is an assessment of alteration in the direction and speed of growth.² Growth pattern of an individual can be influenced by various factors such as genetics, environmental factors and nutritional supply. Evaluating the growth pattern meticulously before initiating treatment improves the reliability and stability of treatment in orthodontic patients.³

The advent of lateral cephalogram has brought drastic changes in diagnosis and treatment planning in Orthodontics. It became an important tool in clinical and research domains to assess the underlying skeletal disproportions.⁴ Cephalometry permits the evaluation of the spatial relationships between cranial, dental and surface structures. All the evaluations are done by certain landmarks or points on the skull being used for the quantitative analyses and measurements. There are various methods and parameters which are used for predicting mandibular growth pattern using lateral cephalogram. Y-axis angle, SN-GoGn, Frankfort mandibular plane angle, Jarabak's ratio and Facial axis angle are most broadly adopted lateral cephalogram parameters for predicting mandibular growth pattern.³

Bjork suggested structural signs such as curvature of mandibular canal, inclination of condylar head, intermolar angle shape of lower border of mandible, depth of antegonial notch, lower anterior facial height and interincisal angle to find the direction of

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mandibular growth.⁵ Davidovitch studied the association between Bjork structures and skeletal patterns, suggesting that these characteristics can be used radiographically to examine the growth trends.⁶

In everyday practice, an orthopantomogram is routinely utilized to provide a bilateral perspective and adequate data on vertical measurements. The number of teeth present, caries, root resorption, ankylosis, impacted teeth, and shape of the condyles, temporomandibular joints, sinuses, fractures, cysts, alveolar bone levels, and tumors have all been studied using it. Several studies have concluded that orthopantomogram (OPG) can effectively assess ramus height and gonial angle as lateral cephalogram.^{4,7,8} However, lateral cephalogram cannot be reliably used for measuring the right and left sides of cranial structures individually. This is due to overlapping of both the sides and interference of superimposed images.

The reliability of cephalometric measurements when determined on OPG is still to be investigated. Thus, purpose of this study was to determine the mandibular growth pattern using various parameters of OPG.

II. MATERIAL AND METHODOLOGY

An analytical study was designed in which 84 pretreatment lateral cephalograms (28 average, 28 horizontal, 28 vertical mandibular growth pattern) and 84 pretreatment orthopantomogram (28 average, 28 horizontal and 28 vertical mandibular growth pattern) of same patients were retrieved from the record room of Department of Orthodontics, Sri Siddhartha dental college, Tumakuru. The study involved one key person and one examiner. The key person collected the radiographs, did coding and appraised the examiner regarding the parameters. The pretreatment orthopantomograms and lateral cephalograms were divided into three mandibular growth pattern based on SN-Go-Gn angle:

- Average (G1): 28-36 degrees (Average)
- Hypodivergent (G2): ≤ 26 degrees (Horizontal)
- Hyperdivergent (G3): ≥ 38 (Vertical)

Examiner was blinded regarding the study radiographs. The parameters measured to evaluate mandibular growth pattern in the present study includes:

- Inclination of condylar head (ICH): angle between a tangent to the condylar head and tangent to posterior border of the ramus.
- Curvature of mandibular canal (CMC): angle between a line parallel with the first centimeter of the mandibular foramen and a line representing the direction of mandibular canal closest to the mental foramen.
- Anti gonial notch (AN): vertical distance from deepest part of notch concavity to a tangent

through the two points of greatest convexity on the inferior border of mandible, either side of the notch.

- Gonial angle (Go): angle formed by the base of the mandible and posterior border of ramus.

The selected radiographs was traced on 0.03 tracing paper, landmarks located, lines and angles were drawn and the above mentioned variables were measured. The values obtained from linear and angular measurements on orthopantomogram and lateral cephalogram were compared, later the correlation between orthopantomogram (OPG) and lateral cephalogram in evaluating mandibular growth pattern was assessed.

III. STATISTICAL ANALYSIS

SPSS (*Statistical Package for Social Sciences*) version 20. (IBM SPASS statistics [IBM corp. released 2011]) was used to perform the statistical analysis

- Data collected from pretreatment radiographs was entered in the excel spread sheet.
- Descriptive statistics of the explanatory and outcome variables was calculated by mean, standard deviation for quantitative variables, frequency and proportions for qualitative variables.
- Inferential statistics like
 - ANOVA was applied to compare among the groups with post-hoc Bonferroni for pair-wise comparison of Orthopantomogram and Lateral Cephalogram parameters.
 - Paired sample t test was used to compare the difference between Orthopantomogram and Lateral Cephalogram parameters.
 - Pearson's correlation to correlate the parameters of lateral cephalogram and orthopantomogram was computed.
- The level of significance was set at 5%

IV. RESULTS

On assessing the mean mandibular plane angle among horizontal, average and vertical, it was found highest for vertical mandibular growth pattern. There was a statistically significant difference seen between all the three groups in pairwise post hoc analysis.

a) Lateral Cephalogram

The Gonial angle for horizontal, average and vertical mandibular growth pattern in lateral cephalogram was 122.82 ± 5.03 , 126.68 ± 4.05 , 129.82 ± 4.9 respectively. The P value obtained was 0.00 and was statistically significant. The antegonial notch for horizontal, average and vertical mandibular growth pattern in lateral cephalogram was 1.38 ± 0.87 , 1.56 ± 0.89 , 1.97 ± 1.01 respectively. The P value obtained was 0.16 and was statistically non-significant. The curvature of mandibular canal for horizontal, average and vertical mandibular growth pattern in lateral

cephalogram was 134.96 ± 3.76 , 136 ± 3.17 , 136 ± 3.59 respectively. The P value obtained was 0.61 and was statistically non-significant. The inclination of condylar head for horizontal, average and vertical mandibular

growth pattern in lateral cephalogram was 167.25 ± 3.77 , 165.82 ± 4.4 , 166.68 ± 3.28 respectively. The P value obtained was 0.50 and was statistically non-significant. (Table 1).

Table 1: Comparison of gonial angle, antegonial notch, curvature of mandibular canal and inclination of condylar head among average, horizontal and vertical mandibular growth pattern in lateral cephalogram.

LATERAL CEPH	Horizontal	Average	Vertical	P value
GONIAL ANGLE	122.82 ± 2.03	126.68 ± 4.05	129.82 ± 4.9	0.00* Significant
AN	1.38 ± 0.87	1.56 ± 0.89	1.97 ± 1.01	0.16 NS
CMC	134.96 ± 3.76	136 ± 3.17	136 ± 3.59	0.61 NS
ICH	167.25 ± 3.77	165.82 ± 4.4	166.68 ± 3.28	0.50 NS

Kruskal Wallis test; *Statistically significant, $p < 0.05$, NS- not significant

The Gonial angle for horizontal, average and vertical mandibular growth pattern in orthopantomogram was 123.38 ± 4.4 , 127.59 ± 3.4 , 130.07 ± 5.35 respectively. The P value obtained was 0.00 and was statistically significant. The antegonial notch for horizontal, average and vertical mandibular growth pattern in orthopantomogram was 1.35 ± 0.88 , 1.39 ± 0.84 , 1.70 ± 0.94 respectively. The P value obtained was 0.04 and was statistically significant. The curvature of mandibular canal for horizontal, average and vertical

mandibular growth pattern in orthopantomogram was 135.95 ± 3.89 , 136.71 ± 3.18 , 158.96 ± 114.81 respectively. The P value obtained was 0.46 and was statistically non-significant. The inclination of condylar head for horizontal, average and vertical mandibular growth pattern in orthopantomogram was 167 ± 2.48 , 165.73 ± 4.14 , 165.16 ± 9.48 respectively. The P value obtained was 0.28 and was statistically non-significant. (Table 2)

Table 2: Comparison of gonial angle, antegonial notch, curvature of mandibular canal and inclination of condylar head among average, horizontal and vertical mandibular growth pattern in orthopantomogram

OPG	Horizontal	Average	Vertical	P value
GONIAL ANGLE	123.38 ± 4.4	127.59 ± 3.4	130.07 ± 5.35	0.00* Significant
AN	1.35 ± 0.88	1.39 ± 0.84	1.70 ± 0.94	0.04* Significant
CMC	135.95 ± 3.89	136.71 ± 3.18	158.96 ± 114.81	0.46 NS
ICH	167 ± 2.48	165.73 ± 4.14	165.16 ± 9.48	0.28 NS

Kruskal Wallis test; *Statistically significant, $p < 0.05$, NS- not significant

V. DISCUSSION

Facial growth and development are of major concern to the clinician. The direction and amount of growth will significantly modify the type of orthodontic treatment modality. The ability to predict growth patterns of maxilla, mandible and other craniofacial structures plays a major role in improving the reliability of treatment planning and long term success of orthodontic patients.³

After the introduction of cephalometric radiography in 1931 by Broadbent, it has been used as a primary tool for Orthodontic diagnosis and treatment planning.⁴ All the evaluations are done by certain points or landmarks on the skull for the quantitative analyses

and measurements. Mandibular growth is primarily related to Condylar growth, it differs in forward and backward rotations.⁵ FMA, SN-GoGn, Y-axis angle, facial axis angle and Jarabak's ratio are the widely used parameters measured on lateral cephalogram to predict the growth pattern of mandible.³ However, the inherent ambiguity of locating landmarks and surfaces on the x-ray image as the image lacks hard edges, shadows and well defined outlines are major drawbacks of lateral cephalogram technique. High radiation exposure and cost are important limitations of this technique. Panoramic radiography provides information such as axial inclination of teeth, maturation phases and comprehensive view of surrounding tissue. This technique is used mainly because of its comparatively

low radiation exposure, patient's comfort and significant amount of diagnostic information which is attained by examining all the teeth and basal bone at once.^{4,9}

Measurements on panoramic radiographs have been called into question because of different methodological errors that includes distortion and magnification of images.⁴

Right and left side structures can be effortlessly visualized individually using orthopantomogram, cluding any overlapping or superimposing structures that helps in minimizing the methodological errors.⁴ The possible application of OPG for evaluating angular and linear measurements is being investigated using different parameters. In order to validate OPG as an assessment tool for identifying growth pattern there should be more parameters for determining the direction of growth and its reliability has to be checked.¹⁰

In this present study mandibular growth pattern was assessed with three angular and one linear parameter measured on orthopantomogram. The pretreatment orthopantomograms and lateral head films were categorized into three mandibular growth pattern based on SN-Go-Gn angle. The values obtained from angular and linear measurements on orthopantomogram and lateral cephalogram were compared.

In this study mandibular plane angle was measured between SN-Go-Gn in lateral cephalogram. Statistical significant difference was found in the vertical growth pattern (39.07 ± 1.86 degree) with $P < 0.001$ which is in line with the study done by Davidovitch et al where he found mandibular plane as a predictor to check for the divergence pattern of an individual. Significant statistical difference was found between G1, G2 and G3 ($P > 0.05$).⁶

Gonial angle represents the form of mandible² and also plays an important role in predicting growth, profile changes and the condition of the lower anterior teeth.¹¹ Studies have evaluated the association of gonial angle with mandibular divergence and investigated the integrity of gonial angle when measured on OPG and lateral cephalogram.^{4,7,8,11} It was shown that gonial angle is related with mandibular divergence and can be employed as a predictor of vertical growth pattern.^{12,13} These studies emphasized on the fact that gonial angle can be assessed on OPG as precisely as lateral cephalogram.^{4,7,8,11} The result obtained in this study showed result in accordance with the earlier studies. Gonial angle was highest for vertical growth pattern in OPG (130 ± 5.35 degree) and lateral cephalogram (129 ± 4.9 degree). There was a statistical difference between horizontal, average and vertical groups ($P > 0.05$). It can be deduced that OPG can be used to determine gonial angle as accurately as lateral head films.

Implant study has found that the prominence of deep antegonial notching is increased by the process of

bone deposition under the gonial angle.⁵ The presence of a deep mandibular antegonial notch is suggestive of reduced mandibular growth potential and a vertical mandibular growth pattern when analyzed on lateral cephalogram.^{14,15} In the present study, antegonial notch was highest for vertical growth pattern in lateral cephalogram (1.97 ± 1.01 degree) and OPG (1.70 ± 0.94 degree). Statistically significant difference seen between horizontal and vertical groups when evaluated in OPG.

Curvature of mandibular canal (CMC) reflects the initial shape of the mandible and curving of mandibular canal can differentiate horizontal and vertical growth pattern. The mandibular canal and the trabaculae related to it can be considered as stationary because they are not remodeled to the same amount as the outer surface of jaw. The curvature of canal tends to be more pronounced than the mandibular contour in vertical type of condylar growth that is in horizontal growth pattern.⁵ Comparison of mean mandibular canal curvature among three growth patterns in this study showed highest value for vertical growth pattern (158.96 ± 114 degree) in OPG. When measured on lateral cephalogram, the mean curvature of mandibular canal was high for both average (136 ± 3.17) and vertical (136 ± 3.59) growth pattern but statistically no difference was found between all three groups.

Forward or backward inclination of the condylar head is a distinguishing sign that can predict the direction of growth. Forward inclination of condylar head is presumed to be found in vertical growth pattern and backward inclination in horizontal growth pattern.⁵ Davidovitch highlighted that when there are changes in remodelling in localized areas of condyle, there can be differences in the direction and amount of condylar growth.⁶ This variation in the condylar growth can lead to slight differences in condylar inclination values in different skeletal groups.⁵ In the present study the mean inclination of condylar head was highest for horizontal growth mandibular growth pattern in OPG (165.73 ± 4.4 degree). The result obtained was contrast from the studies of Issacson et al, Herbert et al which suggested that condylar head is further forwardly inclined in hyperdivergent group and backwardly placed in hypodivergent group.¹⁶

According to Bjork, not all the morphologic characteristics would be found in a particular individual, but the greater the number of features present, the more accurate the prediction would be.⁵ There are various parameters which are used for predicting mandibular growth pattern using lateral cephalogram. An alternative method for predicting growth pattern using certain parameters on OPG has been investigated in this study. The accuracy of using OPG as an alternative tool for lateral cephalogram was analyzed using more number of parameters which makes the study more relevant. Based on the results obtained from the present study it is clear that certain parameters like gonial angle and

antegonial notch can be used for predicting different growth patterns and also the selected parameters can be evaluated using OPG.

Further longitudinal studies with more samples has to be done to evaluate the other parameters which is useful to assess the mandibular growth pattern in OPG.

VI. CONCLUSION

Evaluation of growth pattern carefully before the starting of treatment plays an important role in the long term success and reducing the risk of lapse in an individual. Various parameters should be used in a guarded fashion to enhance the Orthodontist's ability to predict the growth pattern. Different craniofacial parameters have been successfully used in the prediction of growth pattern using lateral cephalogram, though the reliable parameters used for the evaluation on growth pattern on Orthopantomogram is limited. The results of present study evaluating Bjork's indicators in different skeletal pattern on OPG and lateral cephalogram showed that gonial angle and antegonial depth can be used as reliable parameters for growth prediction. It can be concluded that certain parameters like gonial angle and antegonial notch can be used for assessing mandibular growth pattern using OPG.

Clinical Significance

Orthopantomogram which has been already in use for diagnosing several other conditions with its cost effectiveness can emerge as a useful assessment tool which has reduced radiation exposure and convenient for the patients in reducing the need for multiple radiographs for diagnosing and prediction of mandibular growth pattern in orthodontic cases.

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Apert Syndrome: Orthodontic - Surgical Treatment Alternatives and Execution Times. A Review of the Literature

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Abstract- Objective: Carry out a literature review about the orthodontic and surgical treatments of Apert Syndrome, during the different stages of growth and development.

Methods: A search was made in the MedLine (PubMed), Science Direct, Scopus, and Wiley Online Library databases with the combination of the following terms: Syndromic craniosynostosis; Dental treatment; orthodontic treatment; Apert Syndrome; surgical treatment; dental care. Types of the study included: Systematic and literature reviews, retrospective, longitudinal, and cohort studies, series, and case reviews that were published between 1990-2020 in Spanish or English; articles related to other syndromes and animal, or laboratory studies were excluded. The articles were selected according to relevance and availability of full text; repeated findings were eliminated; additionally, the snowball system was used in the selected articles; the quality of the evidence was evaluated using the GRADE system.

Keywords: *apert syndrome; orthodontic treatment; surgical procedures; dental care.*

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Apert Syndrome: Orthodontic - Surgical Treatment Alternatives and Execution Times. A Review of the Literature

Síndrome De Apert: Alternativas De Tratamiento Ortodóntico - Quirúrgico Y Tiempos De Ejecución. Una Revisión De La Literatura

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& Salomón Yezioro-Rubinsky ^ω

Resumen- Objetivo: Realizar una revisión de la literatura acerca de los tratamientos ortodónticos y quirúrgicos del síndrome de Apert durante las diferentes etapas de crecimiento y desarrollo.

Métodos: Se llevó a cabo una búsqueda en las bases de datos MedLine (PubMed), Science Direct, Scopus y Wiley Online Library con la combinación de los siguientes términos: *Syndromic craniosynostosis, Dental treatment, orthodontic treatment, Apert Syndrome, surgical treatment, dental care*. Se incluyeron revisiones sistemáticas y de literatura, estudios retrospectivos, longitudinales y de cohorte, series y revisiones de caso publicados entre 1990 y 2020 en español o inglés; se excluyeron artículos relacionados con otros síndromes, así como estudios en animales. Los artículos fueron seleccionados según su pertinencia y disponibilidad de texto completo; hallazgos repetidos fueron eliminados; adicionalmente, se utilizó el sistema bola de nieve en los artículos seleccionados; la calidad de la evidencia fue evaluada mediante el sistema GRADE.

Resultados: 34 artículos fueron incluidos (calidad alta: 2, moderada: 1, baja: 19 y muy baja: 12). Entre estos, se identificaron discusiones relacionadas con la etapa de crecimiento a la que se recomienda realizar los procedimientos quirúrgicos requeridos para minimizar sus impactos negativos. La mayoría de los artículos apoyan el manejo terapéutico ejecutado por equipos multidisciplinarios.

Conclusiones: Un plan de tratamiento combinado de ortodoncia y cirugía ortognática se presentó como la mejor opción para obtener los mejores resultados funcionales y estéticos para la población en cuestión. El momento adecuado durante el crecimiento y desarrollo de los individuos para implementar cada fase de tratamiento fue decidido por cada equipo multidisciplinario.

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Palabras clave: síndrome de apert; tratamiento ortodóntico; procedimiento quirúrgico; atención odontológica.

Abstract- Objective: Carry out a literature review about the orthodontic and surgical treatments of Apert Syndrome, during the different stages of growth and development.

Methods: A search was made in the MedLine (PubMed), Science Direct, Scopus, and Wiley Online Library databases with the combination of the following terms: *Syndromic craniosynostosis; Dental treatment; orthodontic treatment; Apert Syndrome; surgical treatment; dental care*. Types of the study included: Systematic and literature reviews, retrospective, longitudinal, and cohort studies, series, and case reviews that were published between 1990-2020 in Spanish or English; articles related to other syndromes and animal, or laboratory studies were excluded. The articles were selected according to relevance and availability of full text; repeated findings were eliminated; additionally, the snowball system was used in the selected articles; the quality of the evidence was evaluated using the GRADE system.

Results: 34 articles were included (High Quality: 2; Moderate: 1; Low: 19; Very Low: 12). Controversies were found related to the stage of growth to which it is recommended to perform the required surgical procedures to minimize the negative impacts. Most of the articles support therapeutic management by multidisciplinary teams.

Conclusions: A combined orthodontic and orthognathic surgery treatment plan was presented as the indicated option to obtain the best possible functional and aesthetic results for the population in question. The appropriate time during the growth and development of individuals to implement each treatment phase was decided by each multidisciplinary team.

Keywords: apert syndrome; orthodontic treatment; surgical procedures; dental care.

1. INTRODUCCIÓN

El síndrome de Apert es una anomalía congénita craneofacial de herencia autosómica dominante que se presenta en 1:65.000 casos de nacidos vivos (1). Su etiología se asocia con una mutación en el receptor 2 del factor de crecimiento de fibroblastos, la cual se encuentra en el cromosoma 10q26 en dos

codones adyacentes que codifican para serina(755TCG) y prolina(758CCT) (2).

Clínicamente, se caracteriza por presentar afectaciones sistémicas, craneomaxilares y funcionales como enfermedades cardiovasculares, obstrucción de vías respiratorias, sindactilia en ambas extremidades, hidrocefalia, craneosinostosis(3), turribrachicefalia(4), retrusión de la parte media de la cara, hipertelorismo y exoftalmia, así como alteraciones dentales y oclusales(3).

El marcado compromiso craneomaxilar, antes mencionado, implica que para su manejo debe disponerse de un equipo multidisciplinario que incluye, entre otras especialidades, neurocirujanos, cirujanos plásticos, cirujanos maxilofaciales y ortodoncistas. Los protocolos de manejo varían; mientras algunos autores señalan que el avance del tercio medio facial es conveniente realizarlo de manera temprana, otros argumentan que hacerlo de esta forma requiere procedimientos secundarios y algunas veces terciarios(5-7).

Es relevante determinar las consecuencias de las alternativas terapéuticas reportadas en la literatura y el momento de su implementación, poniendo a disposición una herramienta que oriente a los profesionales para decidir las alternativas de tratamiento y el mejor periodo para ejecutarlas (8). El objetivo del presente trabajo es realizar una revisión de literatura acerca de los tratamientos ortodónticos y quirúrgicos del síndrome de Apert durante las diferentes etapas de crecimiento y desarrollo.

II. MÉTODOS

a) Tipo de revisión: Revisión narrativa de la literatura

La búsqueda de artículos se efectuó en las bases de datos MedLine (PubMed), Science Direct, Scopus y Wiley Online Library. Se utilizaron combinaciones de los terminos MeSH *Syndromic craniosynostosis and Dental treatment, and orthodontic treatment y Apert Syndrome and orthodontic treatment, and surgical treatment, and dental treatment, and dental care*. Los tipos de estudio considerados fueron revisiones sistemáticas y de literatura, estudios retrospectivos, longitudinales y de cohorte, series y, por último, revisiones de caso.

b) Criterios de inclusión

- Artículos con fecha de publicación entre 1990 y 2020 en idioma inglés o español.
- Estudios que relacionen la edad del paciente con síndrome de Apert y las alternativas de tratamiento implementadas.
- Estudios que involucren pacientes con síndrome de Apert y que hayan recibido tratamiento, sin restricciones de edad.
- Estudios que enfoquen su tratamiento en el área de ortodoncia y cirugía oral y maxilofacial.

- Estudios que presenten el desenlace y consecuencia de la alternativa utilizada. Esto teniendo en cuenta recidiva, eficiencia y menor cantidad de intervenciones.

c) Criterios de exclusión

- Se excluyeron artículos que específicamente presentaran alternativas de tratamiento a otro síndrome asociado con craneosinostosis u otra forma de craneosinostosis.
- Se excluyeron estudios en animales o de laboratorio.

La selección de artículos se realizó en tres fases (Figura 1):

1. Observación de los títulos de los artículos, en relación con el objetivo de la revisión.
2. Análisis del resumen del artículo, en correspondencia con el objetivo y propósito de esta revisión.
3. Revisión y evaluación del artículo en su totalidad.

El estudio fue aprobado por el Comité de Ética de la Facultad de Odontología de la Universidad Nacional de Colombia (Resolución B. CIEFO-189-2020).

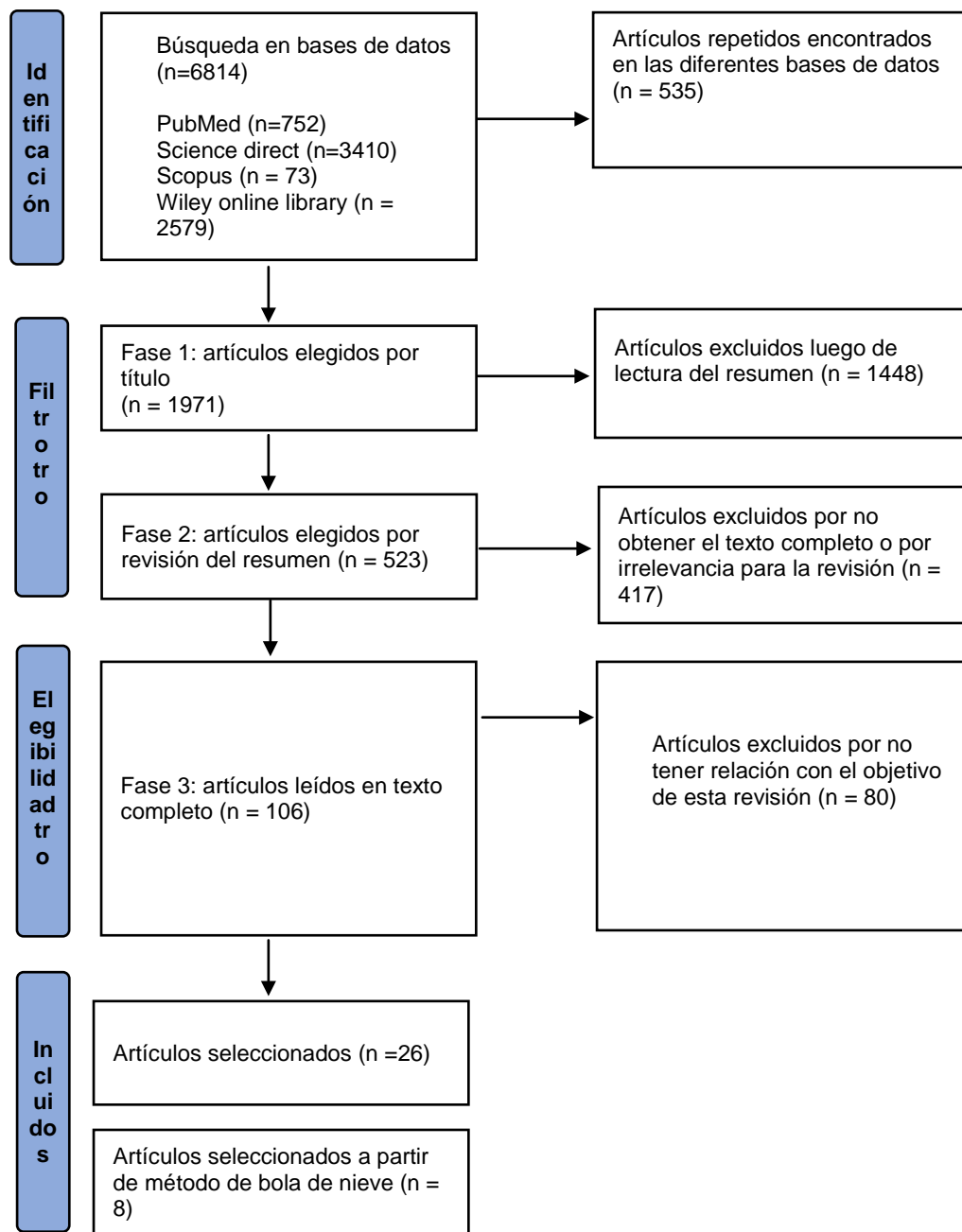
III. RESULTADOS

Fase 1: las búsquedas se efectuaron de acuerdo con combinaciones booleanas, para un total de 2.506 artículos. De estos, se excluyeron 535 por encontrarse repetidos.

Fase 2: de 1.971 artículos de la fase 1, se escogieron 523 que guardaban relación con el objetivo de este trabajo.

Fase 3: de los 523 artículos de la fase 2 se seleccionaron 106. Se descartaron 232, pues no aportaban de manera específica a la construcción de esta revisión y 185 porque no contaban con texto completo gratuito. Así, se leyeron 106 artículos en texto completo, de los cuales se excluyeron 80 por no tener relación con el propósito de la revisión. Finalmente, se escogieron 26 que sí cumplían los criterios de inclusión propuestos y se utilizó el método de bola de nieve. De ese modo, se realizó su revisión bibliográfica, lo que permitió encontrar ocho artículos adicionales.

El análisis de la calidad de la evidencia de los artículos seleccionados se ejecutó utilizando el sistema GRADE, mediante el cual se clasifica la calidad de la evidencia (9) (Ver Tabla 1). Para ello, en primer lugar, se toma como consideración inicial el diseño del estudio, para posteriormente incrementar o disminuir la calificación según otras variables metodológicas y sus resultados. Dos de los autores crearon una matriz de evaluación basándose en esta metodología; en caso de discrepancia, se procedió nuevamente a revisar el artículo por ambos autores hasta llegar a un acuerdo.



Fuente: elaboración propia.

Figura 1: Diagrama de flujo de búsqueda y selección de artículos

Resultados

Como resultado de la búsqueda fueron seleccionadas 2 revisiones sistemáticas, 5 estudios retrospectivos, 1 estudio de cohorte retrospectivo, 9 revisiones de literatura, 1 estudio tipo encuesta, 8 series de casos, 2 estudios de casos y controles, 1 estudio retrospectivo longitudinal, dos estudios longitudinales, dos reportes de caso y finalmente 1 estudio prospectivo (Ver Tabla 1).

De los artículos obtenidos, 1 se enfoca en las características anatómicas de la craneosinostosis, 5 en las características clínicas del síndrome y el tratamiento en odontología general, 3 en el desarrollo dental de

estos pacientes, 14 en el tratamiento quirúrgico, 2 en el tratamiento ortodóntico y 9 en un tratamiento integrado ortodóntico-quirúrgico (Ver Tabla 1).

Tabla 1: Tipos de estudio, enfoque y calidad de la evidencia

Tipo de estudio	Autor/año	Enfoque	Nivel de calidad de la evidencia
Revisión sistemática	Lopez-Estudillo <i>et al.</i> 2017 (10)	Características clínicas y tratamiento odontológico	Alta
	Saltaji <i>et al.</i> 2014 (11)	Tratamiento quirúrgico	
Estudio retrospectivo	Kaloust <i>et al.</i> 1997 (12)	Desarrollo dental	Moderada
	Letra <i>et al.</i> 2007 (13)	Características clínicas y tratamiento odontológico	Baja
	Allam <i>et al.</i> 2011 (14)	Tratamiento quirúrgico	
	Woods <i>et al.</i> 2015 (15)	Desarrollo dental	
	Wery <i>et al.</i> 2015 (16)	Tratamiento quirúrgico	Muy baja
	Oberoi <i>et al.</i> 2012 (17)		
Revisión	Vargevik <i>et al.</i> 2012 (18)	Tratamiento integrado	Baja
	Fadda <i>et al.</i> 2015 (19)	Tratamiento quirúrgico	
	Vilan-Xavier <i>et al.</i> 2008 (20)	Características clínicas y tratamiento odontológico	
	Hoyos <i>et al.</i> 2014 (21)		
	Ferraro <i>et al.</i> 1991 (22)	Tratamiento integrado	
	Prahl-Andersen 2005 (23)	Tratamiento ortodóntico	Muy baja
	Blount <i>et al.</i> 2007 (24)	Características anatómicas de la craneosinostosis	
	Panchal <i>et al.</i> 2003 (25)	Tratamiento quirúrgico	
	Azoulay <i>et al.</i> 2020 (26)	Tratamiento integrado	
Estudio tipo encuesta	Susami <i>et al.</i> 2018 (27)	Tratamiento ortodóntico	Baja
Series de casos	Fearon <i>et al.</i> 2013 (28)	Tratamiento quirúrgico	
	Carpentier <i>et al.</i> 2014 (29)	Tratamiento integrado	
	Posnick <i>et al.</i> 1995 (30)	Tratamiento quirúrgico	Muy baja
	Dalben <i>et al.</i> 2006 (31)	Características clínicas y tratamiento odontológico	
	Ko <i>et al.</i> 2012 (32)		
	Laure <i>et al.</i> 2015 (33)	Tratamiento quirúrgico	
	Ponniiah <i>et al.</i> 2008 (34)		
	Hohoff <i>et al.</i> 2007 (35)	Tratamiento integrado	Baja
Estudio de casos y controles	Khonsari <i>et al.</i> 2016 (36)		
	Glass <i>et al.</i> 2018 (37)	Tratamiento quirúrgico	
Estudio retrospectivo longitudinal	Shetye <i>et al.</i> (38)		Muy baja
Estudio longitudinal	Reitsma <i>et al.</i> 2014 (39)	Desarrollo dental	
	Meazzini <i>et al.</i> 2012 (40)	Tratamiento quirúrgico	
Reporte de caso	Shin <i>et al.</i> 2020 (41)	Características clínicas y tratamiento odontológico	Muy baja
	Miyazaki 2013 (42)		
Estudio prospectivo	Kahnberg <i>et al.</i> 2010 (43)	Tratamiento integrado	

Fuente: elaboración propia según Guía GRADE.

En síntesis, de acuerdo a López-Estudillo *et al.* (10), dos tipos de tratamiento se realizan en los pacientes con síndrome de Apert:

Tratamientos de soporte: estos incluyen los siguientes especialistas: pediatra, otorrinolaringólogo, ortopedista, neurólogo, psicólogo, fonoaudiólogo, cardiólogo pediatra, oftalmólogo y médico internista.

Tratamientos reparativos: estos abarcan procedimientos de neurocirugía, cirugía plástica y maxilofacial, cirugía correctiva de manos y pies, así como de tipo preventivo - restaurativos en odontopediatría y de ortodoncia.

a) Tratamiento quirúrgico del síndrome de Apert

Según Faddaet *al.*(19), el plan de tratamiento quirúrgico en el síndrome de Apert se divide en tres pasos:

Nacimiento – 2 años:

El tratamiento para la craneosinostosis implica una intervención quirúrgica que consiste en la expansión de la bóveda craneal. Las preocupaciones sobre el aumento de la presión intracraneal influyen en la decisión del momento y la estratificación de la intervención quirúrgica. La expansión de esta bóveda se puede lograr como un procedimiento en una o varias etapas. Hay defensores de cada técnica y ningún enfoque individual ha demostrado ser superior a otros de una manera significativa. La mayoría de los autores prefiere una descompresión anterior temprana con una craneotomía como procedimiento principal, seguida de una expansión de la bóveda craneal posterior (24). Si hay alteraciones graves en el bulbo ocular, a nivel respiratorio o cerebral, se realiza un primer procedimiento quirúrgico de manera temprana.

Periodo de crecimiento (hasta los 12 años):

Cirugía de avance del tercio medio facial

El proceso de avance del tercio medio facial va a consistir usualmente en:

- Bipartición facial y osteogénesis por distracción

Este procedimiento consiste en la división del hueso frontal del borde supraorbitario. Así, las órbitas y la parte media de la cara se liberan de la base del cráneo mediante una osteotomía monobloque. Posteriormente, se extrae un fragmento óseo de forma triangular de la línea media del tercio medio de la cara. La base de este segmento triangular se encuentra por encima de la órbita y el ápice se halla entre los dientes incisivos superiores. Después de eliminar este segmento, es posible rotar las dos mitades de la cara media una hacia la otra, lo que resulta en una reducción de la distancia orbitaria y, al mismo tiempo, permite la nivelación del maxilar. Igualmente, se efectúa el avance del tercio medio por medio de distracción osteogénica en un procedimiento llamado bipartición por distracción. Esto con el fin de normalizar la relación entre el borde orbitario y el globo ocular, además de normalizar la posición del hueso cigomático, la nariz y el maxilar en relación con la mandíbula (36).

Fin del crecimiento/edad adulta

- Cirugía LeFort II o III y osteotomía mandibular, para solucionar la maloclusión clase III y, en ocasiones, mordida abierta.
- En algunos casos se utiliza la distracción osteogénica.

Cirugías tipo Le Fort II o Le Fort III

Las personas con síndrome de Apert normalmente son intervenidas quirúrgicamente para la fase final, a la edad de 17 o 18 años. Generalmente,

primero las mujeres, ya que en ellas cesa el crecimiento más rápido que en los hombres; de esta forma, la capacidad de crecimiento óseo no estaría restringida por la formación de cicatrices ni la intervención quirúrgica como tal. Cuando este procedimiento quirúrgico se realiza de manera temprana se tiende a formar una cicatriz, que a futuro podría requerir cirugías adicionales. Por otro lado, se ha observado que cuando la cirugía se lleva a cabo tardíamente puede haber un riesgo de recidiva; por lo tanto, es necesario avanzar en el conocimiento de técnicas quirúrgicas que brinden mayor estabilidad a largo plazo (23).

b) Tratamiento ortodóntico del síndrome de Apert

El tratamiento de ortodoncia, idealmente, consta de dos fases: la primera en dentición mixta (preferiblemente mixta tardía) y la segunda en dentición permanente (18,27).

- *Primera fase:* preferiblemente entre los 8 a 9 años (27). Se realiza el movimiento de los dientes para la corrección del apiñamiento anterior, si existe, el manejo tanto de los dientes impactados, o su erupción ectópica, como de espacios y la mejora de la relación maxilomandibular. Esta se hace utilizando aparatos fijos o removibles, para lo que se suele usar comúnmente un expansor maxilar rápido o lento, una máscara de protracción maxilar o aparatos funcionales; la elección del aparato a utilizar será del ortodoncista encargado del caso. Este tipo de procedimientos se deben planear en conjunto con el cirujano, debido a que el solo tratamiento con estos aparatos, sin el acompañamiento quirúrgico, no tendrá los resultados esperados, especialmente en casos muy severos; es decir, casos en los que la anomalía afecta la función de forma grave y no pueden ser solucionados únicamente con tratamiento ortodóntico (18,27).

Es recomendable que el paciente tenga acceso a una valoración en ortodoncia mínimo a los 6 años, preferiblemente antes, pues se hace necesario un estudio adecuado sobre la edad en la que es más conveniente hacer una expansión maxilar, que debe ser consultada a su vez con el cirujano. Al respecto, Prah Andersen (23) recomienda que no debe ser realizada antes de la erupción de los caninos permanentes, para evitar daños en el germen dental, por lo que solo a partir de los 9 años, o un poco después, es recomendable efectuar la expansión quirúrgica maxilar. Esto como preparación para la futura distracción osteogénica en el plano sagital. Además, la expansión maxilar temprana reduce, pero no elimina la ocurrencia de impactación y apiñamiento dental, así como la necesidad de posteriores extracciones de los dientes permanentes maxilares (26). Por esa razón, no es primordial realizarla de manera temprana, a menos de que se evidencie la necesidad de hacerlo.

Si se realiza el avance de la mitad de la cara de manera temprana, se podría alterar el desarrollo de los dientes vecinos a los procedimientos quirúrgicos requeridos así como su formación, lo que ocasionaría la necesidad de procedimientos adicionales(27). Este hallazgo suele encontrarse en las yemas dentarias de los molares superiores, porque estas sufren lesiones causadas por el corte quirúrgico que debe ser ejecutado para el avance del tercio medio. Muchas veces esto provoca su erupción ectópica o anomalías en este diente, que según el estudio de Susami *et al.*(27) estuvieron presentes en el 58.3% de los casos después de la cirugía de avance del tercio medio facial.

- *Segunda fase:* preferiblemente entre los 14 a 15 años (27). En esta fase se hace el manejo de impactaciones dentales con exposición quirúrgica y tracción de dientes incluidos. Asimismo, se logra la alineación completa de los dientes con aparatos fijos tipo multibracket. En ocasiones se hace

necesaria la extracción de dientes y se requiere cirugía ortognática en pacientes que tengan problemas esqueléticos severos (18,27), por lo que también se evalúa la posibilidad de utilizar esta etapa como ortodoncia prequirúrgica (Ver tabla 2).

IV. DISCUSIÓN

El síndrome de Apert muestra características clínicas y orofaciales particulares que afectan especialmente el tercio medio facial; sin embargo, también compromete otras áreas como el cráneo, el cual se observa en forma de cono; además se exhiben manifestaciones oculares, orales y sindáctila de manos y pies (10). La literatura es consistente en estos hallazgos, con alta posibilidad de presentarse en los individuos afectados. Una característica que genera controversia es el retraso en la maduración dental de estos individuos en comparación con la población sin síndrome.

Tabla 2: Resumen de etapas de tratamiento y recomendación según el autor

TRATAMIENTO	EDAD	AUTOR/AÑO	NIVEL DE CALIDAD DE LA EVIDENCIA SEGÚN GRADE (9)	RECOMENDACIÓN
Corrección de la craneosinostosis (expansión craneal)	De 3 a 6 meses	Panchal <i>et al.</i> (25)	Muy baja	A esta edad se previene una mayor progresión de la deformidad y posibles complicaciones asociadas con aumento de la presión intracraneal.
	De los 6 a 12 meses	Allam <i>et al.</i> (14)	Baja	En este periodo no se ha demostrado que haya que realizarse una segunda intervención por refusión sutural.
	15 meses	Fearon y Podner(28)	Baja	Podría evitarse posteriormente la probabilidad de hacer una intervención secundaria.
Corrección de la sindáctila	13 meses	Oberoi <i>et al.</i> (17)	Baja	Dependiendo de lo incapacitante que sea la sindáctila, puede realizarse a esta edad.
	1 a 2 años	Prahl-Andersen (23)	Baja	Dependiendo de lo incapacitante que sea la sindáctila, puede llevarse a cabo en estos rangos de edad.
Avance fronto- orbital	4 a 6 meses	Allamet <i>et al.</i> (14)	Baja	La intervención temprana puede dar mejores resultados, para evitar el proceso de refusión sutural.
	6 a 12 meses	Oberoiet <i>et al.</i> (17)	Baja	La intervención ligeramente tardía puede dar mejores resultados.
Tratamiento ortodoncia primera fase	7 a 9 años	Vargeviket <i>et al.</i> (18)	Baja	Objetivos de tratamiento: corrección del apiñamiento anterior, manejo de dientes retenidos o erupción ectópica, mantenimiento de espacio y mejora de la relación maxilomandibular. Se requiere

				acompañamiento quirúrgico para obtener los resultados esperados.
Expansión maxilar quirúrgicamente asistida	9 años	Prahl-Andersen(23)	Baja	Se recomienda no realizar antes de la erupción de los caninos permanentes, con el fin de evitar daños del germen dental.
Avance del tercio medio facial	4 a 5 años	Letra <i>et al.</i> (13)	Baja	Edad adecuada para hacer este procedimiento, porque evita necesidad de traqueotomía.
	4 a 5 años	Prahl-Andersen(23)	Baja	El progreso y la sincronización con la distracción osteogénica va a depender de la obstrucción de la vía aérea que exista, el tipo de maloclusión y el estado psicológico del paciente.
	4 a 6 años	Posnick <i>et al.</i> (30)	Baja	Se debe realizar de manera temprana esta cirugía si el paciente sufre de apnea obstructiva del sueño o exorbitismo severo.
	4 a 6 años	Hoyos <i>et al.</i> (21)	Baja	Edad adecuada para recibir este procedimiento.
	5 a 9 años	Fearon y Podner(28)	Baja	Utilizando LeFort III con bipartición facial, la intervención posterior puede dar mejores resultados.
	6 años	Susamiet <i>et al.</i> (27)	Baja	Es deseable esperar a que este erupcionado el primer molar, pues se ha visto que esta cirugía temprana puede ocasionar daños en el germen dental.
	6 a 7 años	Allamet <i>et al.</i> (14)	Baja	Utilizando LeFort III con bipartición facial, la intervención a esta edad puede dar mejores resultados.
	9 a 12 años	Oberoiet <i>et al.</i> (17)	Baja	Recomendado a esta edad si las demandas funcionales no han dictado una intervención más temprana. Puede realizarse un avance suficiente para la cara de un adulto, evitando con ello repeticiones del procedimiento.
Tratamiento de ortodoncia en segunda fase	12 a 15 años	Vargevik <i>et al.</i> (18)	Baja	Se hace el manejo de retenciones dentales con exposición quirúrgica y erupción asistida por ortodoncia. Ortodoncia prequirúrgica y cirugía ortognática en pacientes con problemas esqueléticos severos.
LeFort III al final del crecimiento Osteogénesis por distracción Avance monobloque frontofacial	17 a 18 años	Prahl-Andersen(23) Koet <i>et al.</i> (32) Laureet <i>et al.</i> (33)	Baja	La capacidad de crecimiento óseo no estaría restringida por la formación de cicatrices ni la intervención quirúrgica como tal. Cuando la cirugía se realiza tardíamente puede haber un riesgo de recidiva.

Fuente: elaboración propia.

Considerando que tanto el diagnóstico como el manejo clínico de pacientes con anomalías craneofaciales no constituyen procedimientos rutinarios para la odontología general, es relevante actualizar a esta y otras disciplinas. Esto a través de la revisión de la literatura disponible acerca de los aspectos principales asociados con una adecuada atención ortodóntico-quirúrgica de los sujetos con síndrome de Apert. Al efectuar el análisis de calidad de la evidencia, según el método de GRADE (9), la mayoría de artículos resultaron de baja calidad, lo cual podría explicarse por la poca prevalencia que tiene el síndrome a nivel mundial y, asimismo, a la dificultad de realizar estudios prospectivos y aleatorizados (Ver Tabla 1).

Los hallazgos en cuanto al desarrollo dental de estos pacientes es relevante, porque permite elegir la alternativa de tratamiento más adecuada, aunque se encuentran algunos contrastes. Kaloust *et al.* (12), en su estudio retrospectivo, que examina las radiografías de 36 pacientes con este síndrome usando los métodos de Demirjian y Goldstein, concluyen que 31 de los 36 individuos tenían una edad dental inferior a su edad cronológica. Por otro lado, Reitsma *et al.* (39), en su estudio longitudinal, en el que cotejaron los cambios en la morfología de la arcada dentaria entre 28 pacientes con síndrome de Apert y 457 controles, evidenciaron que las dimensiones de la arcada dentaria eran menores en pacientes con síndrome de Apert en comparación con los sujetos de control.

Los dos estudios defienden la idea de que hay un retraso en el desarrollo dental en pacientes con este síndrome, mientras que Woods *et al.* (15), en su estudio retrospectivo, cuyo objetivo era cuantificar, mediante los métodos de Demirjian y Haavikko, el desarrollo dental en 26 pacientes con síndrome de Apert en comparación con controles emparejados, concluyeron que no hay diferencia en el desarrollo dental entre ambos. No obstante, siguiendo la guía GRADE (9), el estudio de Kaloust *et al.* (12) es de nivel de calidad moderado y está respaldado por el de Reitsma *et al.* (39), mientras que el de Woods *et al.* (15) es de calidad baja. Se debe considerar que la metodología empleada por el estudio de Kaloust *et al.* (12) es más rigurosa estadísticamente; por su parte, la de Woods *et al.* (15) tiene limitaciones por el pequeño tamaño de la muestra empleada.

La mayor controversia entre los autores es la relacionada con el tratamiento quirúrgico. Para la corrección de la craneosinostosis se proponen tres edades. Primero, Panchal *et al.* (25) afirman que de 3 a 6 meses; pero es una revisión que no evidencia la metodología utilizada; Fearon y Podner (28) plantean un tiempo de 6 a 12 meses, en su estudio de series de casos, que observó la evolución de 135 pacientes operados por un mismo cirujano durante 20 años; y, por último, Allam *et al.* (14) proponen 15 meses en su estudio retrospectivo, en el cual registraron la evolución de los procedimientos quirúrgicos de 35 pacientes a

largo plazo; todos estos estudios son de calidad baja según la guía GRADE (9).

Sin embargo, se puede concluir que, si la severidad del caso lo permite, es conveniente esperar entre los 12 y 15 meses para realizar este procedimiento, con el fin de evitar que se dé un proceso de fusión sutural y se tenga que llevar a cabo una segunda intervención. De igual manera, el avance fronto-orbital, como destaca Allam *et al.* (14), debe realizarse entre los 4 a 6 meses de edad; según Oberoi *et al.* (17), entre los 6 a 12 meses, de acuerdo a su estudio de cohorte, en el cual evaluaron los resultados después de terminar el tratamiento integrado de 8 pacientes con este síndrome. Hacerlo antes de los 6 meses, señalan Allam *et al.* (14), tuvo la ventaja de no presentar fusión sutural, mientras que Oberoi *et al.* (17) no especifican cuáles son las ventajas de llevarlo a cabo después de los 6 meses.

Con relación a la corrección de la sindactila, Oberoi *et al.* (17) y Pahl-Andersen (23), en su estudio tipo revisión, en el que expusieron las controversias en el manejo de las malformaciones craneofaciales, consideran que puede realizarse entre los 12 a 24 meses de edad; la priorización de este tratamiento dependerá de lo incapacitante que sea la sindactila. Entre mayor incapacidad le genere al paciente, más rápido debe efectuarse la cirugía.

Es relevante también que el paciente tenga atención por parte de la especialidad de ortodoncia en la etapa de 7 a los 9 años, o si es necesario antes (18), porque se pueden requerir procedimientos ortopédicos que ayuden a la protracción y expansión maxilar, haciendo uso de expansores maxilares rápidos y lentos. Se emplean expansores rápidos en pacientes con potencial de crecimiento, antes del cierre de la sutura media palatina, y lentos cuando este potencial se ha perdido, como mecanismos de anclaje de la máscara facial. Con relación a la expansión maxilar, Pahl-Andersen (23) recomienda realizarla solo después de la erupción de caninos permanentes, para evitar daños en el germen dental de este diente. Además, es importante reconocer que será una expansión quirúrgicamente asistida, ya que en la mayoría de los casos los pacientes presentan un cierre temprano de otras suturas como la palatina (35), y el procedimiento temprano de ortodoncia ayuda a mejorar la estética y la función del paciente, pero se hace necesaria una cirugía posterior para obtener los resultados esperados. Por otro lado, en esta etapa también se evaluará el desarrollo dental de estos pacientes, determinándose si existen agenesias u otras anomalías dentales, con el propósito de hacer una adecuada planeación a futuro que lleve al paciente a una oclusión adecuada.

Es necesario tener en cuenta que el tratamiento ortodóntico debe complementarse con las recomendaciones del equipo de cirugía a cargo, considerando la severidad del caso, pues suele ser

insuficiente el tratamiento ortopédico para corregir la alteración sagital maxilar. Por lo tanto, de común acuerdo entre ambas especialidades, se definirán los alcances de la expansión y la protracción maxilar, evitando que se vean comprometidos los procedimientos quirúrgicos posteriores, como el avance del tercio medio facial. La técnica quirúrgica más usada para este procedimiento es la osteotomía Le Fort III combinada con distracción osteogénica, debido a que tiene ventajas como la eliminación de la necesidad de injertos óseos, la posibilidad de un mayor avance, la reducción de requerir transfusiones y una estancia hospitalaria más corta (16).

Letra *et al.* (13), en su estudio retrospectivo, que analizó las características intraorales de 36 pacientes con este síndrome, y Prah Andersen (23) están de acuerdo en que el avance quirúrgico maxilar debe realizarse entre los 4 a 5 años. Con ello se evita la necesidad de una traqueotomía (13), lo que permite igualmente un mejor proceso de sincronización de la distracción osteogénica (23), que es la técnica quirúrgica con la que comúnmente se hace. Posnick *et al.* (30), de acuerdo a su estudio de series de casos de 21 pacientes, en el cual observaron los cambios en las mediciones intracraneales antes y después de los procedimientos quirúrgicos, y Hoyos *et al.* (21), en su revisión que no indica los métodos utilizados, reportan que es mejor realizarlo entre los 4 a 6 años; ellos consideran que si el paciente sufre de apnea obstructiva o exorbitismo severo, postergarlo puede afectar su desarrollo normal (30). Por otro lado, Allam *et al.* (14) y Susami *et al.* (27), en su estudio tipo encuesta, el cual analiza el tratamiento ortodóntico de estos pacientes en 46 clínicas de Japón, afirman que debe llevarse a cabo a los 6 años; realizarlo antes afecta el germen dental del primer molar maxilar, lo que provoca anomalías dentales tanto de forma, tamaño y posición, o erupción ectópica e impacta de forma negativa la oclusión del paciente (27). Fearon y Podner (28) recomiendan que debe hacerse entre los 5 a 9 años y Oberoi *et al.* (17) de los 9 a 12 años, y solo si las demandas funcionales no indican que tenga que realizarse de manera temprana. Hacerlo a esta edad se justifica, porque el desarrollo del tercio medio facial va a estar lo suficientemente avanzado, lo cual reduce la posibilidad de necesitar una segunda intervención quirúrgica.

Frente a lo anterior, es relevante considerar lo mencionado por Shetye *et al.* (44), en su estudio retrospectivo longitudinal, que examinó la estabilidad y el crecimiento esquelético del tercio medio facial a largo plazo (10 años) después del avance de Le Fort III en 192 pacientes. Los investigadores indican que hay una alta posibilidad de que esta intervención se tenga que repetir al terminar el crecimiento, porque la mandíbula continúa creciendo y eso hace que se dé una re-expresión de un perfil de clase III esquelética. Otra

opción de tratamiento sería esperar a que el paciente tenga la parte media de la cara lo suficientemente avanzada para realizar este avance, como lo menciona Oberoi *et al.* (17); pero si hay demandas funcionales que ameriten hacerlo de manera temprana, estas deben ser estimadas.

Existe acuerdo entre todos los autores respecto a que, posteriormente, es importante iniciar la segunda fase del tratamiento de ortodoncia entre los 12 a 15 años (18). En esta fase se lleva a cabo la alineación completa de los arcos maxilares, la exposición quirúrgica y la tracción de dientes incluidos y en algunos casos, cuando se necesite cirugía ortognática, se requerirá ortodoncia prequirúrgica para hacer la posterior cirugía de LeFort III al final del crecimiento, entre los 17 y 18 años (23). Se debe considerar que si se hace a una edad más temprana podría crearse una cicatriz que requeriría una cirugía adicional, según Prah Andersen (23).

De la misma manera, es significativo considerar la estabilidad de este tipo de cirugía; Saltaji *et al.* (11), en su revisión sistemática, la cual evalúa la estabilidad, a corto y largo plazo, de las estructuras óseas después del avance medio facial mediante osteotomía Le Fort III convencional frente a Le Fort III con distracción osteogénica, establecieron que si la cirugía LeFort III se realiza en conjunto con distracción osteogénica el resultado es estable a largo plazo.

En esta fase final también se puede hacer, indican Ko *et al.* (32), de acuerdo con su estudio de serie de casos, en el que investigaron el efecto del tratamiento y la estabilidad de la osteogénesis por distracción monobloque fronto-facial en 5 pacientes y Laure *et al.* (33), en su estudio de series de casos, que observó el avance monobloque frontofacial con craneoplastia frontal en tres adolescentes con huesos faciales adultos y deformaciones, una osteogénesis por distracción o un avance monobloque frontofacial respectivamente. Se debe considerar, sin embargo, que ambos estudios fueron calificados de calidad muy baja según la guía GRADE (9), y al ser estos de series de casos no podemos sugerir cuál sería la mejor opción. Pese a esto, de acuerdo a lo observado en la revisión, las técnicas que hacen uso de osteogénesis por distracción han demostrado dar mejores resultados a largo plazo de acuerdo con Saltaji *et al.* (11) y Meazzini *et al.* (40), en su estudio longitudinal, en el cual analizaron los datos de 40 pacientes por 10 años que fueron sometidos a osteogénesis por distracción.

En conclusión, la presente revisión de literatura evidencia que un plan de tratamiento combinado de ortodoncia y cirugía ortognática es la opción más indicada para obtener los mejores resultados funcionales y estéticos posibles para la población afectada por el síndrome de Apert. El momento adecuado del crecimiento y desarrollo para recibir cada fase del tratamiento será decisión del equipo

multidisciplinario tratante. A su vez, este trabajo refleja la necesidad de establecer estudios multicéntricos que generen publicaciones de alta evidencia científica, con protocolos de tratamiento consensuados que redunden en mejores resultados de tratamiento para la población afectada por el síndrome estudiado.

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Conflictos de interés

Los autores y las autoras de este artículo manifiestan no tener ningún conflicto de interés.

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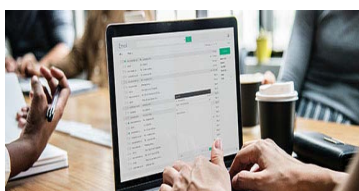
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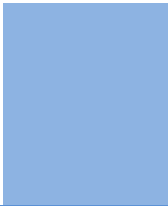
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Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.



Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

PREPARATION OF ELETRONIC FIGURES FOR PUBLICATION

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

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TIPS FOR WRITING A GOOD QUALITY MEDICAL RESEARCH PAPER

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of medical research then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.



20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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BY GLOBAL JOURNALS

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	C-D	E-F
<i>Abstract</i>	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
<i>Introduction</i>	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
<i>Methods and Procedures</i>	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
<i>Result</i>	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
<i>Discussion</i>	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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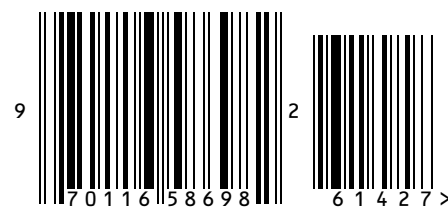
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