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Highlights

- Endoscopic Sinus Surgery
- Donka National Hospital in Conakry
- Obtrusive Syndrome of Apnea
- Analysis of Influence and Composition

Discovering Thoughts, Inventing Future

VOLUME 23 ISSUE 3 VERSION 1.0

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Orthodontics Intrication to Maxillo-Facial Surgery Preparation of Cases with Obtrusive Syndrome of Apnea

By Jean-Luc Pruvost

Introduction- Obstructive sleep apnea and its associated risk factors can now be more easily identified by specialists in the oro-facial zone, not only through clinical diagnosis but also with the help of new imaging tools such as CBCT or scanners. Orthodontists, who intervene at the intersection of the aero-digestive spheres, have long had an excellent diagnostic tool called Cephalometrics, which they systematically use on a daily basis. For this reason, they are best equipped to detect early morphological signs of possible apneas or indications that an individual may be prone to obstructive sleep apnea and/or hypopnea, and to recommend more specific examinations and consultations, including a Polysomnography.

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Orthodontics Intrication to Maxillo-Facial Surgery Preparation of Cases with Obtrusive Syndrome of Apnea

Jean-Luc Pruvost

I. Introduction

Obstructive sleep apnea and its associated risk factors can now be more easily identified by specialists in the oro-facial zone, not only through clinical diagnosis but also with the help of new imaging tools such as CBCT or scanners. Orthodontists, who intervene at the intersection of the aero-digestive spheres, have long had an excellent diagnostic tool called Cephalometrics, which they systematically use on a daily basis. For this reason, they are best equipped to detect early morphological signs of possible apneas or indications that an individual may be prone to obstructive sleep apnea and/or hypopnea, and to recommend more specific examinations and consultations, including a Polysomnography.

Fig. 1: KC cephalometric Xrays and analysis before and after Surgery showing Narrowness of the retro-basi-lingual area before surgery

This pathology is traditionally addressed with propulsive orthosis, which enlarges the retro-basi-lingual area but can also cause immediate discomfort to the TMJ and teeth, as well as chronic problems when used over the long term (such as slow mesialization of the entire mandibular denture and potential edge-to-edge occlusion for patients starting in CI1). Positive Pressure appliances (PPC) provide an immediate solution to the problem but are burdensome to support and can be embarrassing to wear in marital life.

For this reason, an increasing number of patients, mainly adults, are resorting to a more drastic and definitive solution that resolves this pathology in 90% of cases. This solution is called "bi-maxillary advancement surgery."

Based on many years of activity in the field of Maxillo-Facial Surgery related to Orthodontics, I have come to understand that major dysmorphosis are often complex and involve a combination of skeletal dysmorphosis and compensatory dental-alveolar changes. They are nothing more than a means of preserving the vital functional role of the masticatory apparatus. However, visualizing possible orthodontic and skeletal improvements that occur in 3D on two moving elements that depend on two delicate joints, the TMJ's, can be quite challenging.

In this context, the subject at hand is the management of the surgical puzzle assembly and its postoperative stability, particularly when significant expansion of the maxilla has been achieved. Focusing on this difficulty, I will present a protocol that allows for a functional and ideal occlusion in the postoperative period using a very precise interface with micrometric adjustments called ORTHOGNATOR®, which perfectly complements the Galetti articulator.

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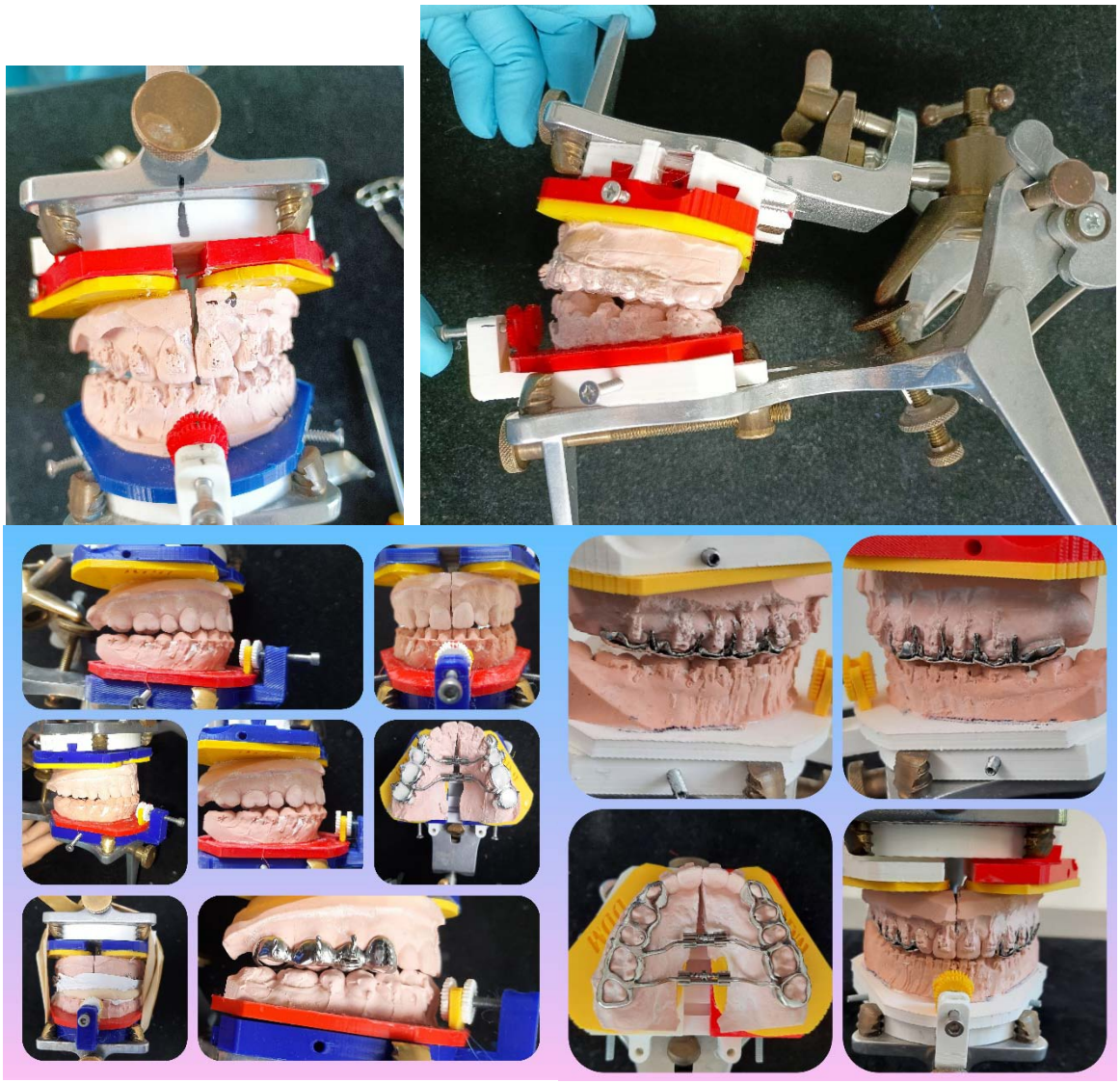


Fig. 2: Orthognator (the Multi colored appliance) and Maxillary dual-screw-expander: An interface to drastically improve the Galletti Articulator

A rigid protocol is necessary because Orthognathic Surgery should only be undertaken with a final resolution in mind that includes all the obligations imposed by our knowledge concerning periodontal longevity 7,8, occlusal stability, and facial harmony, to which smile and beauty contributes. These respond to a number of constraints that we will call our therapeutic envelope.

Fig. 3: The assembly of the puzzle, and on the right maxilla an additional osteosynthesis plate as an anchoring supplement. Surgery Jean-François Tulasne showing not only bone syntheses by plates but also intermaxillary grafting by bone transplants

In addition, treatments by lingual approach (often chosen by adults) presents, as everyone knows, particular difficulties. Some of these are related not only to the irregularity of lingual surfaces compared to vestibular surfaces, to access to the working area but also to the height of bondable enamel spaces. These are understood, at least in the maxilla, between the occlusion of the supporting cusps and the gingival cervical limit. When orthognathic surgery has to be linked to this type of orthodontic appliance (Lingual), the problem arises of the relationships of the appliance to the surgical per-operative anchorage (Surgical arches Fig5), and/or to the expansion infrastructures fig 2 and 4 and to the surgical guide (fig4).

The whole system representing superimposed layers Fig 4, which is a vector of possible errors. Moreover, this surgery often involves an intra-arcade modification: rapid palatal expansion aided surgically by a differential expansion gradient or even a three or four-pieces maxillary surgery linked or not to a mandibular displacement. The coherence of the whole system with regard to the final insertion of the surgical guide in the phase preceding bone synthesis is based on well-established protocols and suffers no "prosthetic" imprecision because each error will have a significant impact on post-operative orthodontic outcomes.

The ORTHOGNATOR© permits simulation of simultaneous transversal and rotative movements of the maxillary fragments, full rotative movement of each jaw for midline alignement as well as micrometric sagittal adjustment of the position of the mandible for overcorrection: each full turn of the dented wheel equal a ¼ of a mm. With the four vertical screws in the posterior area it permit also small adjustments of vertical and transversal tilts.

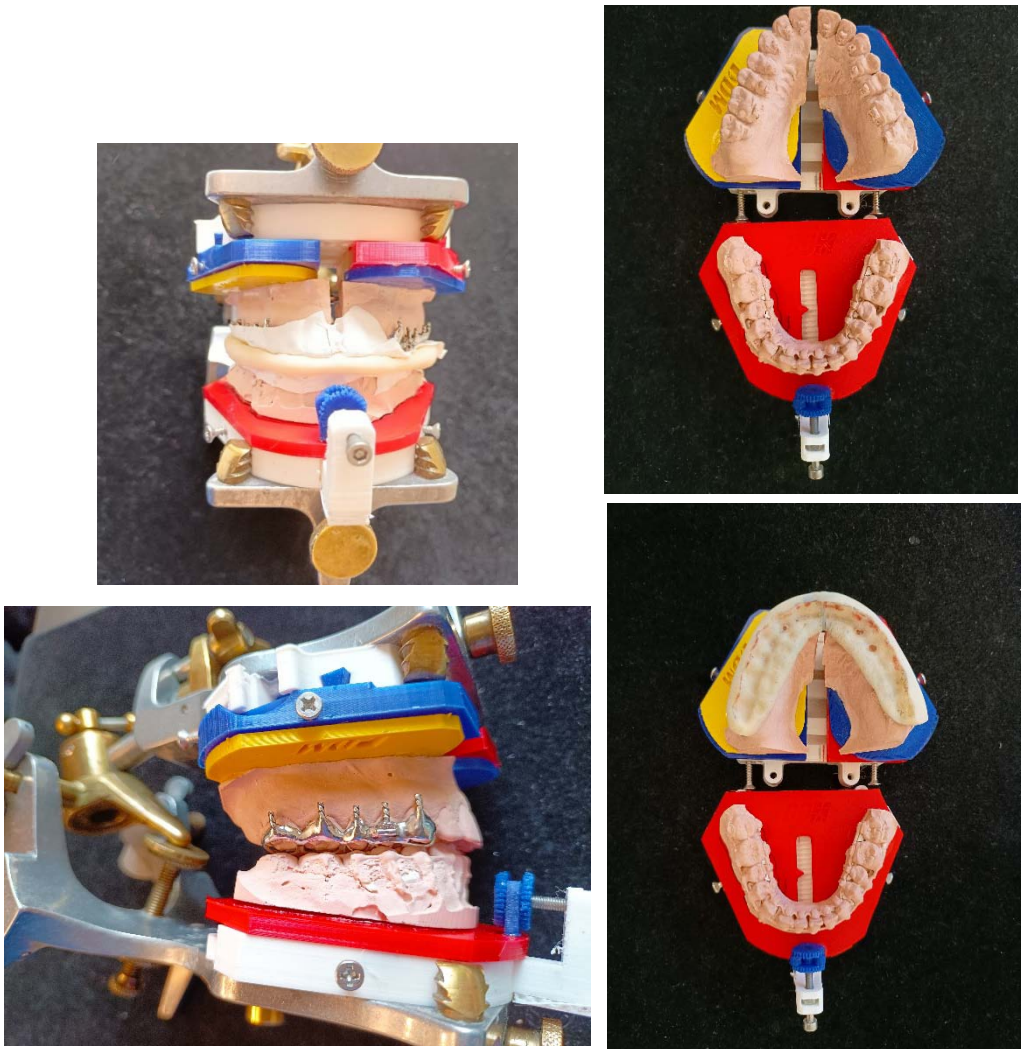


Fig. 4: Predictive assembly, simulation of a Cl3 case and then manufacture of a surgical guide consistent with maxillary expansion and sagittal over-correction, then balanced so that its per-operative insertion is indisputable

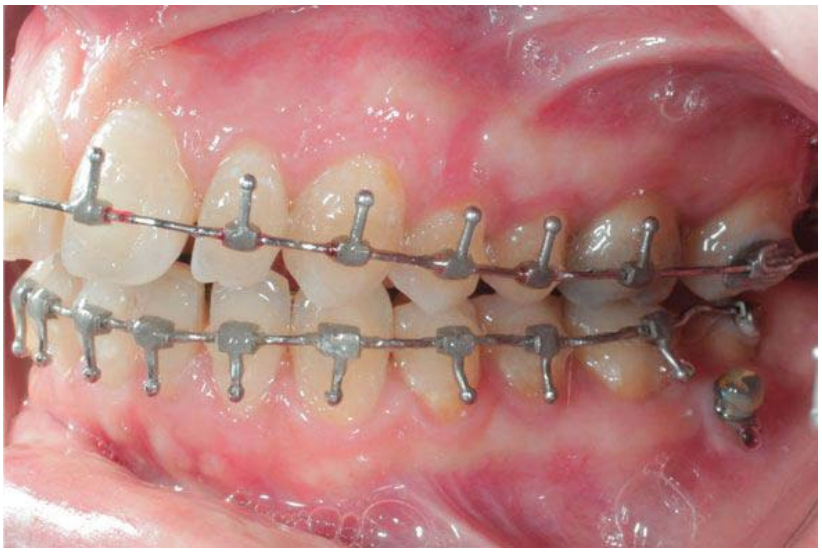


Fig. 5: TP Stainless Steel 19x26 surgical arcs with glued captive hooks for better hygiene away from embrasures, and Paracrestal screws placed as anchorage in the lower left and right quadrant of the mandible for control of the projection of the lower mandibular incisors during Lingual orthodontic preparation

Once these technical difficulties are solved, it is important to also achieve goals with respect to aesthetic finishing. In the case of Sleep Apnea Surgery, a significant advancement of both maxillae is necessary in order to pull the Hyoïd bone forward, thus increasing the retro-basi-lingual area. Our priority lies in understanding the implications on occlusion and the alignment of soft tissues. As a matter of fact, Eric Solyom, with whom I work routinely, consistently applies a counter-clockwise rotation of the maxilla whenever feasible. Placing the maxilla first is also a way to ensure a good exposure of the anterior teeth at rest, while speaking, and when smiling.

Fig. 6: Ideal Smile should show sufficient discovery at rest

Fig. 7: Ideal Smile should show sufficient discovery in a sketch smile

The analogy with prosthetics is very interesting because as dentists we know that every 1mm in excess in the posterior area creates a bite opening of 3mm in the anterior part of the mouth.

This is exactly what Dr. Solyom's technique does: it creates a huge prematurity that will oblige the mandible to rotate around in the second phase of surgery. Thus something which in turn demands an

extra sagittal lengthening of the horizontal branch of the mandible, 15 to 20 mm.

This technique has proven to be extremely efficient on the treatment of SAOS as many patients report. (most of them feel the first benefits in the awaking room). We also experienced excellent aesthetic result, amazingly in Cl3 hyperdivergent cases because the rotation of the mandible highly overcome its important lengthening.

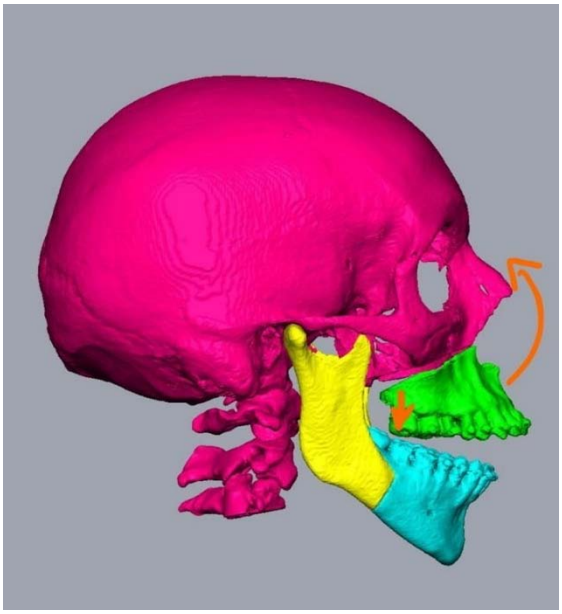


Fig. 8: Counter clockwise rotation of the maxilla induces secondary counter clockwise rotation of the mandible

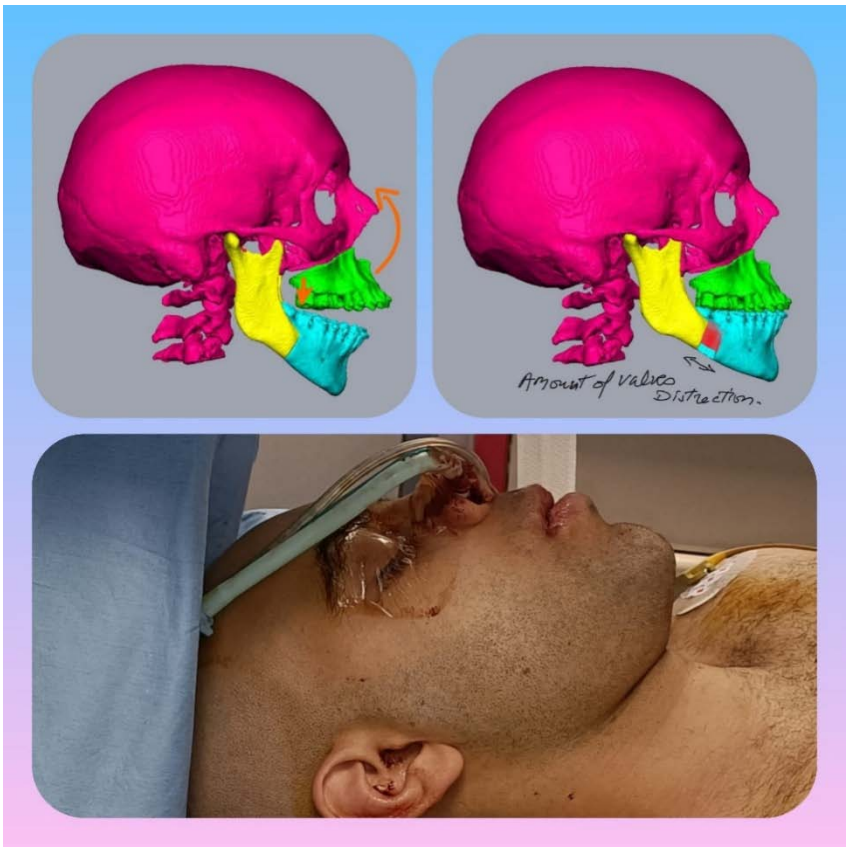


Fig. 9: Counter rotation of the maxilla by inducing secondary counter rotation of the mandible gives better volume to the chin avoiding genioplasty Surgery which is somehow destructive to the Genioglossus thus counter-productive as far as the cure to Apnea. Dr. Eric Solyom

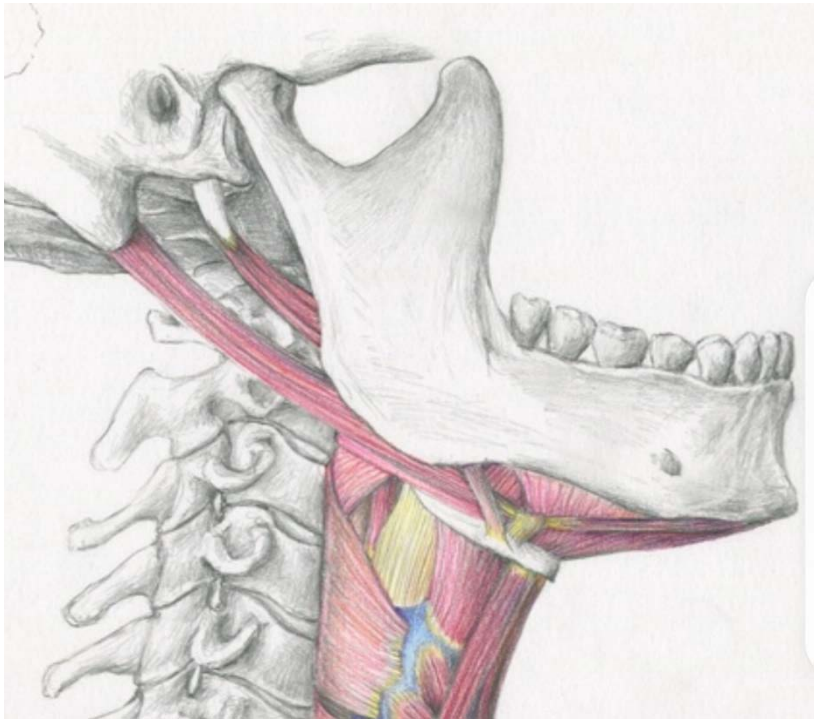


Fig. 10: The Genioglossus is the transmission "belt" to the advancement of the hyoid bone thus to the enlargement of the Retro-Basi-Lingual area or low Pharyngal area

II. Discussion

Counter clockwise rotation of the mandible has the secondary effect of enlarging the retro-basi-lingual aero-digestive crossway. This helps prevent airway natural tendency to collapse during unconsciousness, as the muscles of the airways tend to relax and the negative pressure from inspiration can exacerbate this collapse.

Traditionally, counter clockwise rotation of the mandible was avoided in mandibular bi-sagittal osteotomy due to concerns about creating an open bite. However, the use of Titanium Osteosynthesis plates with proper compensation, such as temporary posterior disocclusion provided by the surgical guide established on the ORTHOGNATOR©, has demonstrated the ability to overcome this previously feared side effect.

Despite its potential to reduce the effect of surgical mandible retraction on the retro-basi-Lingual area of prognathic cases, there are several morphological contraindications to this procedure. One such contraindication is a prominent but wide symphysis, for which chin reduction is not a favorable aesthetic option. This becomes more problematic in normo-divergent and hypo-divergent Class III cases as it accentuates the concavity of the profile, resulting in an older appearance.

Excessive torque or proclination of the upper incisors can also be a contra-indication or a serious complication when using the counter-clockwise rotation technique for the maxilla, as it can further increase the apparent torque or proclination of the upper incisors. Space is needed to reduce this apparent torque in the maxilla, and while distalization with bony anchorage is a viableoption, it can be a time-consuming procedure. Another approach, if necessary and feasible, is to expand the anterior portion of the maxilla to flatten it and reduce the flaring of the incisors.

The rapid expansion of the anterior part of the maxilla poses a delicate issue due to concerns about losing the height of the median papilla. This is a recurrent problem reported by many colleagues, but in my practice, it is not an issue thanks to the cast piggyback Chrome-Cobalt dual-screw-expander©, which offers a solution to address this concern.

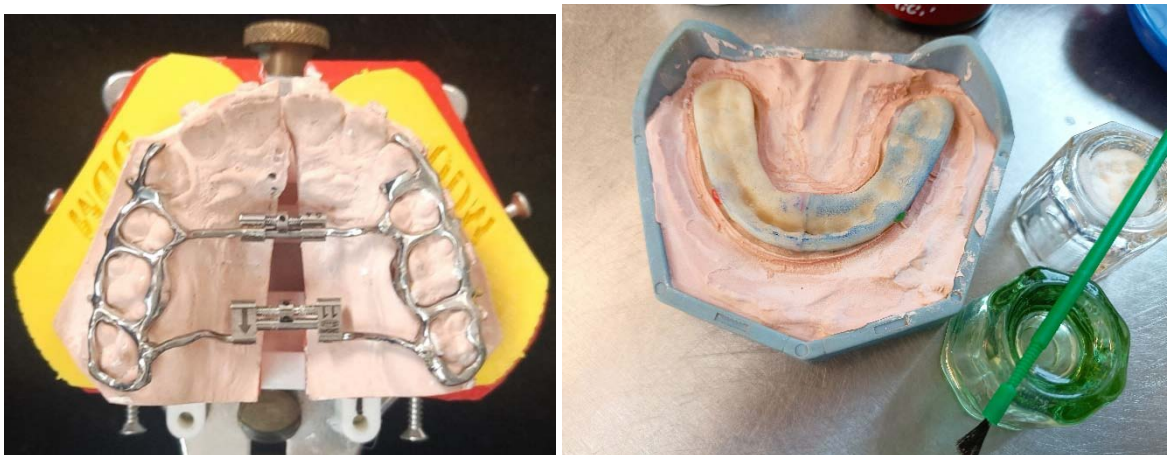
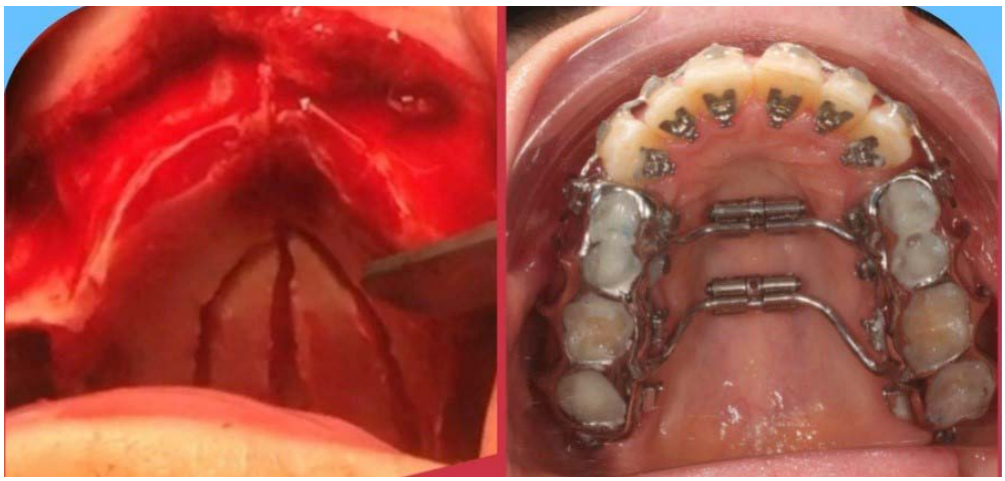


Fig. 11: A: Cast Chrome Cobalt Dual-screw-rapid expander© permits very precise opening gradients of the palatal vault without damage to the medial papilla. B: Prospective or final surgical guide equilibrated by half arches are subsequently recomposed on a plaster key



A B

Fig. 12: A: Nasal fossae and open sinus views of Maxillary 4 pieces osteotomies in closed bird wings giving flexibility to the palatal vault thus avoïding tearing of the palatal mucosa. B Oral palatal view of the Piggy back Chrome-Cobalt dual-screw- expander

i. The Dual-Screw-Expander was devised in my office in 1987

A

B

C

D

E

F

G

H

Fig. 13: Integrity of the median papilla is preserved with the expansion controlling device. (A to B) Oclusal finishing in lingual Technique (C to E) Centering of the midlines on the face (F to G)

On a young person it is important for the long term to show a little amount of gum line (G)

Finally the real contra-indication or the serious complication to such surgery happens when patients needing surgery for correction of ASOS also present a serious anterior vertical deficiency[6] In these types of cases only extensive-intermaxillary grafts could solve the problem.

III. Conclusions

In order to achieve precision and stability in cases of expansion linked to the cure of Sleep Apnea, surgical orthodontic prosthesis is crucial in this complex surgery. It effectively addresses the challenges posed by the powerful connective tissue and elastic fibers of the palatal mucous mantle, which often lead to transverse relapse. Additionally, this procedure allows for bimaxillary surgery to be performed in a single operative time, providing reliability and operative comfort that Maxillo-facial-surgeons have acknowledged, regardless of whether it involves a simple or differential palatal expansion.

In the context of SAOS (Sleep Apnea and Obstructive Syndrome), surgery often becomes a priority due to health concerns. The combination of a Cast Chrome Cobalt dual screw Rapid expander© and the "Orthognator©" tool offers a precise approach for implementing a "surgery first" protocol and managing the aesthetic zone while preserving the delicate gingival tissue, which is challenging to regenerate. Moreover, this protocol enables an assessment of the anterior vertical dimension, which directly impacts the smile.

Compared to the difficult mastery of the virtual aspect and program control in the Workflow technique, as well as the challenges of transferring the results to a solid articulator, the Orthognator© provides a more tangible approach. It allows the practitioner to maintain direct control over the intricate "Puzzle" assembly, including over corrections and relapse simulations that are challenging to convey to a lab technician. By keeping the practitioner closely connected to the surgical reality and its outcomes, the Orthognator© facilitates a concrete approach.

Significant improvements can be observed, such as the unfolding of the labio-mental fold and naso-genien grooves resulting from maxillary advancement. Additionally, there is improved lip support and eversion of the vermillion zone due to better alignment between the incisal border of the upper anterior teeth and the lower lip. When palatal expansion is required in many cases, the use of a bi-expander and of the Orthognator© to model the desired outcome ensures precision, stability, and surgical comfort, leading to a significantly improved prognosis, despite the challenges similar to those encountered with a large prosthesis.

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The Role of Classification of Endoscopic Sinus Surgery in Surgical Planning

By Dr. Nanda Kishore G., Dr. Satish Chandra Tripuraneni, Dr. Sravanthi K. K. & Dr. Sameera G

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Abstract- Endoscopic sinus surgery being an approach, there is no proper classification system to address the extent of surgery required for Sinonasal pathologies. The current study attempts to propose and evaluate the role and efficacy of a classification system for endoscopic sinus surgery in addressing various Sinonasal and skull base pathologies.

Materials and methods: It's a prospective study that included 50 patients. We classified ESS into six types based on the extent of surgery. After thorough evaluation, depending on the extent of the disease, all 50 patients were planned and treated according to the classification. Patients were followed for one year.

Keywords: endoscopic sinus surgery, sino nasal pathologies, CRS, ESS.

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The Role of Classification of Endoscopic Sinus Surgery in Surgical Planning

Extent of Surgery for Sino Nasal Pathologies

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Abstract- Endoscopic sinus surgery being an approach, there is no proper classification system to address the extent of surgery required for Sinonasal pathologies. The current study attempts to propose and evaluate the role and efficacy of a classification system for endoscopic sinus surgery in addressing various Sinonasal and skull base pathologies.

Materials and methods: It's a prospective study that included 50 patients. We classified ESS into six types based on the extent of surgery. After thorough evaluation, depending on the extent of the disease, all 50 patients were planned and treated according to the classification. Patients were followed for one year.

Results: The average symptom score improvement was 95.6 % in all the 50 patients we treated. Only in 2 cases, we deviate from the pre-planned procedure.

Conclusion: So, the current study with the analysis of the technique and results, supports this classification of endoscopic sinus surgery into six types can be helpful but may require a multi-center study for further evaluation.

Keywords: endoscopic sinus surgery, sino nasal pathologies, CRS, ESS.

I. Background

Functional endoscopic sinus surgery is a concept to approach sinus pathology, although the term was coined by Kennedy in 1985, It came into existence through the pioneering work of Messerklinger and Stammberger in 1978. It is the primary treatment modality inchronic rhinosinusitis patients who failed with maximal medical therapy. The FESS technique is based on the hypothesis that the osteomeatal complex (OMC) is the critical area in the pathogenesis of chronic rhinosinusitis. The removal of mechanical obstruction in the OMC area leads to proper ventilation, drainage, and resolution of secondary mucosal changes without touching the mucosa in these sinuses.

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The term FESS is generalized and applied to any technique used to treat Sinonasal pathology irrespective of the group of sinuses involved, the extent of the disease, and even the type of the pathology.Furthermore, contemporary surgeons, following the work of the pioneers of rhinology, expanded the limits beyond the nose and paranasal sinuses with a nasal endoscopic approach to treat. Areas of the skull base were also accessed and different types of procedures amenable to this approach revolutionized the field of endoscopic sinus surgery. However, there is a lack of a standardized classification system that accurately describes the procedure to be performed. The surgical technique needs rationalization which helps in individualizing the technique for documentation and for comparing the results and outcome. This study attempts to propose and evaluate the role and efficacy of the classification system for endoscopic sinus surgery in addressing various Sinonasal and skull base pathologies. The classification is based on the symptoms, clinical findings, diagnostic nasal endoscopy, and CT scan findings. In this study, we want to standardize the surgical steps required for addressing the specific pathology and anatomical variations with maximal benefit and minimal alteration of the mucociliary clearance pathways

II. Methods

This is a prospective study performed in a tertiary care center. The present study includes the evaluation of 50 cases of endoscopic sinus surgery with a follow-up period of one year. The study group constituted of patients with Sino-nasal pathologies who required surgical intervention.

Ethical approval: This is an observational study. The institutional ethics committee has confirmed that no ethical approval is required.(Ref: 33/IEC/20)

Informed consent: Written informed consent of patients was obtained following a detailed explanation that their data will be used for publication purposes. We haven't performed any new procedure only used the data obtained from their treatment process.

Inclusion criteria: Patients of age (5-70 years) and both sexes with various Sinonasal and skull base pathologies who require ESS were included.

All the patients were evaluated clinically, endoscopically, and radiologically. Based on these clinical, endoscopic, and radiological findings the type of endoscopic sinus surgery to be done is decided. Further by correlating the intraoperative findings with the preoperative findings any deviation from the predecided type of surgery was documented.

The classification system for ESS adopted was:

Type 1

Septoplasty+/-, partial uncinectomy, middle meatal antrostomy, with or without concha bullosa reduction

Possible indications: Localised maxillary antrum disease – cysts/polyps, Antro choanal polyp, Fungal ball in the maxillary antrum

Type 2

Type 1 plus bullectomy, ethmoidal clearance anterior to basal lamella, frontal

Clearance (including Draf 1 and 2 – endoscopic frontal sinusotomy)

Indications: Isolated frontal, anterior ethmoidal, and maxillary disease, Frontoethmoidal mucocele/pyocele, Frontoethmoidal Osteomas

Type 3

Type 2 plus opening basal lamella, posterior ethmoidal cell clearance with or without Sphenoidotomy.

Symptoms Distribution

Indications: Sinonasal polyposis, Allergic fungal sinusitis, Pan sinusitis

Type 4

Type 3 plus skull base/lamina identification with mucosal stripping, with or without Draf 3 procedure

Indications: Extensive Sinonasal polyposis, Fungal rhinosinusitis, Benign tumors

Type 5

Nonsinus disease

As an approach

Normal nasal and sinus anatomy

Indications: Endoscopic dacryocystorhinostomy, Skull base surgeries, Juvenile nasopharyngeal angiofibroma, Orbit and optic nerve decompression, Pituitary lesions

Type 6

Revision surgery

Indications: Recurrent disease, Distorted anatomy, Mucociliary disorders, Malignant tumors

III. Observations and Results

A total of 50 patients with various Sino nasal pathologies were included. Of the 50 patients, 33 had bilateral disease and 17 were with unilateral disease so finally making a tally of 83 sides.

Table 1

Symptom	Number of patients	Percentage
Nasal obstruction	46	92
Nasal discharge	41	82
Postnasal drip	35	70
Headache/Facial pain	43	86
Epistaxis	4	8
Disturbance of smell	18	36
Swelling/Deformity	3	6
Snoring	12	24
Change in speech	8	16

Table 2: Distribution of pathology in different sinuses

Pathological findings	Number of sides (/100)
Maxillary sinus	
Mucosal thickening	35
OMC block	15
Sinonasal Polyps	4
Allergic Fungal rhinosinusitis	5
Retention sinusitis	12
Antro choanal polyp	4
Sinonasal tumor	1
	Total -76
Anterior ethmoid sinus	
Mucosal thickening	37

Sinonasal polyposis	16
Allergic Fungal rhinosinusitis	5
Sinonasal tumor	1
	Total – 59
Posterior ethmoids	
Mucosal thickening	16
Sinonasal polyposis	16
Allergic Fungal rhinosinusitis	5
Sinonasal tumor	1
	Total – 38
Frontal sinus	
Mucosal thickening	29
Sinonasal polyposis	4
Allergic fungal rhinosinusitis	4
Air fluid level	12
Sinonasal tumor	1
	Total -50
Sphenoid sinus	
Mucosal thickening	14
Sinonasal polyposis	4
Allergic Fungal rhinosinusitis	4
Air fluid level	15
Sinonasal tumor	1
	Total - 38
Polyps	
Sinonasal polyposis	4
Ethmoidal polyposis	12
Antro choanal polyp	4
Allergic Fungal rhinosinusitis	4
	Total - 24
Sinonasal tumor	1

A total of 83 diseased sides were identified. Maxillary sinus involved in 76 sides. The unilateral disease was seen in 17 patients and bilateral disease in 33 patients. Fungal sinusitis was seen only on 5 sides. Bilateral Fungal rhinosinusitis was seen in 2 patients accounting for 4 sides. Unilateral fungal sinusitis involving maxillary and ethmoids is seen in one patient. Other unilateral diseases are Antro choanal polyp (4), odontogenic maxillary sinusitis (4), CSF rhinorrhoea (2), inverted papilloma (1), and chronic rhinosinusitis (5). Two patients are with extensive Sinonasal polyposis accounting for 4 sides. Bilateral ethmoidal polyps were seen in 6 patients. The remaining 23 patients are having bilateral pansinusitis.

Surgical Management: Planned Type

Table 3: Distribution of various Sino nasal pathologies under types of ESS

Type & indication	Unilateral	Bilateral	total
Type 1			
Antro choanal polyp	2		
Odontogenic maxillary sinusitis	4		
Isolated OMC block	2	2(4)	
Isolated maxillary sinusitis	2	3(6)	20
Type 2			
Anterior group sinusitis	1	10(20)	21
Type 3			
Fungal sinusitis	1		
Ethmoidal polyposis		6(12)	
Pan sinusitis		6(12)	25
Type 4			
Inverted papilloma	1		
Extensive Sinonasal polyposis		2(4)	
Allergic fungal rhinosinusitis		2(4)	9
Type 5			
CSF rhinorrhoea	2		2
Type 6			
Recurrent Antro choanal polyp	2		
Recurrent pansinusitis		2(4)	4

Type of ESS Performed

Table 4: No. of patients under different types of ESS performed

Type	No. of sides	Unilateral	Bilateral	Percentage
Type 1	18	8	5(10)	21.6
Type 2	23	3	10(20)	27.7
Type 3	25	1	12(24)	30.1
Type 4	9	1	4(8)	10.8
Type 5	2	2		2.40
Type 6	6 Total -83	2 Total - 17	2(4) Total - 33	7.22

The deviation from the planned type was seen between type 1 and 2, i.e., two sides with unilateral disease that were originally under type 1 are converted to type 2.

Surgical Outcome

Table 5: Preoperative & postoperative symptoms- the percentage of improvement

Symptom	Pre-op percentage	Post-op percentage	Percentage improvement
Nasal obstruction	92	2	97.8
Nasal discharge	82	6	92.6
Postnasal drip	70	10	85.7
Headache / facial pain	86	4	95.3
Snoring	24	0	100
Change in speech	16	0	100
Disturbance of smell	36	2	94.4
			Average improvement – 95.1

The overall subjective improvement of 95.1% was seen regarding the symptoms. With respect to specific symptoms, improvement was noted in 85 to 100% of individuals. The greatest improvement was seen among patients with nasal obstruction accounting for about 97.8 %

The post-operative endoscopic results showed a patent maxillary ostium in 81 cases out of 83 sides performed. There was a circumferential narrowing of the maxillary ostium on two sides in which type 1 surgery was performed. This was due to the encroachment of anterior ethmoidal cells. There was mucosal edema around the frontal ostium on 4 sides, of which 2 were under type 2 and 2 were under type 3. Polyps were present in the maxillary sinus cavity on 5 sides, two were under type 3 and 3 were under type 4. Polyps in the anterior ethmoids were on 4 sides, two were under type 3 and two were under type 4 which are also the same in posterior ethmoids. Mucosal edema in the ethmoids was present on 6 sides, 2 were under type 3 and 4 were under type 4. The sphenoid ostium showed mucosal edema on two sides under type 3. In both type 5 and 6, endoscopies were unremarkable.

a) *Percentage improvement for different types*

Table 6: Outcome in different types of ESS

Type	Planned	Performed	Successful outcome	Percentage of success
1	20	18	16	88.8
2	21	23	23	100
3	25	25	25	100
4	9	9	9	100
5	2	2	2	100
6	4	4	4	100

IV. Discussion

The primary objective of FESS is to re-establish the physiological pattern of ventilation and clearance. The osteomeatal complex (OMC) and sphenoethmoidal recess (SER) are often the primary targets. In treating CRS, the basic concept of FESS should always be adhered to, i.e., to remove the diseased mucosa and bony septa in the vital areas (OMC, SER) with preservation of normal tissue and widening the true natural Ostia. Uninvolved sinus should be left alone. More extensive surgery may be necessary for complicated rhinosinusitis, extensive fungal or polyp disease, and tumors. Each patient should be individually assessed to determine the site of pathology and obstruction, and surgery is tailored to address them[1].

In this regard, we want to establish a classification for functional endoscopic sinus surgery based on the clinical, endoscopic, and CT scan findings to accurately determine the extent and type of pathology.

One such attempt was made byPanje and Anand[2,3], in 1993 who developed a classification system for CRS based on the preoperative extent of sinus disease as determined by CT imaging.

Type 1: Uncinectomy with or without agger nasi exenteration

Type 2: Uncinectomy, bulla ethmoidectomy, removal of the sinus lateralis mucous membrane, and exposure of the frontal recess or frontal sinus.

Type 3: Type 2 plus maxillary sinus antrostomy through the natural sinus ostium

Type 4: Type 3 plus complete posterior ethmoidectomy

Type 5: Type 4 plus sphenoidotomy and stripping of the mucous membrane

In 2013, the Japanese Rhinologic Society proposed a simple classification for endoscopic sinus surgery (ESS)[4]. This classification consists of five procedures

Type I: Fenestration of the osteomeatal complex, with uncinectomy and widening of the natural ostium;

Type II: Single-sinus procedure, with manipulating the inside of the sinus;

Type III: Polysinus procedure;

Type IV: Pan sinus procedure;

Type V: Extended procedure beyond the sinus wall).

The classification proposed in the current study is

A formal septoplasty was done whenever endoscopic access to the middle meatus is difficult irrespective of the type of surgery performed.

Type 1

Extent: uncinectomy and middle meatal antrostomy with or without concha bullosa reduction

Indications: Antro choanal polyp, odontogenic maxillary sinusitis, chronic rhinosinusitis (isolated maxillary sinusitis).

The disease in the above conditions is mainly confined to the infundibulum. Resection of the uncinate process and widening the natural ostium of the maxillary sinus by removing the mucosa in the fontanelle anteriorly and inferiorly is sufficient to remove this mechanical obstruction without touching the adjacent structures. In patients with an Antro choanal polyp which usually comes out through the accessory ostium, removing the uncinate process and joining the accessory and natural ostium must be sufficient to provide proper ventilation. In the current study, the results of more than 92% cure rate have been proved that. Daniel Simmen et al[5] suggest infundibulotomy (partial uncinectomy) with or without maxillary sinusotomy for the above pathological conditions.

Type 2

Extent: type 1 plus bullectomy, ethmoidal clearance anterior to the basal lamella, frontal clearance including endoscopic frontal sinusotomy (Draf 1 and 2) procedures.

Indications: Isolated anterior group sinusitis, frontal recess disease. The technique includes uncinectomy, middle meatal antrostomy, ethmoidal clearance anterior to the basal lamella, removal of Haller cells, and frontal recess surgeries (Draf1 and 2 frontal sinusotomies). The patients with isolated frontal sinusitis, combined maxillary and frontal sinusitis, anterior group sinusitis, and Frontoethmoid mucocele, Osteomas are included. In these cases, in addition to clearing the disease from the maxillary sinus drainage pathway, the ethmoid air cells anterior to basal lamella are addressed with bullectomy, removal of Haller cells where they encroach upon the posterior part of the maxillary ostium to create wider antrostomy. The block in the frontal recess is cleared by addressing the agger nasi, frontal cells, and mucosal disease. As the drainage pathways for the anterior and posterior groups of sinuses are different, removing the mechanical obstruction and addressing the anatomical variations contributing to the disease process in these sinuses is sufficient without touching the uninvolved posterior group. In the current study, the postoperative success rate of 100% for type 2 fess supports this. Daniel Simmen et al[5] suggest that frontoethmoidectomy with or without frontal sinusotomy for patients with frontal sinusitis, mucocele, osteoma, and partial anterior ethmoidectomy for isolated anterior ethmoid and or maxillary/frontal sinus disease.

Type 3

Extent: type 2 plus ethmoidal clearance posterior to basal lamella and sphenoidotomy

Indications: fungal rhinosinusitis, ethmoidal polyposis, chronic rhinosinusitis involving all sinuses

In type 3, the technique includes uncinectomy, MMA, anterior ethmoidectomy, frontal recess surgery, posterior ethmoidectomy, and sphenoidotomy. The patients with pansinusitis, bilateral ethmoid polyposis with retention sinusitis, and allergic fungal sinusitis are included. This technique is aimed at reversible mucosal changes in paranasal sinuses because of the poor ventilation, creating wider sinusotomies, and removing the mechanical obstruction without radical stripping off all the mucosa is sufficient for proper ventilation, drainage, and resolution of secondary mucosal changes. In the current study, postoperative results of 100% support our classification.

Type 4

Extent: type 3 plus skull base/lamina identification, stripping of the mucosa, with or without Draf 3 or modified Lathrop procedure

Indications: inverted papilloma, extensive Sinonasal polyposis, allergic fungal rhinosinusitis.

In type 4, the technique involved is radical or extensive removal of all the diseased mucosa and allergic fungal mucin up to the skull base and lamina papyracea. The patients with extensive Sinonasal polyposis, allergic fungal rhinosinusitis, and benign Sinonasal tumors are included. This is aimed at the long-standing sinus pathologies that lead to irreversible mucosal damage. The aim of this procedure is to create wide sinusotomies without any obstructions and remove all the irreversibly damaged mucosa rather than conservatively targeting the specific drainage pathways. In the current study results nearing 100% support our classification

Histopathological evaluation of these patients' mucosa shows irreversible changes with subepithelial basement membrane thickening due to collagen deposition, myofibroblasts accumulation with subsequent deposition of extracellular matrix molecules, and pseudocyst formation in nasal polyps. This clinical evidence supports a surgical philosophy that a radical or extended surgical approach (rather than conservatively targeting OMC obstruction) may lead to improvement[6].

Type 5

In this category, endoscopic sinus surgery is used as an approach to access areas beyond the nose and paranasal sinuses like the skull base, Orbit, and Sella with normal Sinonasal anatomy.

In type 5, patients with non-sinus pathology in whom the endoscopic approach is used to access areas like skull base, angiofibroma, pituitary, orbit, and optic nerve were included. The endoscopic approach to these areas requires comprehensive knowledge about the endoscopic skull base and even radiological anatomy along with expertise in handling the instruments beyond what is required for the conventional functional endoscopic sinus surgery, which makes it into an entirely different leap. So, we included them in a separate group.

Type 6

Any revision endoscopic sinus surgery as most of the time there will be distorted anatomy or loss of landmarks so the surgeon has to be very cautious.

In type 6, patients with a recurrent disease requiring revision surgery, those with mucociliary disorders are included. Revision surgery in these cases with distorted anatomy needs a clear knowledge to identify the remaining anatomical landmarks (middle turbinate, skull base) before proceeding to clear the disease. Through endoscopic examination before and on the table during the surgery along with CT scan evaluation is a must. Revision surgeries are most commonly known for intraoperative complications. So, in our classification, we included them in group 6.

The proposed classification for ESS adheres to the basic principle of mucosal preservation[8].

Our study also substantiates the concept of limited resection, addressing the critical areas with more than 90% of consistent results.

The paranasal sinuses do have an intrinsic mucociliary clearance mechanism. The disturbance to that mechanism either by inflammatory pathology or mechanical obstruction leads to the development of rhinosinusitis ranging from acute reversible to chronic irreversible mucosal disease.

The treatment is a combination of medical and surgical modalities. The medical management is directed at the inflammatory process and surgery aims to remove the obstacles to the natural drainage pathways, but not strip all the inflamed mucosa

Our classification is based upon the above principles and our study has proved the concept of clearing the obstacles for the mucociliary clearance is sufficient in treating CRS along with medical management. Each patient should be individually assessed to determine the site of pathology and obstruction, and the surgical technique is tailored to address that specific pathology.

V. Conclusion

The modern endoscopes revolutionized the management of sinus diseases, replacing the most traditional mucosal stripping techniques to treat the pathology more functionally leading to the evolution of functional endoscopic sinus surgery (FESS). With the availability of all the contemporary investigations knowing the extent of the disease beforehand should help us in planning the extent of surgical treatment. The classification of endoscopic sinus surgery proposed in the study is useful in that regard as overdoing may lead to damage to the mucosa which is vital for the proper function of sinuses at the same time underdoing may result in recurrences.

So, the current study with the analysis of the technique and results proposes that this classification of endoscopic sinus surgery into six types can be useful but may require a multi-center study for further evaluation.

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Authors' contributions:

i. Dr. Nanda Kishore G, associate professor. the principal investigator who designed the study
ii. Dr. Satish Chandra Tripuraneni, corresponding author
iii. Dr. Sravanthi K K. the person who collected all the data and analysed the data
iv. Dr. Sameera G, who helped in collecting and analysis of the data

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Analysis of Influence and Composition of the Metal Alloys of Two Implant Drill System

By Lara Rabelo Aragão, Jiovanne Rabelo Neri, Pedro Henrique Gonçalves Holanda Amorim, Rafael Linard Avelar, Isabelle Ramos Pereira Lima, Roque Soares Martins, Alex Oliveira De Moura & Thiago Vasconcelos Melo

Abstract- *Purpose:* The mechanical behavior of two different implant drill systems for osteotomy preparation using polyurethane foam models were evaluated.

Methods: Fourteen polyurethane foam models and 28 Neodent® drills and 28 Dentoflex® drills were used. In a controlled environment, the perforations were timed, and an infrared digital thermometer and a K-type sensor were used to measure the temperature before and after perforations. Each group was divided into 7 subgroups: S5 = 5 perforations, S10 = 10 perforations, S15 = 15 perforations, S20 = 20 perforations, S30 = 30 perforations, S40 = 40 perforations, and S50 = 50 perforations.

Results: In the S5 and S10 subgroup, drilling time of the drills with three helical cutting edges was longer ($p < 0.05$) and temperature 1 was lower ($p = 0.034$) in the S10 group.

Keywords: *biomechanics; dental implantation; mechanical stress; osteotomy.*

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Analysis of Influence and Composition of the Metal Alloys of Two Implant Drill System

Biomechanical Analysis of Implant Drill Systems

Lara Rabelo Aragão [α], Jiovanne Rabelo Neri [σ], Pedro Henrique Gonçalves Holanda Amorim [ρ], Rafael Linard Avelar [ω], Isabelle Ramos Pereira Lima [¥], Roque Soares Martins [§], Alex Oliveira De Moura [χ] & Thiago Vasconcelos Melo [ν]

Abstract- ***Purpose:*** **The mechanical behavior of two different implant drill systems for osteotomy preparation using polyurethane foam models were evaluated.**

Methods: **Fourteen polyurethane foam models and 28 Neodent® drills and 28 Dentoflex® drills were used. In a controlled environment, the perforations were timed, and an infrared digital thermometer and a K-type sensor were used to measure the temperature before and after perforations. Each group was divided into 7 subgroups: S5 = 5 perforations, S10 = 10 perforations, S15 = 15 perforations, S20 = 20 perforations, S30 = 30 perforations, S40 = 40 perforations, and S50 = 50 perforations.**

Results: **In the S5 and S10 subgroup, drilling time of the drills with three helical cutting edges was longer ($p < 0.05$) and temperature 1 was lower ($p = 0.034$) in the S10 group. In the 50-perforation group, time, temperature 1 and 2 were higher for the drills with three helical cutting edges, ($p < 0.001$), ($p = 0.020$) and ($p < 0.001$) respectively.**

Conclusion: **The drilling time of the Neodent® drills was shorter, but temperature was higher in the S5 to S30 subgroups due to its conical geometry. In S40 and S50 subgroups, drilling time and temperatures 1 and 2 was higher for Dentoflex®.**

Keywords: biomechanics; dental implantation; mechanical stress; osteotomy.

I. Introduction

The number of patients in need of prosthetic rehabilitation with dental implants has been increasing significantly due to the increase in life expectancy associated with the search for better esthetics and functional results. Simpler and more effective osteotomy for the placement of implants has been a major challenge for oral surgeons.[1] Transoperative management is challenging due to surgical trauma and the biotype of periodontium influences the esthetic outcome. *In vivo* and *in vitro* studies have shown that osseointegration, which may lead to failure of dental implants, cutting speed, pressure exerted at the time of instrumentation, drilling time, quality and drill design, external and internal irrigation, material used to manufacture drills, the surgical process and bone morphology all influence the outcome of implantation.[2,3] Other authors also mention that cleaning and sterilization of surgical drills are a determining factor in instrument wear, which would lead to loss of efficiency, thus directly compromising final osseointegration.[4] The currently used clinical protocol for osteotomy for the placement of implants is the gradual increase in the diameter of the surgical drills to a diameter compatible with the external diameter of the implant thread.[5] Bone perforation for the placement of implants results in heating due to friction and fragmentation of bone particles on the cutting surface of the drill,[6] and peripheral thermal bone necrosis may occur due to inadequate cooling or loss of the cutting efficiency during the preparation of the alveoli.[7]The evolution of materials used in implantology has led to the development of new types of drills. Surface treatments and new metal alloys have been used to improve physical properties for greater efficiency and durability.[8] The most widely used metal alloy in medical and dental instruments for surgical procedures is martensitic stainless steel, which contains carbon (to increase hardness), chromium and molybdenum (to improve corrosion resistance). Different drill designs have been introduced for greater bone-cutting efficiency.[9] Thus, the aim of this study was to evaluate *in vitro* the mechanical behavior of two specific implant drill systems for bone bed preparation after osteotomy using polyurethane foam models.

II. Material and Methods

Fourteen polyurethane foam models (Nacional Ossos, Jaú, São Paulo, Brazil) and 56 surgical drills were used in this study and divided into 2 groups: *Group N:* Neodent® group composed of helical drills made from heat-hardened surgical stainless steel (440C) (Neodent®, Curitiba, Paraná, Brazil); *Group D:* Dentoflex® group consisting of heat-hardened surgical stainless-steel drills (XM-16) with three helical cutting edges (Figures 1 A and B). Each experimental group was then divided into 7 subgroups: S5, S10, S15, S20, S30, S40 and S50 that correspond to the quantities of perforations (S5 = 5 perforations, S10 = 10 perforations, S15 = 15 perforations, S20 = 20

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perforations, S30 = 30 perforations, S40 = 40 perforations and S50 = 50 perforations). A total of 170 cavities were made in seven polyurethane foam models for each experimental group. The 30-PCF polyurethane foam models (specimen) simulating a 1-mm thickness type I cortical bone (measuring W 6.0 x L 14.0 x H 3.3 cm) received the number of cavities corresponding to their respective subgroups. The drilling protocol was carried out by the vertical displacement of the contra-angle fixed to a bench forming a right angle between the end of the drill and the polyurethane foam model, exerting constant pressure in all the perforations, at a rotation speed of 1400 rpm with constant irrigation (Figure 2). All perforations were evenly distributed at 6mm and standard depth of 11mm. The drilling for the placement of the K-type thermocouple thermometer was carried out using the PROSS electric micromotor (Dabi Atlante®, Ribeirão Preto, São Paulo, Brazil), and a Ø 1.5mm helical drill, at a depth of 11mm from the cortical surface and 1.5 mm in front of the perforation of the experimental groups, previously marked with an endodontic ruler. The milling sequence was the one recommended by the manufacturers (Neodent® and Dentoflex®), as follows: 1- Ø 2.0mm initial drill; 2- Ø 2.0mm helical drill; 3- Ø 2/3 pilot drill and 4- Ø 3.0mm helical drill (Neodent®, Curitiba, Paraná, Brazil), and 1- Ø 2.3 mm drill; 2- Ø 2.6mm helical drill; 3- Ø 2.9mm helical drill and 4- Ø 3.2mm helical drill (Dentoflex®, São Paulo, São Paulo, Brazil). The drill was mounted on the PROSS electric micromotor (Dabi Atlante®, Ribeirão Preto, São Paulo, Brazil) with a contra-angle handpiece (Dabi Atlante®, Ribeirão Preto, São Paulo, Brazil) of 20:1 reduction.

a) Analysis of variables

i. *Time*

Cavity preparation time was measured with the aid of a professional digital stopwatch (VL510, Polo Industrial Granja Viana/Cotia - SP- Brazil) with an accuracy of 1/100 seconds. The total milling time was calculated by adding the contact time of each drill on the polyurethane foam model until reaching the depth of 11mm.

ii. *Temperature*

The external thermographic analysis of the cavity preparation was measured immediately before and during milling with the aid of a digital infrared thermometer (Kiray 50, Emerainville, France) fixed to a tripod at a distance of 50cm from the polyurethane foam model (Figure 3). The infrared beam was positioned at the cutting/surface intercession of the model and the highest temperature was recorded in degrees Celsius (°C). To measure the temperature inside the polyurethane foam model, a K-type digital thermometer (Hibok 14, WikaLda., Taoyuan, Taiwan) was used and readings ranged between -50 to 800°C. The thermocouple probe was calibrated (at 11 mm) against traceable standards (5°C and 55°C) before each perforation. After being placed on the prepared place, it was sealed with blue wax, thus allowing no temperature interference due to irrigation.

iii. *Statistical analysis*

Statistical analysis was performed using the SigmaStat 3.5 software (Systat Software Inc., San Jose, CA, USA). The Shapiro-Wilk and Brown-Forsythe test were applied to all groups to analyze the normal data distribution and equality of variance, respectively. Parametric data were analyzed using the Analysis of Variance test and non-parametric data were submitted to the Kruskal-Wallis test. For post-hoc comparisons, the Student-Newman-Keuls test was used and the level of significance adopted was $p < 0.05$.

III. Results

The results of the evaluation of time and temperature variation are described in Table 1. Regarding drilling time, helical drills were statistically faster than drills with three helical cutting edges for all subgroups ($p < 0.05$), except for the 15-perforation subgroup ($p = 0.520$). Regarding temperature variation measured with the K-type digital thermometer (temperature 1), helical drills generated significantly more heat than drills with three helical cutting edges in the 10-perforation subgroups (2.8 ± 1.2 vs 1.6 ± 0 , 5 °C), 15 (3.3 ± 1.2 vs 0.9 ± 0.4 °C) and 20 (2.9 ± 1.2 vs 1.5 ± 1.3 °C) ($p < 0.05$). In 5 (1.5 ± 0.3 vs 1.3 ± 0.4 °C), 30 (2.7 ± 1.2 vs 2.6 ± 1.9 °C) and 40-perforation subgroups (2.5 ± 1, 2 vs 3.3 ± 2.3). There was no statistical difference between the groups ($p > 0.05$). On the other hand, drills with three helical cutting edges produced more heat than helical drills when 50 perforations (2.3 ± 1.1 vs 3.6 ± 2.7) were performed ($p < 0.001$).Regarding temperature variation measured by the infrared thermometer (temperature 2), there was no statistical difference between the groups in the 5-perforation (0.4 ± 0.3 vs 0.3 ± 0.1 °C), 10 (0.3 ± 0.3 vs 0.3 ± 0.1 °C), 20 (0.5 ± 0.3 vs 0.8 ± 1.3 °C) and 30-perforation (0.5 ± 0.3 vc 1.3 ± 1.0 °C) subgroups ($p > 0.05$). However, when 15 (0.6 ± 0.3 vs 0.2 ± 0.1 °C) perforations were made, the helical drills generated more heat ($p < 0.001$) and when 50 perforations (0.5 ± 0.3 vs 2.0 ± 1.8 °C) were made, the drills with three helical cutting edges presented higher temperatures ($p = 0.024$).

IV. Discussion

In the present study, the mechanical behavior of two different sets of national implant drills was analyzed, which are specific for implant bed preparation with osteotomies in polyurethane models. We compared drill wear after repeated use and their influence on heat generation and time related to milling. In addition, a

comparison was made between the values found. In order to carry out this study, we decided to use synthetic bones (polyurethanes) with densities similar to those found in human bones, since the standardization of specimens and homogeneity of samples, which greatly influence statistical analysis, are achieved. Synthetic bones with mechanical properties similar to natural bones are a promising alternative, as human bones are difficult to store and obtain homogeneity of samples. In addition, there are characteristics that can influence the reliability and validity of measurements, such as unknown fenestration.[10,11] In a study that evaluated the standardization and reproducibility of the homogeneity of polyurethane foam models used as bone substitutes in research, the authors concluded that polyetherane models with densities (per cubic centimeter - DCC) from 30 to 40 were the ones that showed the best results in the tests of compression and bending tests in comparison with others, being, therefore, the most suitable for mechanical tests of implants.[12] Due to these factors, our research used polyurethane models with 30 DCC, being similar to type 1 bone. Surgical instruments are generally produced from stainless steel due to its strength, hardness, corrosion resistance and ease of sterilization. Surgical materials composed of AISI 410 martensitic stainless steel generally require greater wear resistance while maintaining a sharp cutting edge, such as scalpel blades, needles, scissors and surgical cutters.[13] The XM-16 stainless steel alloy, in turn, was developed to meet the needs of a high mechanical strength/hardness, with better resistance to corrosion/oxidation and greater flexibility than conventional martensitic stainless steel.[14,15] Thus, these characteristics may explain the increase in the temperature of the drills made of XM-16 alloy after sudden use in comparison with the 420C alloy. Taking into account the negative influence of overheating caused by the drills during bone preparation and the future of implant osseointegration, the excessive and repetitive use of drills in osteotomies can influence heat generated in the bone.[16,17] Several studies[5,18–21] have used different ways to measure temperature. In the present study, we chose to follow the model recommended by Singh et al[22]. Another factor that was considered when evaluating the temperature for implant bone bed preparation was related to the values of pressure exerted during drilling. In the present study, we used a standardized pressure of 2 kg to assess the temperature generated during bone drilling, considering that it is the most commonly used pressure in surgeries, which was also used by Sumer et al[8] and Möhlhenrich et al[23]. Pressure was standardized by using a 50 millesimal scale. The design, material and mechanical properties of the drills significantly affected their cutting efficiency and durability.[24] The drills in our study had different designs. The Neodent drills are helical and the Dentoflex drills have three helical cutting edges of different compositions. Thus, we expected to be able to determine which drill composition would be the best for drilling procedures. We observed that time and temperature of the groups evaluated showed a significant statistical increase ($p < 0.05$) when used repeatedly. Scarano et al.,[25] comparatively evaluated the effect generated in temperature with the reuse of drills and concluded that drill wear plays an important role in heat generation that can significantly interfere in peri-implant healing. Likewise, Misir et al.,[26] observed that temperature increase was observed after the thirty-fifth use regardless of the type of irrigation. Thus, the repetitive use of drills can significantly increase temperature of the cortical bone and directly influence the expected outcome. The initial drills of the two systems evaluated in all subgroups increased temperature and drilling time when compared to other implant drills. These findings suggest that these drills are responsible for disrupting the integrity of the cortical bone, which is a denser bone and consequently more difficult to penetrate. In conclusion, within the limitations of the study, we observed that the cutting time of Neodent® drills was shorter and internal temperature was higher in the S5 to S30 subgroups due to its conical geometry. Time and temperature were higher for the Dentoflex® drills in the S40 and S50 subgroups, which is explained by increased wear after reuse. Further studies should be carried out to elucidate the mechanical behavior of different implant systems after osteotomies to promote standardization among manufacturers and reduce trauma to peri-implant tissues.

Declarations & Statements

Conflict of interest

We have no conflicts of interest.

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Competing interests

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Fig. 1: (A) Drills in the Neodent group (Group N) were made of surgical stainless steel (440C). (B) Drills in the Dentoflex group (Group D) were made of surgical stainless steel (XM-16).

Fig. 2: Fixation of the contra-angle (20:1 reduction) on the vertical displacement device at 90° perpendicular to the specimen.

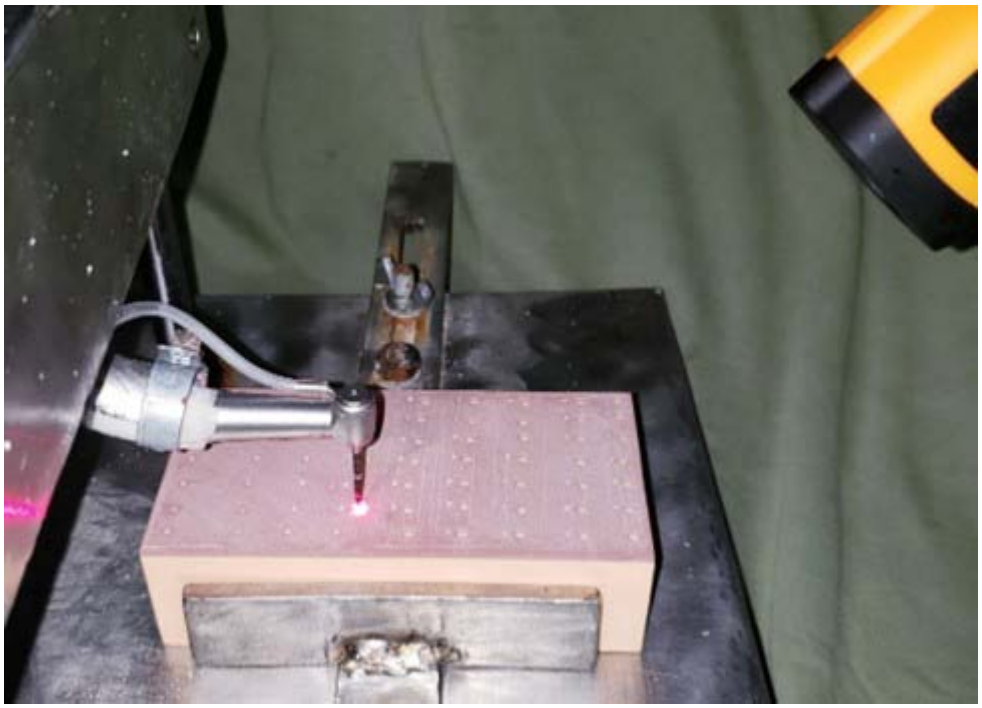

Fig. 3: Infrared placed at the intersection of the drill/model surface

Table 1: Values related to evaluation of time (measured in seconds) and temperature variation in °C, according to the implant drill system used. The data are described as mean ± standard deviation.

Temperature 1 = K-type digital thermometer; Temperature 2 = Infrared thermometer. * p <0.05

Perfurações	Avaliação	Brocas		p-Valor
		Helicoidal	Tri-Helicoidal	
5 Perfurações	Tempo	24,0±3,5	53,2±9,3	<0,001*
	Temperatura 1	1,5±0,3	1,3±0,4	0,484
	Temperatura 2	0,4±0,3	0,3±0,1	0,400
10 Perfurações	Tempo	36,3±12,5	43,0±5,8	0,004*
	Temperatura 1	2,8±1,2	1,6±0,5	0,034*
	Temperatura 2	0,3±0,3	0,3±0,1	0,835
15 Perfurações	Tempo	28,4±6,8	45,0±31,2	0,520
	Temperatura 1	3,3±1,2	0,9±0,4	<0,001*
	Temperatura 2	0,6±0,3	0,2±0,1	<0,001*
20 Perfurações	Tempo	23,7±8,5	60,6±39,0	0,009*
	Temperatura 1	2,9±1,2	1,5±1,3	<0,001*
	Temperatura 2	0,5±0,3	0,8±1,3	0,223
30 Perfurações	Tempo	22,0±7,2	84,3±60,7	<0,001*
	Temperatura 1	2,7±1,2	2,6±1,9	0,322
	Temperatura 2	0,5±0,3	1,3±1,0	0,337
40 Perfurações	Tempo	24,0±8,2	108,6±58,7	<0,001*
	Temperatura 1	2,5±1,2	3,3±2,3	0,376
	Temperatura 2	0,6±0,3	1,7±1,6	0,024*
50 Perfurações	Tempo	23,3±5,7	121,9±65,8	<0,001*
	Temperatura 1	2,3±1,1	3,6±2,7	0,020*
	Temperatura 2	0,5±0,3	2,0±1,8	<0,001*

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Prevalence and Treatment of Maxillary Incisivo-Canine Block Anomalies at the Donka National Hospital in Conakry

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Summary- *Introduction:* Orthodontic anomalies are deviations from normality, variations in the morphology and functions of the orofacial sphere.

Many types of dental anomalies can be observed in the anterior region, and can cause real aesthetic damage to our patients.

The objectives of this study were to determine the prevalence of orthodontic anomalies of the maxillary incisivo-canine block; to identify the orthodontic anomalies of the maxillary incisivo-canine block encountered, and to describe the type of appliance used to manage these anomalies.

Material and methods: This was a prospective descriptive study, lasting one year from 1erAout 2020 to 1erAout 2021. Our data were collected using a survey form. The study included all elderly patients from 9 to 26 years of age in whom one or more orthodontic anomalies of the maxillary incisivocanine block were detected and managed during the study period.

Keywords: *abnormalities, incisivocanine block, maxilla, treatment.*

GJMR-J Classification: *LCC: RK301-493*

Strictly as per the compliance and regulations of:

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Results: The prevalence of orthodontic anomalies of the maxillary incisivocanine block in the study population was 17.08% (20 subjects) out of 117 subjects. Maxillary proalveolism was the most frequently diagnosed with 8.54%, followed by maxillary interdental diastemas with 5.98%, with equitability between the sexes.

Conclusion: Early diagnosis and management of orthodontic anomalies of the maxillary incisivo-canine block leads to better results, and treatment is often multidisciplinary.

Keywords: abnormalities, incisivocanine block, maxilla, treatment.

I. Introduction

The various orthodontic anomalies can be described by means of a semiology that makes it possible to precisely define the variations from normal of the different signs. The various cases are described according to a plan that successively addresses signs affecting the teeth: dental anomalies, localized malocclusions, alveolar signs, without skeletal repercussions, signs of sagittal malocclusions (Angle's classification), signs of transverse malocclusions (skeletal or alveolar), signs of skeletal anomalies in the vertical direction, their consequences on the face, dento-maxillary disharmony. Of course, these different categories can be found in the same patient, associating dental anomalies, alveolar anomalies and skeletal anomalies[1]. Numerous types of dental anomalies can be observed in the anterior sectors, and can constitute real aesthetic prejudices for our patients. The descriptive classification is the simplest, and allows us to schematically distinguish various types of anomalies, such as those of shape, structure, number, size, eruption or color. In terms of management, the

The polymorphism of these anomalies, their degree of severity, the time of consultation and the patient's age multiply the therapeutic possibilities [2]. Several studies have been carried out on these anomalies in various countries. Vishnoi et al in 2017 in the city of Udaipur, India reported 28.7% definitive need for orthodontic treatment in schoolchildren aged 7 to 16 [3]. Yassir et al in 2016, in a study of a Lebanese population, found that 31.3% of the sample had a strong need for orthodontic treatment [4].

The aims of this study were to determine the prevalence of orthodontic anomalies of the maxillary incisivo-canine block; to identify the orthodontic anomalies of the maxillary incisivo-canine block encountered, and to describe the type of appliance used to manage these anomalies.

II. Materials and Methods

The maxillofacial surgery and odontostomatology department of the Donka national hospital in Conakry was used as the setting for this study. It was a prospective descriptive study, lasting one year from August 1er2020 to August 31 2021. The study covered all patients in whom one or more orthodontic anomalies of the incisivocanine block were detected and managed during the study period.

Patients seen for one or more orthodontic anomalies of the maxillary incisivocanine block during the study period were included. Patients seen for any other dental pathologies were not included in this study.

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The selection criteria were applied to 117 subjects, and patients were sampled exhaustively. The sample size obtained was as follows: n = 20

Data were collected manually, using an established survey form. Data entry and analysis were carried out with the help of Word and Excel software from the 2013 office pack. The results were presented in the form of tables and figures, commented and discussed according to recent data in the literature.

Informed consent was obtained from each patient or patient's relatives prior to data collection. Data were collected anonymously. The following evaluation parameters were adopted:

– An exaggerated vestibular orientation of the anterior alveolar processes and the upper or lower incisors is referred to as proalveolism.

– Dento-maxillary disharmony corresponds to a disproportion between the mesio-distal dimensions of the permanent teeth and the perimeter of the corresponding alveolar arches: the continuity of the dental arches at proximal level is no longer ensured. The most obvious sign is crowding or spacing of the dental arches (interdental diastemas).

III. Results

Table I: Prevalence of orthodontic anomalies of the maxillary incisivocanine block.

Type of fault	Workforce	%
Maxillary proalveolysis	**10**	**8,54**
Interdental diastema	**7**	**5,98**
Dental crowding	3	2,56
Other dental pathologies	97	82,92
Total	117	100

Table II: Age distribution of subjects.

Age range	Workforce	%
9 - 14	**10**	**50**
15 - 20	6	30
21 - 26	4	20
Total	**20**	**100,00**

**Average age: 17. 60 Extremes: 9 years and 26 years*

Table III: Distribution of subjects with orthodontic anomalies of the maxillary incisivocanine block by gender.

Type	Workforce	%
Female	10	50
Male	10	50
Total	20	100

Table IV: Distribution of subjects according to clinical signs.

Clinical and paraclinical findings	Workforce	%
Labial occlusion	15	75
Lipin occlusion	5	25
Dental ectopy*	5	25
Exaggerated maxillary overhang	9	45
Insufficient maxillary overhang	6	30
Normal maxillary overhang	5	25
Hemi symmetrical arches	16	80
A symmetrical arch hemi	4	20
Incisal overlap		
2-3 mm	5	25
˃3mm	11	55
˂1mm	4	20

(*) Ectopy of maxillary canines

Table V: Distribution of subjects according to the type of appliance used to manage orthodontic anomalies of the maxillary incisivocanine block

Device type	Workforce	Percentage(%)
Hawleyplate	2	10,00
Fixed devices (Brackets or multi-attachment)	14	70,00
Orthodontic extractions+ Fixed appliances	4	20,00
Total	20	100

Patient SB14- year-old patient with an anterior reverse occlusion (11,12; 22) of the maxilla prior to orthodontic treatment

During orthodontic treatment with a Hawley plate with palatal springs and elevation of the first molars

After orthodontic treatment

Figure 1: Treatment of an anterior reverse bite.

Patient DS22 years old with anterior crowding of the maxilla prior to orthodontic treatment

During orthodontic treatment with multi-attachment fixed appliances

After orthodontic treatment

Figure 2: Orthodontic treatment of anterior crowding.

IV. Discussion

The study revealed a prevalence of orthodontic anomalies of the maxillary incisivocanine block of 17.08%. This result is comparable to that of Uslu et al in Turkey in 2009, who reported a 16.1% frequency of orthodontic anomalies of the maxillary incisivocanine block [5]. According to Liausas et al, adolescent age is a predictive factor for orthodontic anomalies [6]. In this series, the average age of patients was 17.60 years, with extremes of 9-26 years. These results differ from those of Liausas et al in Lithuania in 2019 and Baron et al in France in 2018, who found mean ages of 12 and 15.23 respectively [6,7]. The young age of the patients would be due to the fact that this period corresponds to that of adolescence when, very often, an awareness of self-appearance is significant.

In the present study, the gender distribution of patients was characterized by equitability of both sexes. This result differs from those of Blige et al in Turkey in 2017, who obtained a gender distribution of 44.8% boys and 55.2% girls [8].

The majority of patients with orthodontic anomalies in the study were schoolchildren at 65%. These results corroborate those of Liausas et al in Lithuania in 2019 who reported that, 42.60% were schoolchildren [6]. This could explain the young average age obtained in the series.

Ectopic maxillary canines were the most common dental position anomalies, accounting for 25%. These results are similar to those of Nasreen et al in Pakistan in 2021, who found 30.6% of subjects with ectopic maxillary canines [9].

Patients with interdental diastemas in the present series were the most represented at 75%. This result is contrary to that of Farid et al in a study carried out in 2012 in Morocco, who found a frequency of dental crowding/overlap of 50% [10]. This predominance of interdental diastemas could be explained by the diversity of risk factors linked to the appearance of interdental diastemas. In the study, the distribution of patients according to overhang showed that maxillary overhang predominated, with a value of 45%. These results were superior to those obtained by Ouédraogo et al, who obtained 22.8% of exaggerated maxillary overhang[11]. This predominance may be explained by the high frequency of maxillary interdental diastemas in the study.

During the study period, incisaloverlap(>3mm) was the most represented (incisaloverlap>3mm (55%)). This result is superior to that of Faridetal, who reported 23.6% of 4mm incisal overlap [10]. These results may be linked to the predominance of exaggerated maxillary overhang in this series. Maxillary proalveolism was the most frequently diagnosed condition, at 8.54%, followed by maxillary interdental diastema at 5.98%. This could be linked to heredity or to various deforming habits, notably digital suctioning, which most often act on the maxilla, depending on the technique used.

Orthodontic treatment of patients mainly involved the use of fixed appliances (Brackets or multi-attachment) followed by Hawley plates, preceded by tooth extractions, particularly in cases where temporary teeth remained.

V. Conclusion

At the end of the study, a low prevalence of orthodontic anomalies of the maxillary incisivocanine block was observed. The most common subjects were schoolchildren, with both sexes equally represented. Proalveolism and maxillary interdental diastemas were the predominant manifestations of orthodontic anomalies of the incisivocanine block in the majority of subjects. Early diagnosis and appropriate therapeutic management of orthodontic anomalies of the maxillary incisivo-canine block provide better results, and their treatment is often multidisciplinary.

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Craniofacial Features of Cleidocranial Dysplasia (CCD) - A Case Report"

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Abstract- Cleidocranial dysplasia (CCD) is an autosomal-dominant malformation syndrome affecting bones and teeth. The most common skeletal and dental abnormalities in affected individuals are hypoplastic/aplastic clavicles, open fontanelles, short stature, retention of primary teeth, delayed eruption of permanent teeth, supernumerary teeth, and multiple impacted teeth. Treatment of CCD requires a multidisciplinary approach that may include dental corrections, orthognathic surgery and cranioplasty along with management of any complications of CCD. Early diagnosis of this condition enables application of the treatment strategy that provides the best quality of life to such patients. Notably, Runx2 gene mutations have been identified in CCD patients. Therefore, further elucidation of the molecular mechanism of supernumerary teeth formation related to Runx2 mutations may improve understanding of dental development in CCD. The insights into CCD pathogenesis may assist in the development of new treatments for CCD.

Keywords: *cleido cranial dysplasia, autosomal, runx 2 gene, mutations.*

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I. Introduction

The term cleidocranial dysplasia (CCD; OMIM 119600) is derived from the ancient Greek words cleido (collar bone), kranion (head), and dysplasia (abnormal formation). This rare hereditary skeletal disorder, which is also known as Scheuthauer-Marie-Sainton syndrome or cleidocranial dysostosis, is characterized by abnormal skeletal and dental development. The prevalence of CCD is an estimated one per million and does not differ by race or by gender.1 In most cases, the disorder is an inherited autosomal dominant trait. In 20-40% of reported cases, however, the disorder occurs sporadically.[1] This syndrome is characterized by hypoplastic and/or aplastic clavicles, patent sutures and fontanelles, wormian bones, wide pubic symphysis, supernumerary teeth, short stature, and various other skeletal changes. Although clavicular defects have been reported in the literature as early as 1765,[2] Scheuthauer[3] in 1871 was apparently the first to describe the syndrome accurately. Marie and Sainton[4] in 1898 coined the term "dysostose cleidocranienne hereditaire" for this condition. The term "cleidocranial dysostosis" was originally used because CCD was thought to involve only bones of intramembranous origin, i.e., bones of the skull, clavicles and flat bones. Subsequent studies showed that bones of endochondral ossification are also affected and that CCD is a generalized disorder of many skeletal structures. Therefore the term "cleidocranial dysostosis" was changed to "cleidocranial dysplasia" to reflect the more generalized nature of the condition.[5,6]

II. Case History

a) Clinical features

The clinical appearance of CCD is so distinct that it is pathognomonic. The main clinical features of CCD are recognized during early childhood and include a short stature, delayed closure of fontanelles, prominent forehead, and abnormal dental development. The head of a CCD patient usually shows frontal and parietal bossing and a groove along the metopic suture. The neck appears to be abnormally long, and the shoulders are narrow with marked drooping. (figure-1) Clavicular abnormalities with associated muscle defects allow excessive mobility of the shoulder girdle. For example, many CCD patients can approximate their shoulders in front of the chest for variable levels. The clinical spectrum is extremely variable even within families and ranges from mild cases with only dental abnormalities to severe cases with pronounced skeletal deformities.[7,8]

b) Radiographic features

The distinctive radiological features of CCD are shortened or absent clavicles, delayed ossification of the skull bones and delayed ossification of pelvic bones.[1] The chest radiographs for CCD patients in show that the clavicles may be completely absent (aplasia) or smaller than normal (hypoplasia). The clavicles are typically hypoplastic or discontinuous, either unilaterally of bilaterally; the clavicles are completely absent in 10% of cases. Hypoplastic clavicles include hypoplasia of the acromial end or absence of the sternal end with the acromial end present. The missing segment may cause fibrous pseudoarthrosis or may be replaced by a fibrous tether or cord.[9]

c) Craniofacial Morphological Features

(Figure -1) shows that the skull in CCD is characterized by brachycephaly, delayed or failed

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closure of the fontanels, open skull sutures, and multiple wormian bones in the coronal and lambdoid suture regions. Defective fusion of frontal and parietal bones leading to open coronal and sagittal sutures are also visible. The nasal bones are missing or hypoplastic. Mandibular prognathism may be secondary to nasomaxillary deficiency. Dense alveolar crestal bone can be seen in the anterior mandible. Other craniofacial morphological features of CCD include abnormally small or non-existent maxillary sinuses, hypoplastic zygomatic bones, and patency of the mandibular symphysis.[1,10] The zygomatic arch may be thin or even discontinuous at the zygomaticotemporal suture. The zygomatic arch has a characteristic downward bend.[1] The mandible is characterized by a narrow ascending ramus with nearly parallel anterior and posterior borders and by an abnormally slender and pointed coronoid process with an abnormally distal curvature.[10] The trabecular pattern of the mandible is very coarse.(Figure-2)

d) Radiographic Features Associated with the Teeth

(Figure-2,3) shows that CCD is characterized by prolonged retention and delayed shedding of the primary teeth and multiple unerupted permanent and supernumerary teeth.[10] Dentigerous cysts occasionally arise in association with these unerupted teeth. Although development of the primary teeth is rarely affected, root resorption and exfoliation of the primary teeth may be delayed. (figure-4)

e) Cone-Beam Computed Tomography (Cbct) Imaging

Other pertinent information provided by CBCT include the precise location of a supernumerary tooth in relation to important structures such as the cortex of the nasal floor, labial cortex of the nasal ridge, nasopalatine duct, and the mandibular canal and adjacent root apices.[11] Because CBCT clearly depicts the position and anatomy of impacted teeth, CBCT is useful for both diagnosis and treatment planning in CCD.

f) Histopathological Features

Tooth formation and eruption occur in a series of complex and highly regulated process. The reasons for failure of permanent tooth eruption and retention of the primary teeth in CCD patients are poorly understood. Absence of cellular cementum at the root apex is presumably one factor in failed or delayed eruption of permanent teeth and retention of the primary teeth in CCD.[12,13] The lack of cellular cementum is presumed to increase the number of unerupted teeth in patients with CCD. However, recent reports of a lack of cellular cementum in normal teeth do not support this presumption.[14-16] Studies of bone from the alveolus overlying unerupted teeth in CCD patients have a higher than normal density as well as reversal lines, which suggest an abnormal resorption pattern.[17,18] Possible explanations for delayed eruption of teeth included increased density and coarse trabecular pattern of the jaw bone, decreased resorption, and multiple reversal lines. A delayed eruption may also be attributable to various other factors such as mechanical obstruction of multiple supernumerary teeth. Therefore, the most likely causes of extreme delay or arrested eruption of permanent teeth in CCD are diminished bone resorption, delayed resorption of the roots of primary teeth, and less commonly multiple supernumerary teeth.[19] One proposed hypothesis is that supernumerary tooth formation results from hyperactive dental lamina, i.e. over-proliferation or prolonged survival of dental lamina epithelial cells.[20] Another hypothesis is that formation of supernumerary permanent teeth in CCD patients results from markedly delayed resorption or from dental lamina of permanent dentition that is normal but does not resolve completely at the expected time.[19]

g) Molecular Genetics

The Runx2 gene is a master transcription factor of bone and plays a role in all stages of bone formation. Core binding factor (Cbf) plays crucial roles during skeletal development. Cbf consists of two subunits: Cbf alpha (Cbfa) and Cbf beta (Cbfb). Runt-related transcription factor 2 (Runx2) has been shown to be critical for the differentiation of osteoblasts and skeletal development.[21,22] CCD results from a Runx2 gene mutation in the small arm of chromosome 6 at 6p21.1.[23,24] A heterozygous mutation in the Runx2 gene encodes runt-related transcription factor 2, also termed core-binding factor alpha1 (CBFA1). Researchers generally agree that the underlying mechanism of CCD pathogenesis is haploin sufficiency or loss of Runx2 function.[8,25] The Runx2 contains a DNA-binding domain (runt domain) which is necessary for transcriptional activation of target genes, a region of glutamine and alanine repeats in the N-terminal region (Q/A domain), and a region rich in proline-serine threonine (PST). The Runx2 is a key transcription factor involved in osteoblastic differentiation and skeletal morphogenesis.[26] Studies also suggest that Runx2plays an important role in odontogenesis via participation in odontoblast differentiation, enamel organ formation, and dental lamina proliferation.[27] Disruption of these functions might explain the distinct dental anomalies associated with this disorder. To date, over 90 Runx2 gene mutations in 500 independent cases of CCD have been reported in the literature, including deletions, insertions, translocations, missense, frameshift, and splice mutations.[28] In most cases mutations occur in the runt domain.23,29 Mutations in Runx2 have a high penetrance and extreme variability. The Runx2 mutation is currently the only known molecular etiology of CCD. Notably, individuals who have CCD and identical Runx2 gene mutations show a wide variation in the number of asymmetrical supernumerary teeth in the maxilla and the mandible, which implies that the number and position of supernumerary teeth are not governed solely by Runx2

mutations. Runx2 mutations, which functions as a heterodimer with core binding factor b (Cbfb), are found in most individuals with CCD.[21,22] Cbfb forms a heterodimer with Runx family proteins and enhances their DNA-binding capacity. Multiple functions of Cbfb are required for skeletal development and homeostasis in postnatal skeletogenesis. Cbfb deficiency reduced the expression of several key factors that mediate osteoblast formation and/or function. Cbfb is crucial for the later stages of chondrocyte differentiation as its deletion affects chondrocyte maturation and the formation of the growth plate. Although no Cbfb mutation has yet been identified in classical CCD patients, genetic alterations in the Cbfb gene may be responsible for CCD in those patients with no Runx2 mutation. Because Runx2 functions as a heterodimer with CBFb, it has been suspected that Cbfb may be responsible for some cases of CCD. In terms of the pathogenesis of CCD, Cbfb deficiency may be equivalent to Runx2 haploin sufficiency as it relates to the function of the Runx2/ Cbfb complex in skeletogenesis.[21] Fibroblast growth factor (FGF) signaling is one molecular mechanism of supernumerary teeth formation in CCD patients.[30] Runx2 might indirectly inhibit FGF signaling by antagonizing Twist1 function. Twist1 is a basic helix-loophelix-containing transcription factor that is expressed in the dental mesenchyme in early stages of tooth development. A relative abundance of unbound Twist1 caused by Runx2 haploinsufficiency may elevate FGF signalling, which then causes formation of supernumerary teeth in human CCD.[30]

h) Treatment

Managing the dental and orofacial manifestations of CCD is a challenging long-term process that requires careful planning and execution by an interdisciplinary team. The treatment strategies may differ according to the age of the patient. Surgical exposure of unerupted permanent teeth with orthodontic guided eruption is the preferred treatment for adolescent CCD patients. Generally, deciduous and supernumerary teeth should be removed to improve the possibility of orthodontic guided eruption.[31,32] Bone overlying permanent teeth should also be removed since histology studies show that alveolar bone in CCD has abnormal dense trabeculation with multiple reversal lines.[17] Orthodontic treatment with mini-implant screws for traction of impacted teeth can reduce the treatment time for CCD patients.[33] Leaving numerous deeply unerupted teeth in place is not an acceptable practice. The dentition associated with CCD is usually responsive to skillful orthodontic therapy and obviates the need for partial dentures. In adults with fully developed jaws, dental implants and fixed prostheses are the preferred therapeutic measures in adult CCD cases requiring multiple extractions of teeth. Calvarial defects in the open anterior fontanelle, sagittal suture, and metopic suture have been successfully corrected by cranioplasty using bone cement.[34] Midface deficiency can be corrected by orthognathic surgery after growth is complete.[35,36] In patients who meet the defined criteria, the above treatments can obtain substantial esthetic and functional benefits.

III. Discussion

CCD is a generalized skeletal dysplasia affecting bones of intramembranous and endochondral ossification. The condition varies from mild cases presenting with only supernumerary teeth to cases with the phenotypic features that characterize CCD. Timely recognition of CCD and counseling for patients with hereditary risk factors are mandatory. Although CCD is associated with various skeletal abnormalities, CCD patients typically visit dental clinics only when they require treatment for dental and orofacial problems. Therefore, dentists have essential roles in identifying CCD and then planning and implementing a multidisciplinary therapeutic treatment aimed at improving quality of life in patients with this condition. Different approaches to the treatment of the dentition in CCD have been proposed in the past. The method suggested by Becker et al.[31,32] may be viewed as the most promising.

The proposed method is founded on several premises:

1) Need for early removal of all obstacles to the eruption of the unerupted permanent teeth and application of traction forces at the biologically appropriate time,
2) Extraneous force needs to be provided to bring about an eruption of the teeth, along with an accompanying vertical alveolar development, and
3) Concentrating initial efforts towards bringing anterior teeth into mouth early, for the patient's psychological wellbeing.

Extract the anterior deciduous teeth and all supernumerary teeth, and expose unerupted permanent incisor teeth. The timing of surgical exposure of unerupted teeth is governed by appropriate root development. Root development should be two-thirds their expected length and is suitable for its active eruption. The approximately 3-year discrepancy in development of the dentition in these cases of dental age 7-8 years generally dictates that the chronological age of the patient is usually around 10-12 years.[31] Further development of the roots of the posterior successional teeth will have increased their length to around two-thirds of the expected final length and are suitable for their active eruption at dental age of 10-11 years and chronological age 13 years. Surgical and orthodontic difficulties and complications abound during the treatment of CCD and there is a risk for the failure of one or other of the many aspects of the treatment or the

prognosis of the result. An inordinately long period involved in the completion of last orthodontic treatment stage.[32] The displacement of the roots of several of the teeth is often extreme and many months of root torquing and uprighting are needed to bring them into their proper positions. Long-term retention of the treatment result is advised. FGF signalling is reportedly a molecular mechanism of supernumerary teeth formation in CCD patients.[30] However, wide variation in the dental phenotype of CCD patients suggests that genetic modifiers and interacting partners await discovery.[37] Twist1 is the functional antagonist of the Runx2. Excess of unbound Twist1 caused by Runx2 haploin sufficiency enhances FGF signaling, which then promotes formation of supernumerary teeth.[30] Runx2 haploin sufficiency in humans affects permanent dentition but not primary dentition.[19] It is difficult to establish direct genotype-phenotype correlation for Runx2 because of very variable phenotypic penetrance of the mutations.[38] There is also a weak genotype-phenotype correlation in case of dental aspect of CCD phenotypes, especially with respect to teeth development.[39] Further elucidation of molecular mechanisms of supernumerary teeth formation related to Runx2 mutations will improve insight into dental development. The insights into CCD pathogenesis may assist in development of novel therapies for CCD.

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To the institution

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Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

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Financial

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Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

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Exclusive | Financial

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Associate	Fellow	Research Group	Basic
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Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

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Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

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2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
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It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

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Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

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Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

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.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

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 though 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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	A-B	**C-D**	**E-F**
Abstract	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
Introduction	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
Methods and Procedures	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
Result	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
Discussion	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
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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