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Dentistry & Otolaryngology



Transplant of Natural Tooth

Cone-Beam Computed Tomography

Highlights

Comminuted Mandibular Fracture

Zygomatic and Conventional Implants

Discovering Thoughts, Inventing Future

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By Dr. Kalamalla A Saran Babu, Dr. Mahammad Rasool, Dr. Dinesh Kumar Perisetty, Dr. Ch. Sumalatha, Dr. E. Srikanth & Dr. Sateesh Babu S

Abstract- Retention, stability & support are three important factors which determine the basic objectives, success and comfort of any removable prosthesis. In acquired surgical maxillary defects; the degree of impairment, size and location of the defect influences the outcome of the overall prosthetic overhaul. Prosthetic therapy with obturator closes the defect by re-establishing the oro-nasal separation, thereby, improving deglutition, speech and hypernasality. After maxillectomy, 3-6 months after surgery, patients with class 4 maxillary defects complains of frequent loosening of temporary prosthesis due to more amount of tissue changes, dimensional stabilization of surgical site, more loss of mucogingival support and rapid healing changes. As a result, there is an every chance of endangerment with the use of temporary prosthesis and allow the patients in seeking the definitive prosthesis over interim prosthesis. In this regard, designing of cast partial metal frame work with linear configuration for class 4 maxillary defects enhances the quality and comfort of the definitive prosthesis over conventional acrylic prosthesis.

This article mainly describes the fundamental designing technique in improving the retention, stability and support of the definitive prosthesis with cast retainers.

Keywords: *maxillary defect, support, retention, stability, obturator.*

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Definitive Obturator for Class IV Maxillary Defect with Cast Retainers- A Case Report

Dr. Kalamalla A Saran Babu [α], Dr. Mahammad Rasool [σ], Dr. Dinesh Kumar Perisetty [ρ], Dr. Ch. Sumalatha [Ω], Dr. E. Srikanth [¥] & Dr. Sateesh Babu S [§]

Abstract- Retention, stability & support are three important factors which determine the basic objectives, success and comfort of any removable prosthesis. In acquired surgical maxillary defects; the degree of impairment, size and location of the defect influences the outcome of the overall prosthetic overhaul. Prosthetic therapy with obturator closes the defect by re-establishing the oro-nasal separation, thereby, improving deglutition, speech and hypernasality. After maxillectomy, 3-6 months after surgery, patients with class 4 maxillary defects complains of frequent loosening of temporary prosthesis due to more amount of tissue changes, dimensional stabilization of surgical site, more loss of mucogingival support and rapid healing changes. As a result, there is an every chance of endangerment with the use of temporary prosthesis and allow the patients in seeking the definitive prosthesis over interim prosthesis. In this regard, designing of cast partial metal frame work with linear configuration for class 4 maxillary defects enhances the quality and comfort of the definitive prosthesis over conventional acrylic prosthesis.

This article mainly describes the fundamental designing technique in improving the retention, stability and support of the definitive prosthesis with cast retainers.

Keywords: maxillary defect, support, retention, stability, obturator.

I. Introduction

Re-construction and Re-establishment of acquired surgical defects through 'obturator' is the suggested treatment of choice over surgical approach due to its ease of maintenance and ease of fabrication.[1] According to glossary of prosthodontics terms, obturator is "a maxillofacial prosthesis used to close a congenital or acquired tissue opening, primarily of the hard palate and/or contiguous alveolar/soft tissue structures.'[2] These prosthesis helps in improvement of speech & mastication; reduces hyper nasal speech; prevents the entry of fluids into nasal cavity which are debilitated during maxillectomy. Among different classes of Armany's maxillary defects, class 4 is a peculiar defect which requires special attention in fabrication of a definitive prosthesis. Factors such as size, location of the defect, more amount of tissue damage, more loss of mucogingival support, presence of few remaining teeth for support will jeopardize the effectiveness of the immediately fabricated temporary prosthesis and exasperate the need of permanent prosthesis for these defects[3,4]. Any definitive prosthesis fabricated should be light in weight, has good retention, support and stability compared to interim prosthesis[5]. Even though fabrication of definitive obturator with cast retainers is tedious and cumbersome over conventional heat cure acrylic prosthesis; designing the cast metal frame work with linear configuration for class 4 defects increases the success rate and outcome of the final prosthesis with enhancement of good retention, support and stability. Similarly there were many techniques described in the literature to reduce the weight of the final prosthesis there by keeping the final obturator with either open or closed hollow bulb prosthesis [6-9].

This article mainly focuses on the importance of linear configuration design for class 4 maxillary defects in increasing the retention, stability and support of the definitive prosthesis.

II. Case Report

A 42 years old male patient with a chief complaint of difficulty in chewing, speech and frequent loosening of the temporary prosthesis was referred to department of Prosthodontics, Narayana Dental College and Hospital, Nellore. On history taking, patient has undergone hemi maxillectomy due to chronic suppurative osteomyelitis on left side of maxilla. Medical history revealed that he was on medication for non-insulin dependent diabetes mellitus for the last three years. On Intraoral clinical examination, the surgical sites included are left maxilla, left buccal sulcus area, hard palate on the left side up to the midline, entire premaxilla and anterior part of right maxilla. All teeth in the 2nd quadrant were removed and only four teeth (i.e., 15, 16, 17 and 18) are present in 1st quadrant (Fig. 1). Moreover, presence of healthy surgical sites, caries-free

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teeth was noticed in remaining maxillary and mandibular dentition. Extra oral examination revealed reduced 'vertical dimension of the face, facial asymmetry due to depression in left malar prominence, hollow cheeks, unsupported lips and diminished nasal speech.

According to the Armany's classification (1978) of post maxillectomy defects, this maxillary defect was categorized as class IV maxillary defect since it crosses the midline involving both sides of maxilla with few teeth remaining in a straight line.[10,11]

Based on the above findings, treatment was planned as definitive obturator and the procedure was as follows:

1. Primary impression was made with irreversible hydrocolloid impression material (Zelgan; Dentsply, India) by packing the defect with gauge (Fig. 2). Following this Primary cast was poured with type III gypsum product and a custom tray was fabricated with self cure acrylic resin. (Fig. 3)
2. Mouth preparation for remaining teeth present in the oral cavity was completed in the subsequent appointment. Peripheral tracing was done to record accurate border extensions and the final impression was made with light body impression material (Aquasil LV, Dentsply, India); master cast was then poured with type 4 gypsum product. (Fig. 4, 5)
3. After surveying of the master cast, procedures such as; wax block out of master cast; Master cast duplication with Agar (Castogel, Bego, Germany); Pouring of refractory cast with phosphate bonded investment material; baking of refractory cast; was performed. [Fig. 6]
4. Designing of linear configuration wax pattern for class 4 maxillary defects on refractory cast with incorporation of occlusal rests, direct retainers, indirect retainers, major & minor connectors work was completed on refractory cast. [Fig. 7]
5. Burnout & casting was completed following standard temperatures. Casting was retrieved and after finishing and polishing, the cast metal framework of obturator was checked introrally for proper fitting. (Fig. 8, 9)
6. An occlusal rim was fabricated on the metal obturator; proper jaw relations were recorded; try-in with monoplane dentition was then performed. (Fig. 10)
7. Flasking, Dewaxing was completed and the defect was filled with table salt during packing of heat cure acrylic resin. After curing, prosthesis was retrieved and table salt was poured out to obtain hollow bulb obturator .Proper finishing & polishing was done. (Fig. 11,12)
8. Insertion was done and proper post -insertion instructions were given.

III. Discussion

Prosthetic therapy for patients with acquired surgical defects of maxilla can be arbitrarily divided into 2 phases of treatment: - The initial phase called surgical obturation which entails the placement of prosthesis at surgery (temporary prostheses) or immediately thereafter (transitional). The objective of surgical obturation is to restore and maintain oral function at reasonable levels during the postoperative period until healing is completed. Three to six months after surgery, the surgical site becomes stable dimensionally thus permitting construction of the definitive prosthesis or the second phase of prosthodontic therapy.

This case report represents the fabrication of definitive obturator with cast retainers replacing temporary conventional acrylic prosthesis for class 4 maxillary defects. The interim prosthesis loses its retention, support and stability due to the tissue changes that occur after maxillectomy (especially during first 6 months). Designing a cast metal framework with linear configuration is the alternative feasible technique in such defects improving the quality and comfort of the prosthesis.

In designing of the definitive prosthesis with cast retainers, one must apply the basic principles of support, retention and stability so as to minimize the stress generated to the structures of the mouth. The location of the fulcrum line, retentive undercuts and potential for indirect retention will be important factors in determining the prognosis. In general, the prosthesis will have a fulcrum line near the defect area.

Masticatory function in patients with removable prostheses is determined by the retention, support and stability of the prostheses. It has been suggested that the quality of retention of the obturator prosthesis is dependent on the following factors: (i) Indirect and direct retention provided by any remaining teeth, (ii) Defect size, (iii) Availability of tissue undercut around the cavity and (iv) The development of muscular control. It is also suggested that obturators exhibit varying degrees of movement depending on the residual maxillary form such as amount &contour of the remaining palatal shelf, height of the residual alveolar ridge, configuration, size of the defect and the availability of undercuts.[12]

The main objective of designing a metal framework with linear configuration for class 4 maxillary defects was to select the most suitable components to resist the various forces acting on the obturator prosthesis without applying undue stress on the remaining teeth and soft tissue structures.[13]Though the pattern of forces affecting the prosthesis are complex because of their concurrent occurrence, these forces may be categorized as vertical dislodging force, occlusal vertical force, torque or rotational force, lateral force, and anterior-posterior force.

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Wide distribution of occlusal rests will help to counteract occlusal vertical force activated during mastication and swallowing. Preservation of teeth or part of the residual ridge across the midline greatly improves obturator stability. Similarly maximum support was obtained by utilization of full palatal coverage. Stress created by lateral forces was minimized by the proper selection of an occlusal scheme i.e monoplane teeh, elimination of premature occlusal contacts and wide distribution of stabilizing components. Anterior-posterior movement is counteracted by the inclusion of guiding planes on the proximal surfaces of abutment teeth. Retainers reduce the stresses transmitted to the abutment teeth while retaining the obturator in place[14, 15]. At the time of delivery of the prosthesis, patient was given proper instructions about how to place the obturator in the mouth and also about proper maintenance of the prosthesis. The patient was recalled for follow-up and satisfactory retention, support and stability levels were noticed with the use of definitive prosthesis in comparison with interim prosthesis.

IV. Conclusion

This paper comprehensively reports the fabrication of a definitive obturator with cast retainers for class 4 maxillary defects that has a metal framework which acts as the palate and supports the teeth with closed hollow bulb. This type of final prosthesis provides good retention, support, stability and comfort over conventional temporary acrylic prosthesis, thereby, improving the functions of mastication, deglutition, and speech; preventing the fluid leakage into the nasal cavity. As a result, with the ease of more comfort in the use of this type of prosthesis in regular basis, the problems encountered by maxillectomy patients diminishes slowly and even day to day mortality can be reduced with the enhancement of oro-facial cosmetic appearance and quality of socilaistic life.

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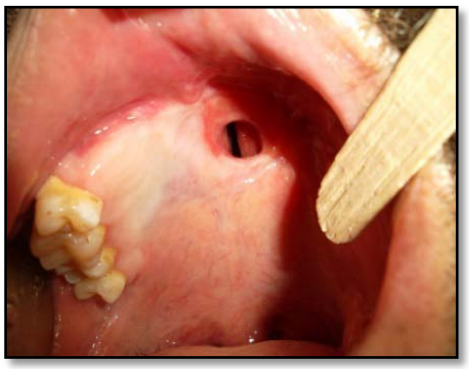


Fig. 1: Intraoral view of the defect

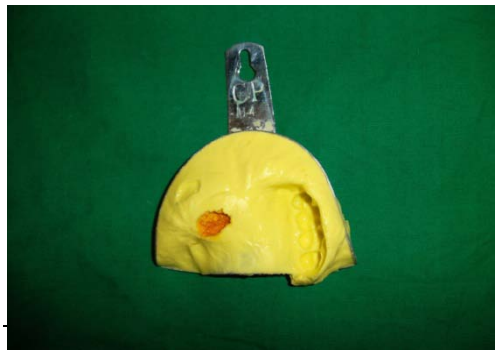


Fig. 2: Alginate Primary Impression

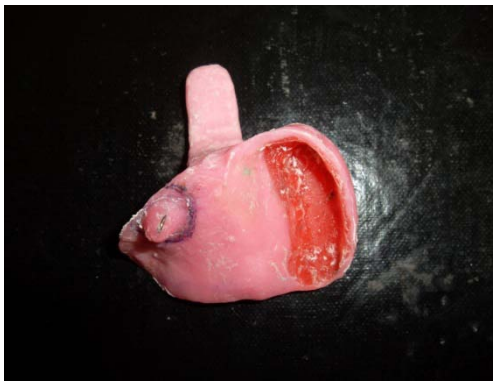


Fig. 3: Fabrication of a custom tray

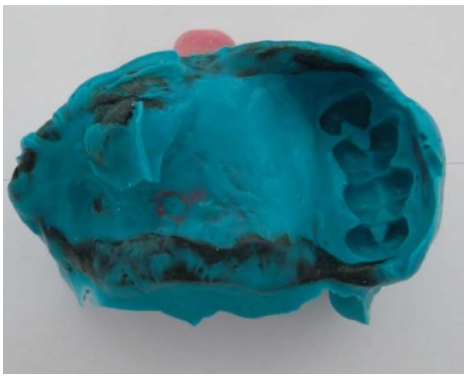


Fig. 4: Master Impression



Fig. 5: Mastercast



Fig. 6: Block out of mastercast

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Fig. 7: Wax pattern with linear configuration on refractory cast



Fig. 8: Cast partial Metal Frame work



Fig. 9 : Metal Frame work trial



Fig. 10: Jaw relations



Fig. 11: Flasking and Dewaxing



Fig. 12: Final Prosthesis

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A Case Report of Comminuted Mandibular Fracture with Condylar Neck Fracture

By Dr. Kavita Wadde, Dr. Nazmul Alam, Dr. Ashwini Chapane & Dr. Sandip Rathod

Abstract- The fracture of the comminuted type has a prevalence of 30 to 50 % when related to the affecting mandibular bone. They are characterized by the presence of multiple bone involving several lines of fracture, resulting in small fragments within the same area. Treatment modalities for the management of comminuted mandibular fractures include closed reduction, external pin fixation, internal wire fixation, and open reduction and internal fixation using miniplates, titanium mesh tray and screws. The following case report highlights open reduction and internal fixation of a comminuted mandibular fracture in a 24-year-old male patient. The patient treated with open reduction and with a reconstruction plate followed by a short period of maxillomandibular fixation.

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I. Introduction

Mandibular fractures are a frequent injury occurred when there is trauma to the face and jaw this could lead to functional and aesthetic problems. The high incidence of mandibular fracture was related to its anatomy and characteristics.[1]

Communited fracture refers to multiple fracture fragments. It is a break or splinter of the bone into multiple lines. Etiology behind this kind of fracture is high impact injuries suchas, traffic accidents and falls.[2]

Mandibular fractures usually have a predictable pattern, determined by the direction and force of the impact sustained. A blow to the symphysis or Para symphysis of the mandible prompts us to look for fractures in the sub condylar regions, the countercoup phenomenon.[3]One of the major goals of its treatment is focused on the union of fractured segments restoring the pre-injury strength and function. It requires a proper anatomical reduction and immobilization that will consolidate the fractured segments.[4]

Earlier, conservative treatment modality was preferred over surgical because surgical procedures would lead to devitalization of soft tissues adherent to splintered bone, leading to increased risk of infection and necrosis. But nowadays, open reduction with internal fixations preferred because of the opinion that lacks stability of bony fragments leads to infection. It is a better treatment modality with a lower incidence of complications in case of moderately or severely displaced fracture bone fragments.[2]

Any treatment to be carried out depends on the severity of injury and general condition of the patient, once the general condition of the patient is stable then the concomitant injuries to be addressed.[5]

The material of choice for rigid internal fixation of mandibular communicated fracture are plates and screws, reconstruction plates and 3D titanium mesh, compared to plates and screws, reconstruction plates provide more satisfying morphology and stability.[2]

Absolute stability of the fracture construct must be achieved; this is the prerequisite for sound bone healing and a low rate of infection. These principles can be adhered to using reconstruction plates .[6]

II. Case Report

A 24-year-old male patient reported to the Department of Oral & Maxillofacial Surgery, with the road traffic accident. He was under the influence of alcohol during accident. The Patient -reported 10 days after trauma. No history of bleeding from ear, nose and oral cavity &unconsciousness. He also had past history of road traffic accident and fractured with right leg femur bone, under the influence of alcohol which was treated earlier. Intra-orally revealed extra oral deep laceration wound approximately 1 cm in length was present below chin region (Fig. 1). Intra oral examination revealed deranged occlusion, and there was a root piece of first left molar & difficulty in mouth opening. All routine investigations for general anesthesia have been carried out.



Figure 1: Extra oral pictures

A Panoramic radiograph revealed, a single oblique radiolucent line extending from the alveolar crest between mandibular left second and third molar passing anteriorly to the Para symphysis region of the lower

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border of the mandible. Amultiple radiolucent line is seen in the left Para symphysis and body region& radiolucent line seen in the right condylar neck region. Above findings suggestive of comminuted left body fracture of the mandible & right condylar neck fracture (Fig. 2).



Figure 2: Pre-operative OPG shows comminuted left body fractures, right condyle neck fracture

Coronal section of CT scan shows communicated left body fracture of the mandible another coronal view shows right condylar neck fracture (Fig. 3).

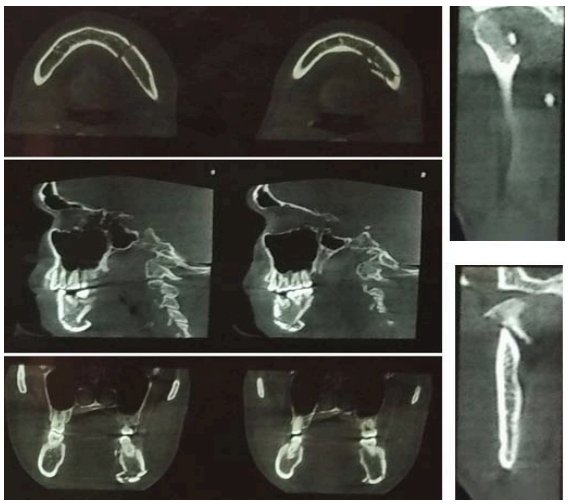


Figure 3: Axial, sagittal and coronal CBCT view shows comminuted fractures

Routine investigations were carried out. Erich arch bar was fixed intra-orally in the maxillary and mandibular region from upper right 1st molar to left first molar & from lower right 1st molar to left 2nd molar. The Patient was planned under General anesthesia infiltration was done with 1:100000 diluted local anaesthesia with adrenaline solution. The Sub mandibular incision was given on left side and extended into the existing wound, posteriorly layer wise dissection was done, Facial artery & facial vein were identified and preserved communicated mandibular body fracture was exposed (Fig. 4). Intra orally the lower left molar was extracted then the fractured fragment was reduced and fixed with the reconstruction plate. The occlusion was achieved. Intermaxillary fixation was done. Reconstruction plate of 13 holes with 2.5 mm in width was adapted and placed at the lower border of the mandible and was fixed with 8mm X 2.5mm interlocking titanium screws (Fig. 5). Layer-wise suturing done with 3-0 ethanol and skin with 4-0 mersilk. Throat pack was removed, and pressure dressing had been given. Recovery was uneventful. A Post-operative panoramic radiograph was been taken, showed reconstruction plate at the inferior border of the left side body mandible (Fig. 6).

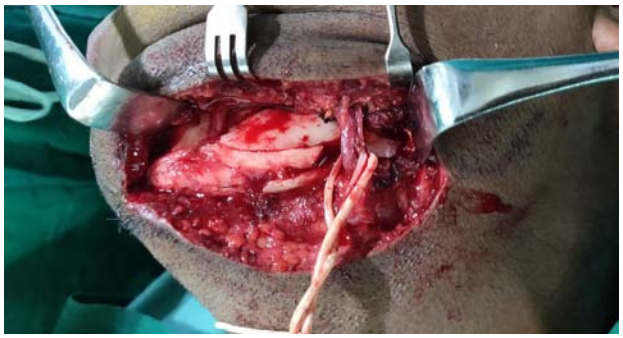


Figure 4: Exposed surgical site showing facial artery and vein

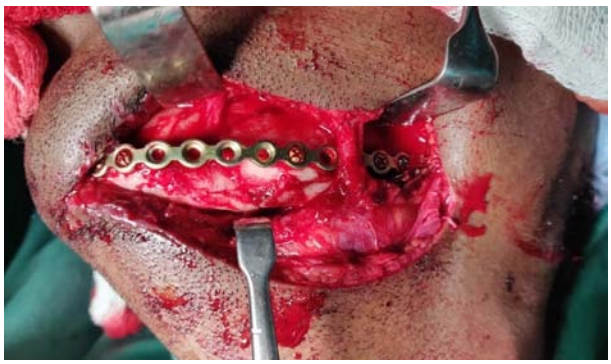


Figure 5: Reconstruction plate of 13 hole with 2.5 mm is fixed at the comminuted fractures



Figure 6: Post-operative OPG showing reconstruction plates with reduced fracture fragments

III. Discussion

To treat communicated fractures is a challenge because of difficulty in reducing fractured fragments. Various treatment modalities include closed reduction,

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external pin fixation, internal wire fixation, and open reduction. Closed reduction was used for management of comminuted fracture before to preserve the periosteal blood supply of fractured fragments. Authors concluded open reduction with internal fixation as a better treatment modality for fixation of comminuted fractures, whenever possible.[2] Its advantages are a stable internal fixation of bone fragments, and return of function and shorter maxillomandibular fixation period.[2]

Materials usually used for internal fixation include titanium plates and screw, reconstruction plate, titanium mesh, and bio absorbable mesh. Most of the studies show either 2.7mmor 2.4 mm reconstruction plate for fixation of comminuted fractures[2]. Firstly, the erich arch bars are placed to form single arch and help in guiding the occlusion while doing open reduction and then fixed with the locking reconstruction plate and three or four screws on either side of the fracture. Usually non-compression plates are used for communicated fracture.[2]

Second option in preserving the vascularity to the communicated fragments and preventing secondary infections, thus closed reduction has been considered as the treatment of choice. However, recent reports insisted that open reduction and internal fixation (ORIF) is a better treatment option with fewer complication rates. Due to advancement in surgical method and armamentarium, the internal fixation is more favored for ORIF in the management of a comminuted mandibular fracture. It was also suggested that closed reduction or conservative treatment is a better choice only when there is minimally displaced comminuted fractures.[1]

Plates and screws are used for rigid fixation to prevent displacement of fracture segments by absorbing a part of the functional load that is present at a fracture site. Subsequently, several things to be taken into consideration or the choice must be made regarding the proper plate length and thickness required, and what type and size of screws to use. First plate length is generally determined to allow for the placement of more than one screw on either side of fracture to nullify the dynamic forces that act on the mandible in ideal conditions. Three screws are placed on either side of the fracture segments for adequate stabilization. The screws are placed at least a millimetre from the fracture site.[8,9]

A plate thickness is determined by the forces required to stabilize fractured bone segments. Options are first load sharing fixation with mini plates, or load-bearing with reconstruction plate. These options differ in their internal screw diameter, thickness, surface area of in-contact bone (footprint), titanium grade, malleability, which has ability to stabilize the bone segments against the intrinsic forces on the mandible. These characteristics, in general, increase as one progress from mini plates, locking plates, to recon plates.[6-10]

The simplification of the comminuted fragments with mini plates and screws are used as an aid in reducing fracture, for subsequent fixation with reconstruction plates.[4,11]

A mandibular reconstruction bone plate can be used to bridge the comminution gap and stabilize the most proximal and distal segments.[11,12] If major fracture parts are fixed, other minor fragments at the site can heal well even if unfixed. Comminuted fractures should have load bearing fixation applied across the area of comminution.[12] A reconstruction plate with at least three and preferably four screws on each side of the comminuted area is the optimal way load bearing fixation is being provided.[3,13] For condylar fractures, the conservative management is the treatment of choice for the majority of fractures.[14] In general, early mouth opening exercises is essential for the treatment of condylar farctures.[14] Open reduction of condylar fracture is recommended when it is impossible to achieve pre-traumatic or adequate occlusion by close reduction.

That's why in our case we have used 13-hole reconstruction plate with 8mm x 2.5mm screw were fixed on either side on the left body of mandible, but the condyle fracture was treated by closed reduction since the vertical height of ramus was maintained we have given intermaxillary fixation for 3 weeks.

IV. Conclusion

In this case report, we observe that there is no consensus concerning the manner of treating comminuted fractures of the mandible. The neck of the condyle fracture didn't compromise the vertical height of ramus hence we have managed it conservatively. We recommend the use of reconstruction plate for comminuted fracture of mandible. Open reduction with internal fixation with large reconstruction plates would provide rigid fixation and with minimum number of complications, combined with the use of post-operative maxillomandibular fixation, should be the treatment of choice.

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Age Old Treatment with a Change: Auto Transplant of Natural Tooth

By Dr. Sanchit Jain, Dr. Rajesh B Dhirawani, Dr. Ankit Sharma, Dr. Garvita Sahu, Dr. Indraj Arora & Dr. Irfan Zunzani

Abstract- One of the goals of dentistry is to replace missing teeth to restore function of mastication and aesthetics. Autogenous tooth transplantation or auto-transplant of natural teeth is the surgical transplantation of vital or root canal treated tooth from its original location in the mouth to another site of the same individual.

The successful auto-transplantation of the third molar was initially reported by Fong in the year 1953. Auto-transplantation is a feasible, fast and economical option for the treatment of non-salvageable teeth. This is possible only when a suitable donor tooth is available. The outcome of any surgical procedure carried out is dependent on careful case selection along with detail understanding of biological principles involved in the procedure.

Success rates reported in studies which are previously reported vary considerably, ranging from 74-100% for transplantation of third molars. The prognosis of auto-transplantation is generally good not only because of the probability of tooth integration in the alveolar bone, but also due to lack of any histocompatibility problem which is associated with other kinds of transplant.

Keywords: *transplantation, autogenous tooth transplantation.*

GJMR-J Classification: *NLMC Code: WU 500*



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Age Old Treatment with a Change: Auto Transplant of Natural Tooth

Dr. Sanchit Jain [α], Dr. Rajesh B Dhirawani [σ], Dr. Ankit Sharma [ρ], Dr. Garvita Sahu [ω], Dr. Indraj Arora [¥] & Dr. Irfan Zunzani [§]

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There is no problem of availability of tooth which has to be transferred at the functional area as the third molars are considered to be vestigial tooth.

Keywords: transplantation, autogenous tooth transplantation.

I. Introduction

Auto-transplantation is the transfer of the one`s self tooth from one portion of the alveolar portion to another site in the same individual. Auto-transplantation is an age-old treatment which was first performed successfully by Fong in the year 1953. (1, 2) Auto-transplantation is not performed commonly these days owing to its surgical requisites. With the advent of the Osseointegrated implants, this treatment modality has further lost its charm. (1) The earliest of the auto-transplantation, performed in ancient Egyptian population where the slaves were forced to give their teeth to pharaohs. (3) The Osseointegrated implants since its advent have attained a lot of popularity and there has been vast research in this field. The auto-transplantation has not been advocated and researched by various authors. This is due to the fear of failure which is associated with the procedure of auto-transplantation and also the surgical difficulty of the same. (3) Auto-transplantation has various benefits which are to be considered and adequately informed to the patients and hence promoting this treatment. Its applicability is well accepted in patients, who are in younger, a growing age group where osseointegrated implants are contraindicated. With increasing incidences of early caries and loss of tooth, there is a need to understand and advocate auto-transplantation with its best potential and treatment modality. (1, 2) The paper aims at demonstrating the success of auto-transplantation and the treatment protocol which can be followed for adequacy of treatment.

II. Material and Methods

The patients are chosen with the utmost care, and adequate history was taken to rule out any chronic illness and medication that would interfere with the healing process. The patients who are chosen did not have any systemic debilitating conditions. Young patients are included in the study with age ranging from 19-26 yrs. Prime inclusion criteria is that the patient should have a non-restorable recipient tooth indicated for extraction along with a non-functional donor tooth. Those patients who are co-operative, with adequate oral hygiene maintenance are included in this study. The adequate width of bone and keratinized gingival tissue at the recipient socket serves as criteria for successful auto-transplantation.

The patient who had acute inflammation and unfavorable root morphology of the donor`s teeth are excluded from this study. The need for any other surgical treatment like cystic enucleation are excluded from this study. This study included patients who are treated from the year 1996 till the year 2014. All the patients whose data are inadequate are excluded from the study. The follow up was carried out on a minimum for one year to determine the success of the treatment.

Adequate treatment planning for the patients who are chosen for the auto-transplantation included the clinical and radiographic evaluation of both the donor tooth and the recipient site. Though CBCT serves as the proper imaging modality, considering the economic constraints of the patients OPG of all the patients are done preoperatively, and buccolingual/mesiodistal dimensions of both the recipient site and donor`s tooth is calculated. Dilacerations and unfavorable pattern of root formation as well as any associated lesion around the donor tooth is evaluated; and all those cases in which extraction of donor tooth requiring tooth

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sectioning or any other surgical procedure are excluded. Auto-transplantation is then performed, and modification of the technique used in accordance with the apex of the donor`s tooth, whether it is open apex or closed apex.

All the patients in this study are treated in single stage. The steps of this treatment protocol are discussed in this section. With the help of Vernier caliper and OPG buccolingual and mesiodistal dimensions of donor tooth and recipient socket is calculated pre-operatively both clinically and radiographically. Atraumatic extraction of the tooth which is present in the recipient site was done. Inter-radicular preparation was done to achieve adequate space and also achieve a "snug-fit." The recipient site is contoured with a rongeur. Thorough curettage is done in cases of long-standing chronic infections. Apical portion of the socket bed is re-contoured where donor`s tooth has closed apex as it not only helps in providing an apical cushion or tension-free zone for the donor tooth but also helps in placing the donor tooth at infra-occlusal level.

For extraction of donor`s tooth, envelope flap was taken to expose the bone of the donor site and adequate bone guttering done to extract the donor tooth in Toto. The donor`s tooth was held with a blunt instrument above the cementoenamel junction (CEJ) to avoid injury to the periodontal fibers and preserve the hertwig`s epithelial root sheath. The tooth was then placed at the recipient site to evaluate the fit. The preparation if found inadequate, is modified with the help of a slow speed headpiece and vulcanite bur to achieve adequate fit. In cases where mesio-distal dimension of donor`s tooth is more than recipient socket, proximal splicing of adjacent tooth is done. In case where recipient socket's dimensions was more than donor tooth dimension, PRF + bone graft was used. We used inter-radicular bone as well as particulate bone grafts. When the desired fit was achieved then the occlusal level of the tooth was evaluated, and the tooth was intended to be placed at an infra-occlusal level to avoid any trauma that would occur during the function which would in-turn affect the healing process. In open apex cases, the tooth is placed 1.0 to 1.5 mm below the occlusal plane as the tooth would erupt with time and in closed apex cases, the tooth is placed 0.5mm. If needed, enameloplasty is done for adequate clearance. The tooth is then stabilized with the help of 2-0 silk sutures and perio-pack. In no case, RCT was done at the time of transplantation.

Follow up of all the patients done at one week, two weeks, one month, three months, six months, and 1 year postoperatively. Parameters for determining success included physiological mobility not more than 1 mm, periodontal pocket not more than 3 mm, root resorption and pulp vitality which are evaluated during follow up.

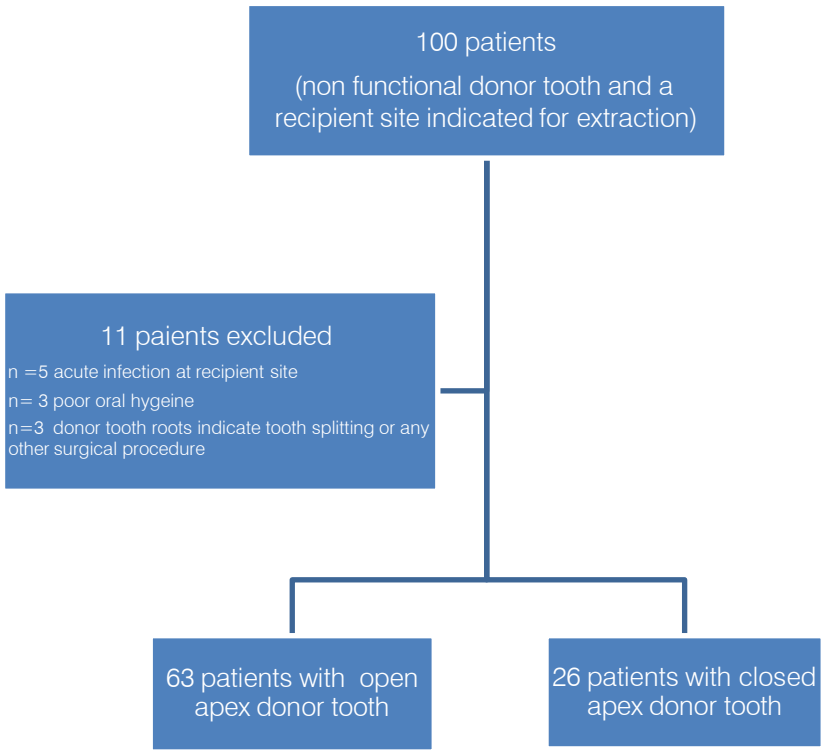


Figure 1

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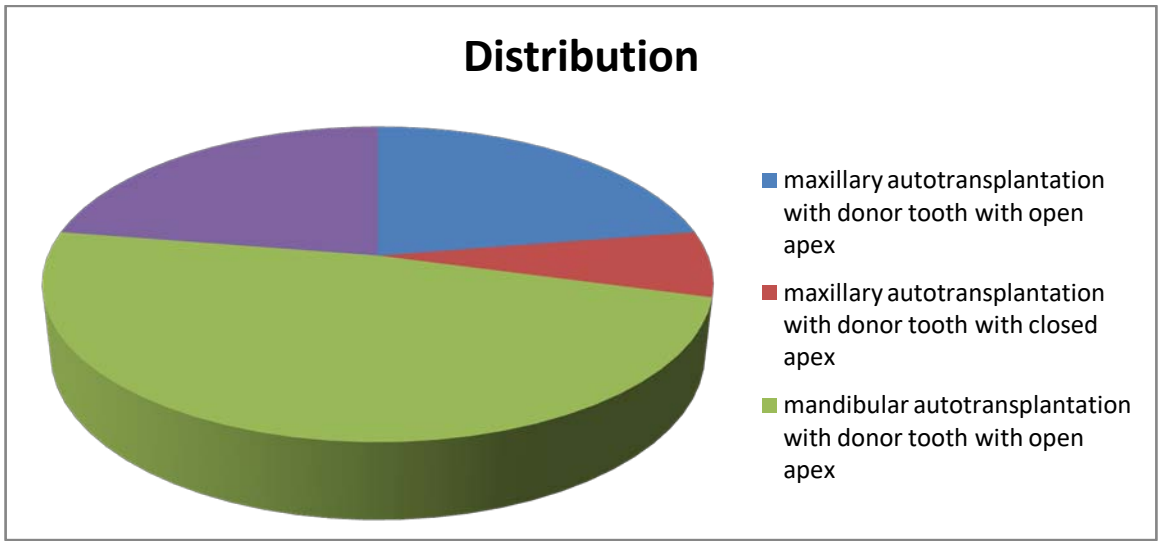


Figure 2

III. Results

89 auto-transplantation of molars was carried out of which 26 were upper molars and 63 lower molars. All the teeth were evaluated radiographically and clinically for any mobility, discoloration, and other reasons for failure. There was no associated pain after the transplantation of teeth and resorption of the root which would indicate for the need of root canal therapy. None of the teeth were root canal treated whether the tooth was having a closed apex or an open apex. There were four teeth which were removed post-surgically because of failure of the tooth to gain stability which hence gave a survival rate of 95.51%. The minimum follows up of patients were for six months, and the maximum follows up for about two years was done. There was no tooth which on follows up showed signs of resorption.

Table 1

Auto-transplanted tooth	Complications	Management
Maxillary tooth transplantation • Total tooth transplanted: 26 • Complications seen in: 6 cases in total including failure	• Failure : 3 cases • Periodontal pocket > 5mm : 3 cases	• Extraction of the teeth • Periodontal therapy Maintenance of oral hygiene
Mandibular tooth transplantation • Total tooth transplantation: 63 • Complications seen in: 4 cases in total including failure	• Failure : 1 cases • Periodontal pocket >5 mm : 3 cases	• Extraction of the teeth • Periodontal therapy Maintenance of oral hygiene

Even after adequate periodontal management of teeth, one transplanted tooth is extracted due to post-operative mobility after six weeks, 15 patients had to undergo RCT out of which 12 had closed apex at the time of transplantation. Periodontal pocket > 5 mm was seen in 30 cases during the initial follow up period but in later stages, periodontal health of 24 patients improved but rest six patients still had pocket depth > 5mm. Tooth resorption is noted in 1 case. Ankylos is occurred in 2 patients. Hence the survival rate dropped to 94.38%, which is lower to the success of the Osseointegrated implants but still significant for adopting the auto-transplantation as a regular procedure. Extra-oral dry time of donor`s tooth is as minimal to 2 mins with a maximum of 12 mins.

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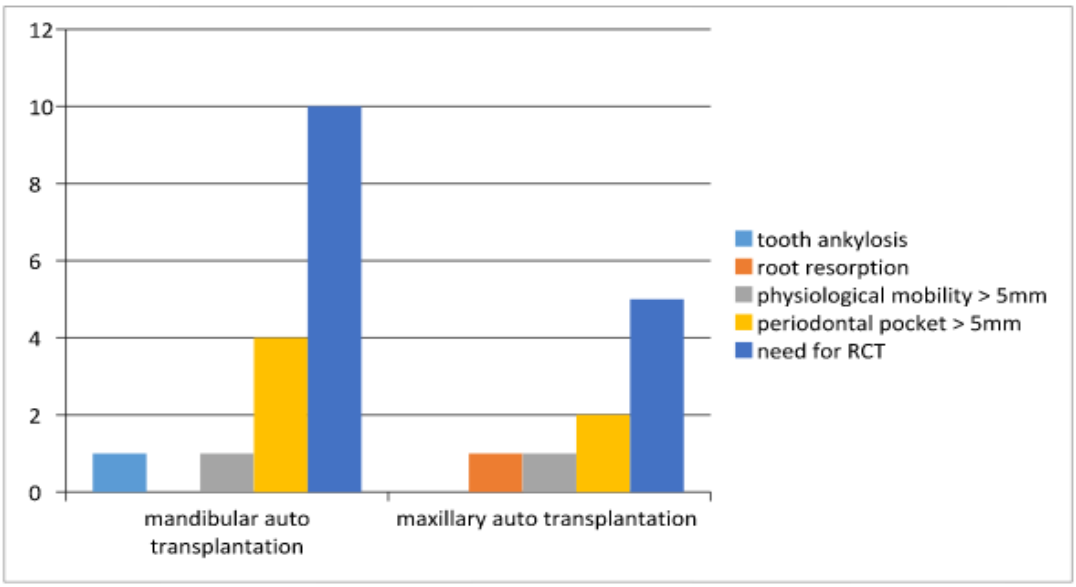


Figure 2

Complications followed by auto-transplantation during one year follow up.

IV. Discussion

Dental rehabilitation should be achieved after the loss of one or more teeth with several techniques, including removable partial dentures, fixed prosthetic framework, Osseo-integrated implant placement, or auto-transplantation. The success rate of autogenous tooth transplantation ranges from 50-80%.(8) The variable success rate is due to the increased rate of dental root resorption and improper preparation of the tooth and also factors that which are considered for proper healing in the auto-transplanted tooth. The incidence of dental root resorption after transplantation has declined over time with advances in materials and more studies which focused on root preparation and maintenance of viability of the periodontal (PDL)fibers of donor`s tooth. Tsukiboshi reported a 90% survival rate and an 82% success rate in 250 cases observed for six years which is similar to the results obtained in our study. (5)

Treatment planning of auto-transplantation is a multidisciplinary approach in which the patient selection is the most important criteria. The analysis of the recipient site includes the calculation of the mesiodistal and buccolingual width of the tooth which also can be done clinically with the help of Vernier caliper. (3) In cases where immediate auto-transplantation is planned, the procedure is carried out within 14 days owing to shrinkage of buccolingual dimension post-extraction. The analysis of edentulous space can be done using trans-gingival probing. Adequacy of the cover of bone on all the sides and keratinized gingiva is mandatory for stabilization of tooth at the recipient site. (LASKIN) The most recent development in the analysis includes the computer-aided rapid prototyping with the help of 3-dimensional tomography. This analysis used in the tooth auto-transplantation can help in determining the amount and type of preparation of the recipient site which would indirectly help in reducing the amount of time extra-orally and hence enhance the success of auto-transplantation. (8)

Successful transplantation requires approximation between the shape and size of the donor`s tooth and the receptor site. It also has been postulated that maxillary transplants have high risk of failure due to the wide variation in the size and shape of the teeth. The proximity of the maxillary antrum to the molar sockets also plays a role in determination of success. (1) Whereas fabrication of a “dummy third molar” either using plaster, ivorine, or hard wax waa described by Hernandez et al. in 1988. The tooth was used to take an impression of the recipient socket before extracting the “real” donor tooth. This technique avoided delay and unnecessary extra manipulation before insertion of the transplanted tooth. (9)

With the help of OPG dimensions of the recipient site and donor, 82% of cases showed snug fit of donor`s tooth on recipient site. In another 12% of cases, there was minimal discrepancy between the mesiodistal space at the recipient site and mesiodistal dimensions of donor`s tooth, where appx. 5 mm proximal splicing of adjacent tooth is done. In another 6% of cases, the recipient space was more than the dimensions of donor`s tooth; PRF along with bone graft was used in these cases.

One of the reasons for the high success rate seen in our study was the age group of the study sample, which was between 19-26 years. Young age patients show a high regenerative capacity of the PDL fibres. With increasing age difficulty with the extraction of

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tooth increases due to increased mineral density of mandibular bone. Also, the osteogenic potential of bone formation decreases.

In the earlier studies, donor`s tooth was extracted first followed by extraction of recipient tooth. But in our study, we advocated extraction of recipient`s tooth first followed by recipient site preparation. It not only reduces the extra-oral time but also minimizes repeated trails of donor tooth on the recipient site. Insufficient buccolingual width in the recipient site can result in resorption of the alveolar ridge along with loss of buccal bone coverage leading to consequent loss of periodontal integrity. We removed the interdental bone after the extraction of the recipient tooth, and the recipient site was debrided. Some of the authors have documented that curettage affects the vitality of PDL fibers. Though none of the cases included in our study had acute/severe infection we still advocated thorough curettage in cases of long-standing chronic infections. As infection in the recipient site with long-standing decayed molars, impair bone regeneration and healing.

The tooth with 1/3rd to 2/3rd root completion can be transplanted with adequate success when compared to tooth whose root completion is less than 1/3rd because of increased chances of damage of PDL fibers. (3,4)A root completion less than 1/3rd may compromise the root development causing altered morphology of tooth. When the tooth roots are longer, they may encroach adjacent vital structures like maxillary sinus for the upper tooth and inferior alveolar nerve canal for the lower tooth. (3) The tooth with closed apex may require root canal therapy because of the decreased blood supply, which is not the case in a tooth with an open apex. (2,4) This increases the chance of revascularization hence increasing the chances of maintenance of tooth vitality. (3)However, the auto-transplanted teeth with obliterated pulp is kept in observation for a follow-up, and crown preparation is avoided. (10) The continuous laying down of osteodentine in the pulpal canals occurs with a time that shows either decrease or increase in size of the chamber. (11)

The success rate of auto-transplantation is extensively dependent on the PDL regeneration around the donor`s tooth. The periodontal ligament cells are extremely sensitive, and their survival ability is significantly reduced in cases where extra-oral dry time is prolonged. The viability of the PDL fibers is dependent upon the extra-oral dry time, which is considered in our study; hence, no external resorption was seen. The excess force which is transmitted during retrieval of the donor`s tooth also affected the vitality of PDL fibers which is of main concern during the performance of the procedure. (3,6)

Bae J. H et al. in the year 2010 postulated that the risk of failure is more in the maxillary tooth due to variation in size and shape of teeth and proximity to the maxillary sinus which is similar to the results obtained in our study. (7)

Splinting of the transplanted tooth is avoided in cases of snug fit by various authors. Semi-rigid splinting is preferred over the rigid splinting cause of increased chances of tooth ankyloses in rigid splinting and also root resorption due to indirect damage to PDL fibers. The various modalities for splinting are periodontal packs, suture splinting, ligature wires, composite splinting. The splitting is done above the CEJ to avoid injury to PDL fibers. (3)Semi-rigid splinting is advocated for 10 -14 days beyond which damage to the PDL fibers is noted. As an active phase of bone formation occurs between 4 to 8 weeks, followed by a quiescent period of 4 weeks in which the individual trabeculae become mature. Therefore, Tsukiboshi et al. reported that the tooth is fixed for between 2 weeks and two months depending upon mobility. (5, 6)

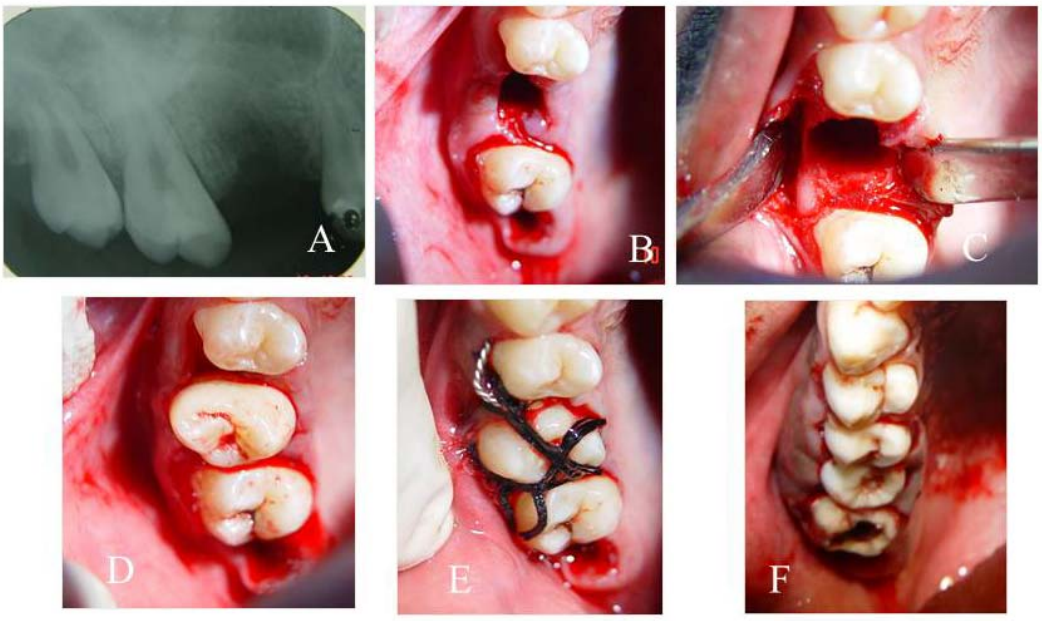
The tooth is placed infra-occluded in the recipient site after the placement of the donor`s tooth. The tooth if placed exactly at occlusion, after the transplantation will lead to force distribution along the root margins damaging the PDL fibers. For the success of auto-transplantation, a proper adaptation of the root surface of the transplanted tooth to the bony walls of the recipient site is of prime importance. Close contact of the transplanted tooth with the bone not only provides better blood supply and adequate nutrition to the PDL but also reduces the chances and probability of tooth ankyloses. (2, 3)

The odentectomy of the tooth is avoided in the cases of the auto-transplantation which required for adequate removal of bone. The amount of force for the delivery of the tooth out of the socket also should be considered. Hence sufficient removal of bone and proper handling is utmost important in these cases. There is a need for further long term studies in these cases for coming towards a proper sequencing and planning in auto-transplantation.

V. Conclusion

The auto-transplantation can be used successfully for patients if adequate treatment planning and assessment are done preoperatively. The success rate of auto-transplantation is significant, and hence, this modality can be used successfully. This treatment needs to be promoted further and assessed by surgeons and modified to increase the success of the same. The growth of jaw which is one of the factor considered for avoiding usage of Osseo-integrated implants can be the one which favors auto-transplantation in the patients which have not attained adequate growth.

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Photos: Case 1: Successful auto-transplantation of third molar on the site of extracted first molar

A. Preoperative post extraction radiograph of the surgical site
B. Clinical photograph of extracted socket
C. Preparation of socket
D. Placement of third molar in the socket of first molar
E. Stabilization of tooth in the socket
F. Post healing clinical photograph taken after 1 year

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C-Shaped Canal System in Mandibular Second Molars Evaluated by Cone-Beam Computed Tomography in an Argentine Subpopulation

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Abstract- *Introduction:* To evaluate cone-beam computed tomography (CBCT) images in order to determine the presence of mandibular second molars with C-shaped canal system and classify them.

Methods: 3035 CBCT images fulfilling the selection criteria were observed. Once established the presence of C-shaped canal system, they were classified according to the anatomic and radiographic classification of Fan et al. Data description was made by frequencies and percentages rates, with a 95% confidence interval (IC95) according to score method. Comparisons were assessed by means of the Chi-square test with a significance level equal to 5%.

Results: Of the 225 selected patients, 44 exhibited C-shaped canals (20%; IC95: 15% to 25%). 70% (IC95: 56% to 82%) of patients showed a bilateral C-shaped canal system pattern. Regarding to the axial plane -anatomic classification-, there was a significant association between the root third and the configuration (Chi-square=76.89; $p<0.05$): at the coronal third prevailed the C1 configuration (47%; IC95: 36% to 58%); at the middle third prevailed the C3d configuration (39%; IC95: 28% to 50%) and at the apical third, the C4 configuration (35%; IC95: 25% to 46%).

Keywords: *C-shaped canal, dental anatomy, mandibular second molar, cone-beam computed tomography.*

GJMR-J Classification: *NLMC Code: WU 500*



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C-Shaped Canal System in Mandibular Second Molars Evaluated by Cone-Beam Computed Tomography in an Argentine Subpopulation

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Conclusions: The present study contributes to the epidemiological information about an anatomical variable of the inner dental configuration and its extrapolation to clinical practice.

Keywords: C-shaped canal, dental anatomy, mandibular second molar, cone-beam computed tomography.

I. Introduction

One of the purposes of the endodontic treatment is the cleaning and shaping of the root canal system. Thus, it is imperative the understanding of the inner dental anatomy to ensure a successful treatment.

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Numerous studies on the C-shaped root canals and their anatomical variations have been published. Historically, Keith & Knowles (1) were the first authors to depict the C-shaped root canals. This specific morphology was observed in cross-sections of mandibular second molars in a Neanderthal man. However, these authors have not assigned a specific terminology to the assessed anomalies.

The C-shaped root was first analyzed in detail by Nakayama (2), who gave it the name *"gutter-shaped root"*. Tratman (3) stated that the C-shaped root morphology can be frequently observed in mandibular second molars of Asian individuals, and he defined this shape as *"horse-shoe reduction form"*. Thirty years later, Cooke & Cox (4) reported a number of cases observed in clinical practice. Since then, the term *"C-shaped canal"* and *"C-shaped root"* have been widely employed by researchers and clinicians around the globe (5).

The main anatomical feature of the C-shaped roots is the presence of a fin or web connecting the individual canals. In this type of molars, the canal orifice is ribbon shaped describing an arc of 180° or larger, instead of the typical pulp chamber form with three root canals (6, 7).

It is postulated by Manning (8) that the failure of the Hertwig's epithelial root sheath to fuse on the lingual or buccal root surface causes this C-shaped root form, which always presents a C-shaped canal configuration.

The prevalence of C-shaped root systems in mandibular second molars is 2.7- 7.6% in the Caucasian population (4, 9), 10.6% in Saudi Arabians (10), 19.14% in Lebanese (11), being higher in Northeast Asia, 31.5% in Chinese (12) and 32.7% in Korean populations (13).

Melton et al. (14) proposed the earliest classification of the C-shaped root canals and later, Fan et al. (15, 16), based on the former one, introduced an anatomic and radiographic classification (7):

a) Anatomic classification

Category I (C1): The shape is an uninterrupted "C", with no separation or division.

Category II (C2): The canal shape resembles a semicolon, resulting from a discontinuation of a "C" outline.

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Category III (C3): 2 or 3 separate canals.

Category IV (C4): Only one round or oval canal in the cross-section.

Category V (C5): No canal lumen can be observed, which is usually seen near the apex only.

b) Radiographic classification

Conical or square root with a radiolucent longitudinal line separating it into distal and mesial parts.

Type I: There is a mesial and a distal root canal merging into one before reaching the apical foramen.

Type II: There is a mesial and a distal root canal continuing their own pathway to the apex.

Type III: There is a mesial and a distal root canal. One canal curves as overlapping with the radiolucent line when reaching the apex and the other root canal appears to run its own pathway to the apex.

The C-shaped canals are not always to be continued from the entrance orifice of the root canal to the apical foramen with this "C". Usually, a tooth is defined as exhibiting a C-shaped canal system when its cross-section presents a C-shaped root.

The C-shaped canals have a high possibility of being divided into two or three canals (13). The root and the canal shape in the middle and the apical thirds cannot be predicted on the basis of the canal shape at the chamber floor level (15, 16). That is why studies are carried out with the aim of classifying them.

Many of the research works done on the anatomic features of the C-shaped canals are invasive studies conducted on extracted teeth. A non-invasive tri dimensional imaging (3D) technique as the cone-beam computed tomography (CBCT) has been reported to be sufficiently accurate for the morphologic analysis (17).

The CBCT images have been more routinely used than the conventional computed tomography (CT) due to its higher resolution, along with a reduction of the radiation dose and a shorter working time (18). The American Association of Endodontists (AAE) states that the CBCT imaging should be considered when the conventional dental radiography does not allow to set an adequate diagnosis (19).

The aim of this study has been to assess the CBCT scans taken at the Department of Diagnostic Imaging, School of Dentistry of the University of Buenos Aires (FOUBA) in order to determine the presence of second mandibular molars with C-shaped canals and classify them. This study has an epidemiological type of repercussion. There have not been found similar reports in the Argentine population.

II. Materials and Methods

A retrospective, observational, cross-sectional and descriptive study. On a database of 5514 PDFs, resulting from 3035 CBCT images of patients, taken with a CBCT unit in the timeframe between September 2016 and April 2018, 225 PDFs were selected fulfilling the following criteria:

a) Inclusion criteria

- Mandibular tomography, in which both second molars can be observed.
- Mandibular second molars with developed apices.

b) Exclusion criteria

- Crown-root decay involving pulp chamber floor.
- Previous endodontic treatment.
- Root resorptions.
- Crown post/core and/or crown.
- Images that cannot be correctly visualized.

Ethical considerations have been taken into account. All the patients participating in this study signed the informed consent form which stated that the information and the imaging studies could be used with academic or scientific purposes, being his/her identity preserved by FOUBA (Resolution (CD) N° 983).

The assessed images have been acquired with a Kodak 9000c 3D CBCT system, with 70 Kv and 10 mA, exposure time from 10.8 to 32.4 seconds depending on the extension -either the hole dental arch or half of the dental arch- and at a voxel size of 200 μm x 200 μm x 200 μm. The above studies have been requested by different clinicians for the diagnosis and resolution of preexisting pathologies that have not been the motive of the present research.

CBCT images have been examined by two endodontists from FOUBA, trained on the observation of tomography slices and updated by means of the continuous critical reading of scientific reports related to the subject matter of this work. To measure the inter-observer agreement, the Cohen's kappa unweighted coefficient was used. The kappa coefficient (κ) with a 95% confidence interval (IC95) was obtained. A Z test was applied to analyze the difference between the coefficient obtained and the zero value, with a significance level of 5%: a $p<0.05$ value indicates that the Cohen's kappa coefficient differs significantly from zero. The Cohen's kappa coefficient value was computed according to the criteria proposed by Altman (20). The assessment was done in software R version 3.5.1 (21): packages "irr" (22) and "psych" (23) were used. When the inter-observer agreement was estimated between the observers who collected the data, it was found that both professionals agreed in all cases. The formal analysis showed a significant and very good agreement for evaluating the presence of C-shaped canals ($\kappa=1$; IC95: 1 to 1; $Z=6.3$; $p<0.05$; $n=40$) and C-shaped type of canal according to axial orientations ($\kappa=1$; IC95: 1 to 1; $Z=11.4$; $p<0.05$; $n=40$) and sagittal ($\kappa=1$; IC95: 1 to 1; $Z=8.2$; $p<0.05$; $n=40$).

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The information was collected by direct observation of the complete volumes with the Extraoral Imaging System software, Carestream Health Inc, Rochester, NY, USA.

One and a half-hour a day shift was arranged to avoid visual strain and the misinterpretation of images. The collected data were entered into specific data recording sheets for this report.

The definition of the C-shaped root canal system in the mandibular second molars requires that all the teeth exhibit the following three features: (I) fused roots, (II) a longitudinal groove on the lingual or the buccal surface of the root and (III) at least one cross-section of the canal should belong to the C1, C2, or C3 configuration. The C3 type can show two or three separate orifices, but an isthmus connecting them can be seen. The round or oval type, which can be encountered near the apex, must be considered as C4 when another part of the canal is C-shaped (15).

The anatomic classification was established performing three axial slices at different levels in accordance with the pertinent root third: "Coronal", 2 mm apical to the canal entrance orifices at the chamber floor; "Apical", 2 mm above the apex; "Middle", average distance between "coronal" and "apical". A sagittal slice was used for the radiographic classification.

Data description was achieved by absolute frequencies and percentages with 95% confidence intervals. The IC95 was obtained by the Wilson *score* method (24). A spreadsheet was used to calculate them, based on the resource ICPROPORCION.xls (25). The Chi-square test was used for the comparison of frequencies, which was implemented in the Infostat software, version 2018p (26). The significance level chosen was set up at 5%.

III. Results

Out of a total of 5514 PDFs, belonging to 3035 CBCT images of patients, 225 corresponded to patients meeting the selection criteria requirements. Out of these 225 patients, 44 showed C-shaped canals, that is to say, a 20% (IC95: 15% to 25%).

The female sex prevailed. Out of 44 patients, 28 were women (64%; IC95: 49% to 76%) and 16 were men (36%; IC95: 24% to 51%): this difference was not significant (Chi-square=3.27; p=0.07) (Fig. 1A).

Out of 44 patients, 31 showed bilateral pattern of C-shaped canals (70%; IC95: 56% to 82%) while 13 patients presented unilateral C-shaped canals (30%; IC95: 18% to 44%) (Fig. 1B, 1D y 1E): This was a significant difference (Chi-square=7.36; p<0.05).

The prevalent tooth was the 4.7 when the unilateral pattern was showed. The tooth 4.7 was found in 9 patients out of 13, presenting unilateral C-shaped canals (69%; IC95: 42% to 87%) and the tooth 3.7, was found in 4 patients (31%; IC95: 13% to 58%) (Fig. 1C): the difference was not significant (Chi-square=1.92; p=0.17).

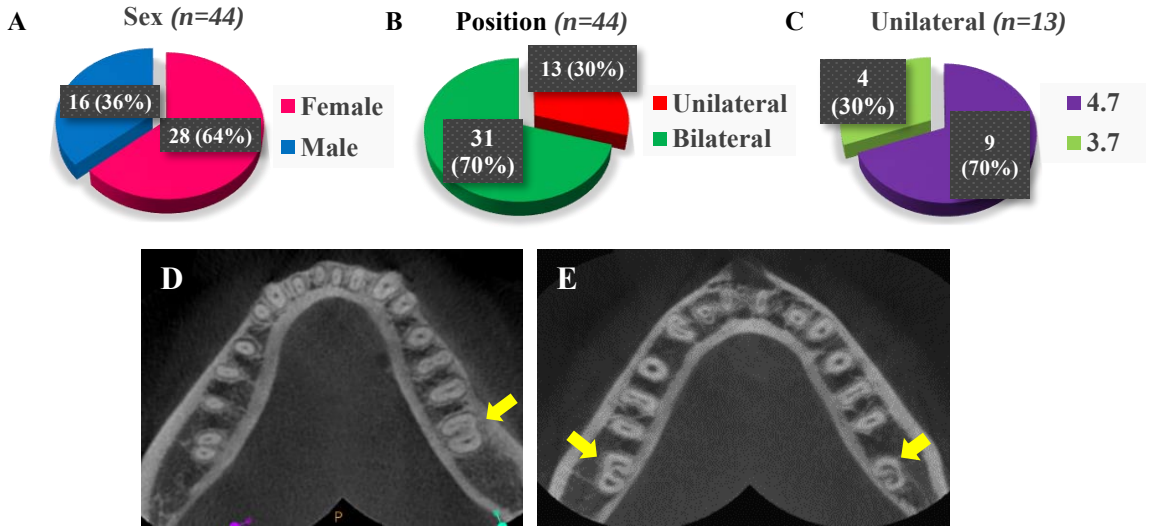


Figure 1: Prevalence of C-shaped canals according to (*A*) sex, (*B*) position, uni or bilateral and, (*C*) tooth 3.7 or 4.7, when were unilateral. CBCT axial slices in which the presence of unilateral *(D)* and bilateral *(E)* C-shaped canals is shown with yellow arrows.

As far as the anatomical classification -axial plane-, there was a significant association between the radicular third and the configuration (Chi-square=7. 89; p< 0.05): in the coronal third prevailed the C1 configuration (47%; IC95: 36% to 58%); in the middle third, C3d (39%; IC95: 28% to 50%); and in the apical third, C4 (35%; IC95: 25% to 46%) (Table 1 and Fig. 2).

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Table 1: Frequency C1, C2, C3c, C3d, C4, C5 as per coronal, middle and apical thirds.

	C1	C2	C3c	C3d	C4	C5	Total
Coronal	*35*	9	16	15	0	0	75
Middle	18	9	19	*29*	0	0	75
Apical	15	5	6	22	*26*	1	75

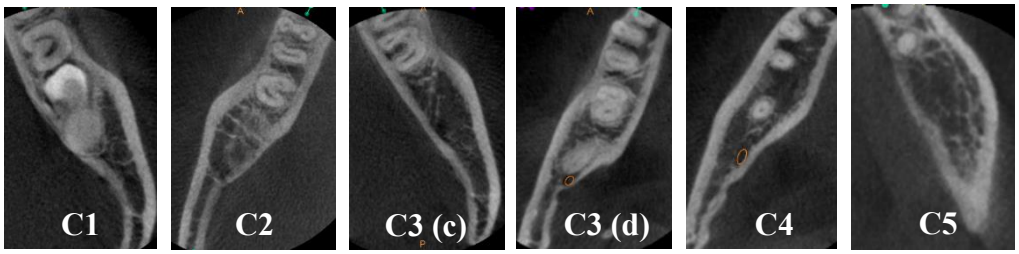


Figure 2: CBCT images of axial slices in which the different categories are shown in accordance with Fan et al. classification.

There was no significant association between the tooth and the radiographic classification -*sagittal plane*- (Chi-square=0, 99; p=0, 61): The type I prevailed in both teeth, 4.7 (58%; IC95: 42% to 71%) and 3.7 (66%; IC95: 49% to 79%) (Table 2 and Fig. 3).

Table 2: Frequency in the sagittal plane. Type I, II, and III.

	Type I	Type II	Type III	Total
4.7	23	12	5	40
3.7	23	7	5	35

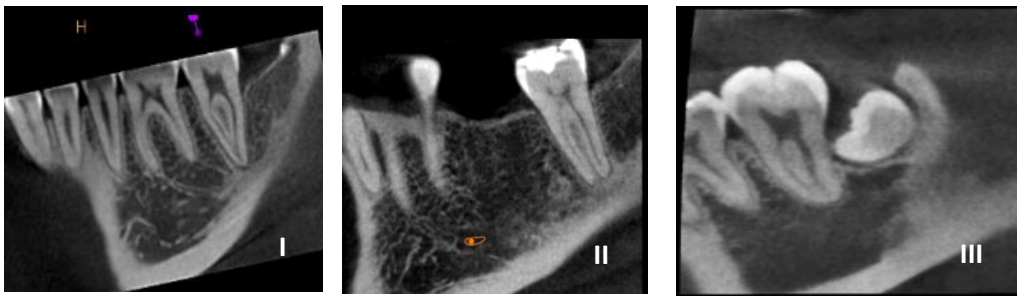


Figure 3: CBCT images of sagittal slices in which the different categories are shown according to the Fan et al. Classification.

In 72% (IC95: 61% to 81%) of the cases, configuration changes have been observed at different levels. In 28% (IC95: 19% to 39%) the same configuration was observed in the three thirds (Table 3 and Fig. 4): this difference was significant (Chi- square=14.52; p<0.05).

Table 3: Configuration in the three-thirds of teeth with C-shaped canals.

Configuration in the three thirds (coronal, middle and apical thirds) of teeth with C-shaped canals	Teeth with C-shaped canals (n=75)
Configuration has no changes	21
Configuration changes	54

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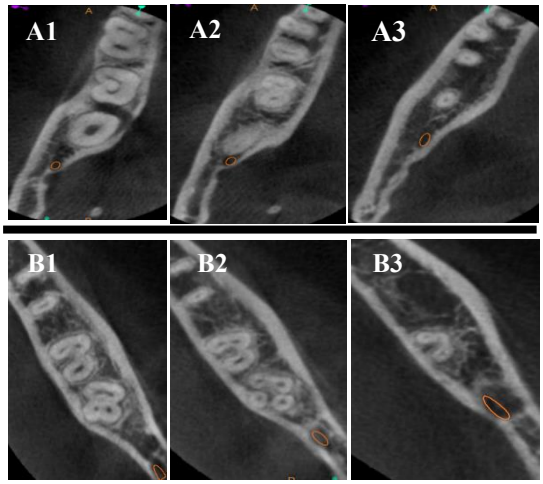


Figure 4: CBCT images showing the C-shaped canal configuration: *(A)* changes *or (B)* no changes. *(A1* and *B1),* coronal third; *(A2* and *B2),* middle third; *(A3* and *B3)*, apical third.

IV. Discussion

The C-shaped canal system has been the subject of many research works performed *in vivo* and *ex vivo* for its study. The literature points out that the presence of C-shaped canals is higher among the East Asian population, exhibiting China the highest prevalence (44%) (12). In European countries, such as Spain and England the prevalence rate varied between 7.8% and 11% (12), whereas studies in Italy reported a 6.2% (27), an 8.5% in Portugal (28), and a 10.7% in Belgium (29). A study performed in Brazil indicates a 3.6% (30) prevalence, whereas another study reports a 6.8% (12). As regards the American population, von Zuben et al. (12) were the first to investigate the C-shaped canals prevalence using CBCT imaging, obtaining a result of 11.3% that was higher than the 7.6% described in prior studies (9). On the other hand, von Zuben et al. reported a 9.3% prevalence in South Africa and a 14.2% prevalence in Mexico (12). Another study conducted on panoramic radiographs in Mexico reports a 36.8% prevalence (31). At the time this work was performed, similar reports were not found regarding the Argentine population.

Earlier reports show that sex has no significant influence on the C-shaped canal prevalence (27, 32, 33); in the present study, even though a higher percentage in women appeared, this difference was not significant. Martins et al. (28) report that women show a higher prevalence, as well as Kim et al. (34) and von Zuben et al. reports do (12).

The presence of the bilateral C-shaped canals had a higher representation than the unilateral pattern in previous reports (12, 32, 34), as well as in the present work.

The tooth position, either right or left, would not influence the prevalence of the C-shaped canals (12, 28, 32, 33); this study is in line with the reports of these authors.

The C1 configuration prevailed in the coronal third, the C3d configuration type was prevalent in the middle third, and the C4 was prevalent in the apical third. Zheng et al. (32) reported that the prevailing type of configuration in the coronal third was C1, in the middle third was C3d and apical was C3c. Similar results were reported by Fan et al. (15). Kim et al. (34) encountered that the C1 configuration predominated at the canal entrance orifices level, in the coronal third predominated the C3 configuration as much as in the middle and apical thirds.

Along the canal, in 72% of the cases, configuration variations at the three-thirds have been observed, while 28% kept the same configuration along the root. Zheng et al. (32) observed that in the highest percentage of the teeth there was a variation from coronal to apical. Only in 5.5% there was no variation.

No studies evaluating the radiographic classification *-sagittal plane-* in cone- beam tomographies were found.

Regardless of the different configurations found along the root, the incidence of 20% of the C-shaped canals in the Argentine Republic can be explained from a genetic and ethnic perspective of the population, which is diverse and heterogeneous (35).

Argentina is considered to be an “immigration country” in the sense of the major impact that different migratory flows have had on the ethnic composition of its population.

V. Conclusion

The classification and the percentages obtained in the present research work contribute to the theoretical understanding and its extrapolation to the clinical field based on an anatomical variable of the inner teeth configuration. It is of paramount importance that the endodontist considers the C-shaped canal as a complex configuration of canals, but not as an unusual one, so that suitable procedures can be applied, leading

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to a successful treatment. Unquestionably, CBCT imaging is a substantial tool for diagnosing and planning a predictable treatment *in vivo*.

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Assessment of Efficacy (Time Taken during Stage I and Pain Perception) of Customizedlingual Orthodontic System

By Dr. Priyal Billaiya, Dr. Vivek Amin & Dr. Mohammadi Begum

Abstract- *Introduction:* To assess of the efficacy of customized lingual orthodontic system (Incognito™ 3M Unitek), during initial aligning and Levelling based on time factor and also to assess patient"s discomfort during initial aligning and Levelling.

Methodology: 12 patients between age group of 15 – 26 years with mild to moderate crowding based on Little"s irregularity index, in upper and lower arches which were bonded with Incognito™ Appliance System.

Results: The average rate of initial aligning and levelling for all patients is 0.0361mm/ day. When time taken for initial aligning and levelling in both the arches was compared, it was seen that time was more for maxilla than mandible but it was statistically insignificant.

Conclusion: Majority of patients reported, eating and having hot drinks aggravated pain while lying down, medication, sleep and having cool drinks relieved pain. 83.33 % of patients described the overall pain experience as mild.

Keywords: *incognito appliance system, ibraces, invisible, pain perception, VAS.*

GJMR-J Classification: *NLMC Code: WU 400*



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I. Introduction

As society and science advances, patients are seeking treatment not only for cure but also for enhanced esthetics.[1]Esthetics is one of the objectives in orthodontics in present era. The demand for esthetics in treatment has been the reason for change in bracket morphology and material. Lingual orthodontics is one of the best approaches for meeting demand of enhanced esthetics and quality treatment outcome. Incognito™ (3M Unitek) appliance system is an individually customized precision lingual bracket system with customized robot bent wires, individual precision bonding clear trays and software planned treatment outcome.[2-7] Since the bracket base is individualized as to the lingual surface of teeth in each patient, the bracket is closely bonded to the tooth with no resin base. Various case reports were published to highlight the versatility of the Incognito™ appliance in the treatment of malocclusions with varying severity.[8] However, there was no literature evidence about its efficacy during initial aligning and leveling stage of fixed Orthodontic treatment. This study tried filling the void and also listing out the patients levels of discomfort in the due course.[9,10]

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II. Aim

To assess the efficacy of customized lingual orthodontic system in terms of time taken during the stage stage I and pain perception by the patient during the same period. (Leveling and alignment) (Incognito™ 3M Unitek).

III. Objectives

1. To assess the time-efficacy in initial aligning and leveling using Conventional Labial(SS 0.022) appliance and Incognito appliance
2. To determine the patient's levels of discomfort if any in these stages using the above said appliances therefore.

IV. Methodology

Criteria for Patient Selection: 12 patients between age group 15 – 26 years were selected with mild to moderate crowding based on Little's Irregularity Index in maxilla and mandible. Patients who were willing to undergo orthodontic treatment with good oral hygiene having aesthetic concerns were selected from Yenepoya Dental College and other centers. Ethical clearance was obtained from Yenepoya University; Incognito appliance system certification was done.

a) Inclusion Criteria

- Subjects with/above 4 mm crowding in the anterior region.
- Subjects between ages 15-26 years.
- Subjects with class I molar occlusion.

b) Exclusion Criteria

- Subjects with compromised periodontal status.
- Uncooperative subjects.
- Subjects with previous fixed mechano-therapy orthodontic treatment

Steps Involved

Step I- Impression making of the patient: Maxillary and mandibular impressions of all subjects are made by

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using PVS Impression material. Dual Impression technique with two different consistency of putty materials: heavy body and light body. Heavy body impression material was kneaded properly; a homogenous mix was loaded on the plastic tray for primary impression. Light body putty material was loaded on the primary impression and final impression was made. Check the impression for details. (Fig: 1)

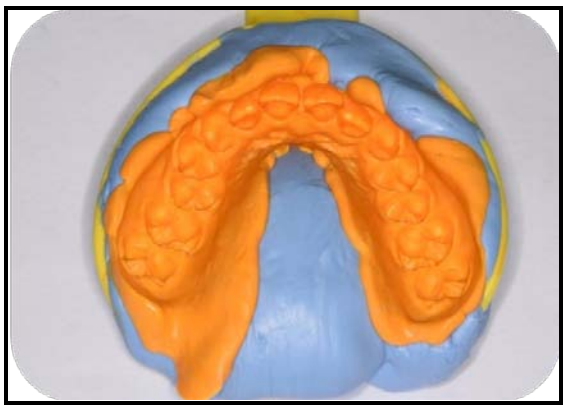


Figure 1: Heavy body PVS impression

Step II- Uploading prescription in TMP: Photographs and radiographs were uploaded in TMP portal. Prescription form was filled for the particular case. Patient details and bracket requirement form was filled and barcode for the patient was generated in 3M TMP software. A request for pick-up of impressions was made in TMP software. The impressions made were packed well and sent to the Incognito Lab (TOP Services, Bad Essen, Germany and Monrovia, CA, USA) through 3M, Monaco USA. Laboratory technicians check the impressions and pour cast. A high-resolution optical 3D scanner permits non-contact scanning of the plaster model or impressions. The scan produces a three-dimensional digital representation of the teeth consisting of many thousands of minute triangles (Standard Triangulation Language, STL surfaces). The surface resolution is at least 0.02 mm that can be documented and processed in the computer.[5] (Fig: 2)

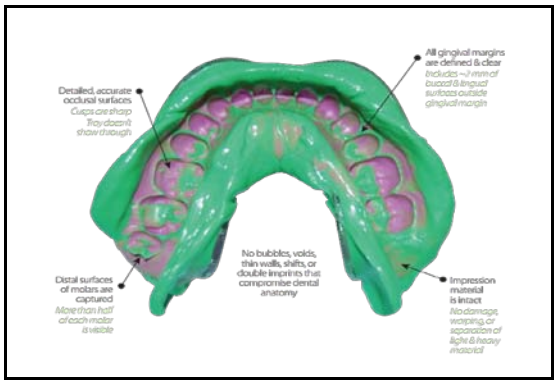


Figure 2: Check PVS Impression

Step III- Steps in making virtual model: The malocclusion digital model is uploaded in TMP software. The laboratory corrects the malocclusion by moving the teeth in the desired tooth positions. This was done all the three planes and treatment sequence was decided. Finally, a final treatment setup and uploaded in TMP for reviewing and approval of the practitioner. (Fig: 3-6)



Figure 3: TMP software

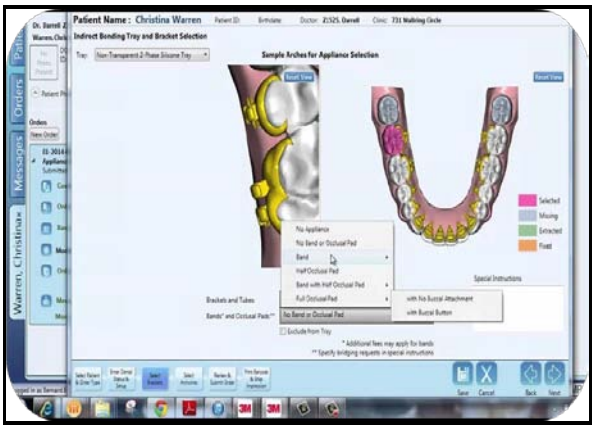


Figure 4: Selecting prescription of brackets on TMP software



Figure 5: Scanning of PVS impression

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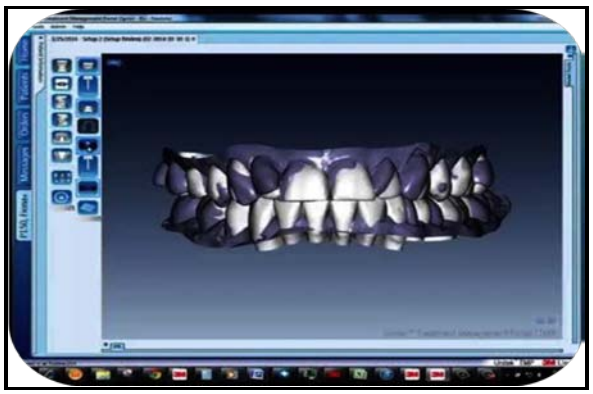


Figure 6: Virtual treatment setup on TMP

Step IV- steps in bracket manufacturing: After practitioner reviewed and approved the setup, Incognito appliance system was sent for manufacturing to the lab by CAD/CAM technology. Virtual construction of individualized bracket base (yellow). The pad surfaces are generously dimensioned to permit a positive lock. The thickness was 0.2–0.3 mm. The bracket body was manufactured specifically for the individual teeth with a CAD program used in mechanical engineering. The bracket slot runs parallel to the tooth surface. In the buccal region, the slot runs parallel to the tooth surface (Ribbon wise). However, the insertion direction of the archwire remains horizontal. The bracket bodies (red) were added as a complete library to the arches fitted with individualized bases (yellow). Whereas the second- and third-order positions were preset, the bracket body was placed optimally in the slot plane by shifting and turning. After positioning, the bracket bodies (green) are virtually fused with the bracket bases. In the Rapid Prototyping technique, the individualized lingual brackets were first made of wax. After casting, the brackets are tumbled and polished until they are smooth to ensure high patient comfort. They are then positioned on the original malocclusion model. Bonding tray of two-layer silicone with the new lingual brackets made of Degunorm M® or clear precision trays are made. (Fig. 7-11)

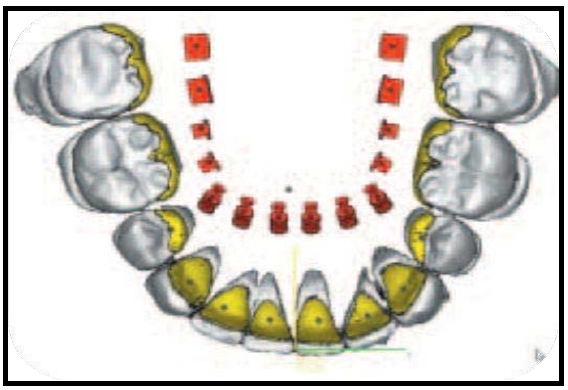


Figure 7: Bracket base (yellow) and bracket slot (red)

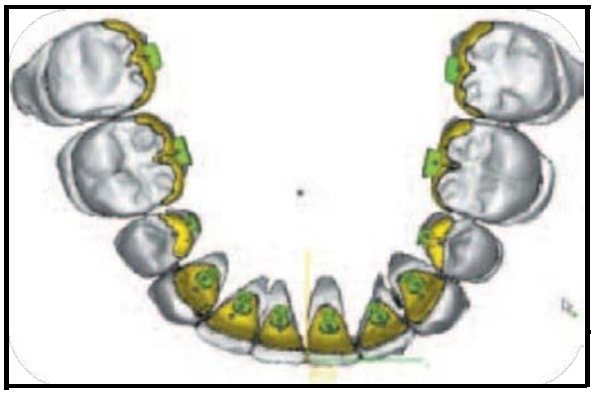


Figure 8: Bracket slot (green) attached to bracket base

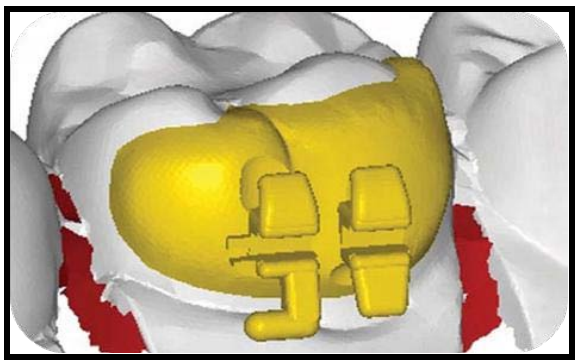


Figure 9: Final virtual model of the bracket



Figure 10: Incognito bonding kit

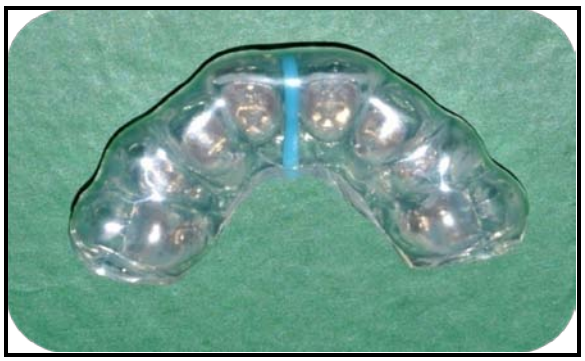


Figure 11: Occlusal view Bracket Placement Precision Tray

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Step V- Incognito kit: Finished brackets are sent to the clinician. (Figure: 12-15) Incognito kit included:- Impression, Cast, Bonding trays with brackets, Robotic bent wires, Bracket design.



Figure 12: Base of the Bracket Placement Precision Tray

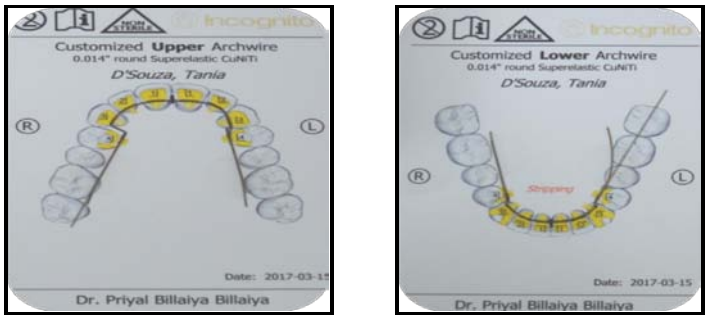


Figure 13: Upper and Lower Copper Nickel Titanium Wires

Step VI-Assessment of Patients: Patients with or above 4 mm of crowding in the maxillary and/or mandibular anterior region according to Little's irregularity index were selected for this study. A quantitative method of assessing mandibular anterior irregularity is proposed. The technique involves measurement from the mandibular and maxillary cast with a caliper (Calibrated to at least tenths of mm) held parallel to the occlusal plane. The linear displacement of the adjacent anatomic contact points of the mandibular and maxillary incisors is determined, the sum of the five measurements representing the Irregularity Index value of the case. Questionnaire using Visual analog system (VAS) is made to evaluate the pain experience during initial alignment phase. (Fig. 14)

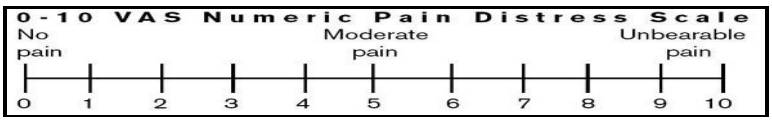


Figure 14: Visual Analogue Scale

Step VII- Measurement of Aligning and Levelling: Measurements were made on the initial pre-treatment (T1), obtained after aligning and levelling (T2) by using a fine-tip digital calliper. The rate of initial alignment and levelling of the anterior region was measured from the difference in the irregularity index at T1 and T2 using digital Vernier calliper, divided by the number of days between the 2 measurements.

Step VIII- Measurement of discomfort: Questionnaire using Visual analog system (VAS) is made to evaluate the pain experience during initial alignment phase.

c) Method of Study

Prospective Clinical Study, Sampling Technique: Purposive Sampling.

d) Statistical Analysis

Descriptive statistics using Paired and Independent sample 't' test Repeated measure ANOVA using SPSS for windows.

V. Results

A total of 12 arches within the age group 15 – 26 years, diagnosed with mild to moderate crowding according to Little's irregularity index, who required orthodontic correction for their malocclusion were enrolled for the study. Patients were bonded with Incognito appliance system.

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This study evaluated:

1. Efficacy of Incognito appliance system in initial alignment and leveling in terms of Time taken for the rate of initial alignment.
2. Evaluation of patient's discomfort.

The pain experience was assessed using a questionnaire using100mm VAS at three different intervals, at the end of 3weeks (T1), 2 months (T2) and 3 months (T3). Data was compared using t-test.
These were tabulated and compared.

a) Data analysis:

i. *Assessment of time bound efficacy of Incognito appliance*

There was a significant difference noted in time taken for leveling and alignment of maxilla and mandible using conventional labial appliance (SS 0.022 slot) and Incognito appliance.

Maxilla & Mandible: It took on an average 254.5 (SD=144.2744), 203.833 (SD=49.3372) days for initial leveling and alignment in maxilla and mandible with the reduction of irregularity index by 7.1317mm and 6.8433mm in the maxilla and mandible respectively. The difference was statistically significant with p value of 0.4346 using Incognito, whereas the labial appliance took on an average 179.8 (SD= 154.667), 184.0 (SD= 63.891) days for maxilla and mandible with the reduction in the irregularity index by 8.1380mm in the maxilla and 7.5792 mm in the mandible.

Males and females: The initial rate of alignment was more for male 0.0444(SD=0.0176) mm/day compared to female 0.0279 (SD=0.0063) mm/day. There was a statistical difference with p value of 0.2858

ii. *Assessment of patient's discomfort*

Using incognito appliance the overall pain perception was found to be more in specific region such as tongue (p< 0.01), whereas patients using labial appliances reported pain in the cheek mucosa (p< 0.01). However additionally the following details were reported with Incognito appliance:

- Highest pain during alignment was after initial archwire placement and second archwire placement.
- Difference in pain experienced at different time intervals with initial archwire was found to be significantly high (p 0.00001).
- 41.67% of patients reported pain as continuous steady constant, 58.33% as rhythmic periodic intermittent.
- 83.33% of patients have described the overall pain experience as mild, while 16.67% have described pain as discomforting.

VI. Discussion

Customized lingual appliance treatment has an obvious advantage over labial treatment. Despite of the advantage, lingual appliances have disadvantages as well. Lingual brackets are attached to irregular and inconsistent lingual surface of the tooth. Lingual side of the tooth has less crown height and inter-bracket distance. These factors make the lingual biomechanics differ from labial. Our study conducted statistically states that the average rate of initial aligning and leveling for all patients is 0.0361 mm/ day using Incognito appliance, whereas it is found to be 0.0288 mm/day using labial appliance. This customized system addresses 3 problems traditionally associated with the conventional lingual brackets: the brackets are more difficult to bond and tend to debond more often, finishing is more difficult, and the brackets cause speech problems or irritate the tongue in some patients. Several steps have been taken to address the problem of difficult bonding and frequent debonding. First, the bracket bases have been extended; this results in greater bond strengths. Overall, the brackets have a lower profile, which induces less leverage when biting on appliance components. The virtual production of the brackets on the computer almost completely eliminates errors in the actual production of the bracket bases. Since all the archwires are also produced with CAD/CAM technology, thus minimizing the potential source of errors associated with finishing process including inaccurate bracket positioning, improper archwire fabrication and inaccurate fit between brackets and archwires.[11-17]

As Incognito is a new concept, this study was carried out to assess the efficacy of Incognito in initial aligning and leveling. It was noted that the rate of initial alignment using lingual appliances is more when compared to that of labial appliances may be contributed due to the decreased inter bracket distance in lingual brackets and non-extraction therapy [18]. In this study we used questionnaire and visual analog scale (VAS) to investigate the perception of pain during chair side manipulation and the delayed type of pain with Incognito brackets. All patients reported decrease in pain while lying down and when on medication and 58 % had relief while having cool drinks. Majority of patients described the overall pain experience as mild and statistically highly significant. It was found that significantly greater discomfort was experienced during arch wire insertion and removal with the smart clip appliance.[19] Tecco S et al[20] found that patients with conventional brackets reported significantly more constant' pain than those treated with self-ligating brackets who complained of chewing/biting' pain. Correlating the above studies with our findings we can say that Incognito Appliance System have definitely improved the comfort level and pain experience of the patients. Pain during chair side manipulations was minimal with Incognito Appliance System, giving an edge over Smartclip brackets.

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VII. Conclusion

The custom bracket manufacturing like Incognito, provides new opportunities by solving the most frequently cited drawbacks of lingual appliances: Thus it can be concluded that, the advantage of customized brackets is not only the individualization of brackets but also highly comfortable for both the patient and the orthodontist.

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Zygomatic and Conventional Implants for Management of Severe Alveolar Atrophy in Partial Edentulous Maxilla and Completely Edentulous Mandible

By Dr. Anshuman Dwivedi, Dr. Manmeet Kour & Dr. Amit Sarkar

Abstract- The geriatric population, atrophic maxilla is a common condition.[1.] Severely resorbed maxilla is challenging for the installation of conventional osseointegrated implants.[2.] To reduce the complications associated with bone grafting procedures and to simplify the rehabilitation of atrophic maxilla, zygomatic implants play an essential role.[3.] With the use of zygomatic implants the wait for osseous graft maturation is eliminated saving the treatment time and money.[4.] In this case report, nasal floor lift for anterior implants was performed with placement of bilateral zygomatic implants and conventional implants.

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Dr. Anshuman Dwivedi [α], Dr. Manmeet Kour [σ] & Dr. Amit Sarkar [ρ]

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I. Introduction

TO rehabilitate the atrophic maxilla is very challenging for the oral and maxillofacial surgeons. Restoration is not possible in majority of patients of atropic maxilla with conventional implants due to lack of alveolar bone caused by pneumatization of the maxillary sinus. From the past few years, these cases had been treated with cortical-medullar bone grafts from the iliac crest performed under general anesthesia.[2.] Zygomatic implants offer a satisfactory function, improves aesthetic results, costs low, execute time and also provide low morbidity for patients as it is less invasive surgery as compared to other treatment options for atrophic maxilla such as reconstructions with autologous grafts. For the very first time, zygomatic implants were used in cancer patients who underwent maxillectomies or tumor resections, trauma and congenital defects by Professor P-I Branemark in 1987. An excellent alternative in the rehabilitation of the atropic maxilla was proposed by Aparicio, et al in 1993 that Zygomaticmalar bone can be used as an anchorage for oral implants[5]. Zygomatic implants are immediately loaded as their length is enough to provide anchorage as there is a larger contact between the surface of the implant and the bone; therefore, the stability is also greater[5].

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II. Case Presentation

An 85- year- old male patient with the chief complaint of missing teeth and difficulty in chewing food for 10 years visited our maxillofacial hospital opd. (Figure 1) A preoperative CBCT (Cone Beam Computed Tomography) was performed which showed atropic maxilla on both the left and right posterior region. (Figure 2). The operation was performed under local anesthesia with adrenaline (1; 2,00,000) and a prescription of pre and post-operative antibiotics and analgesics was made.

III. Surgical Procedure

A palatal incision along with a bilateral posterior vertical incision more of like Le fort exposure was performed on the maxillary crest. A full muco periosteal flap was reflected to expose the alveolar bone, the piriform aperture in the center and the posterior part of the zygomatic complex. The superior dissection was limited to the infra orbital nerve which emerges from the lateral wall of the maxillary sinus. The L shaped retractors were used to elevate the muco periosteal flap superiorly and posteriorly. The osteotomy marking was done on the maxillary crest till the zygomatic complex. One ditch was made on the crest of the maxillary alveolus and another on the zygomatic complex. A connection was made in between the ditches with the help of long drills which comes under three configurations (fine, medium, coarse). The osteotomy site was copiously irrigated during surgical preparation; grooves were prepared on the lateral wall of the maxillary sinus with the long drills until Sheridan membrane was visible. Elevation of Sheridan membrane was done with the help of sinus lift instruments .Drilling was done with the help off long zygomatic implant drills from the alveolar crest to the zygomatic complex. The zygoma complex was drilled until the tip of the drill could be felt on the index finger of the contralateral hand which is placed on the cheek bone. Then after the zygomatic implant is inserted in the prepared osteotomy from the maxillary crest to the zygomatic complex. Then we proceeded towards the maxillary anterior region

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towards piriform aperture then the nasal floor was lifted carefully then after osteotomy was performed from the anterior maxillary crest and implants placed simultaneously and bovine bone graft was used to graft the deficit site. (Figure 9). Interrupted 3-0 silk sutures were placed on the incision line and post-operatively a prescription of Xylometazoline nasal spray (to reduce swelling and congestion), and antibiotics was made. The patient was instructed to strictly follow the oral hygiene, and regular follow-ups. A placement of Eleven freehand implants were done in both the arches in which six ADIN Implants were placed in mandibular arch and five implants were placed in the maxillary arch out of which two were Zygomatic, and three were conventional of NORRIS MEDICAL ITALY. Delivery of the provisional prosthesis was made possible on the same day of surgery, and the final prosthesis was given 12 weeks post-operatively. CBCT scans were performed post-operatively, which showed excellent integrated implants with new bone formation at the region of nasal floor lift. (Figure 9). The patient was followed up for two years; on CBCT all implants were osseointegrated with no marginal bone loss.

IV. Discussion

The latest scientific technology had provided a huge benefit for recuperation of maxilla in patients. Various possibilities like traditional implants, bone reconstruction, or zygomatic implants were used for the rehabilitation of totally edentulous patients with severe atrophy of the maxilla.[2] Out of various treatments, zygomatic implants have been in clinical use for 20 years and is an excellent treatment plan for patients with severely resorbed fully or partially edentulous maxillary arches.[9] When direct alveolar support for conventional implants is lacking; Zygomatic implants offer a relatively measured approach to restore missing upper dentition. Parel et al developed the concept of remote implant anchorage from which the zygomatic implant is derived. In many studies, the zygomatic implant has been demonstrated a high survival rate of 97% after more than 12 years of follow-up. Malevezand Bedrossian reported a 100% survival rate using 2 stage protocols. [3]

In our case report, the patient was partially edentulous with the severely atrophic maxilla. Besides placing the zygomatic implants, the nasal floor of the patient was also lifted, and placement of conventional implants in the maxillary anterior and mandibular region was also done. According to El- Ghareeb et al. Nasal Floor Lift is the most reliable method for reconstruction of the anterior atrophic maxilla when the residual height is less than 10 mm for implant- supported overdentures. The use of osteoconductive bone graft substitutes with simultaneous implant placement is a predictable approach for augmentation of up to 5 mm in height, and eliminates the need for more invasive procedures such as Le Fort I osteotomy, as well as donor-site morbidity associated with autogenous bone graft harvest.[6]

Using a fixed prosthesis to connect all implants with adequate anteroposterior spread provides cross-arch stabilization and allows the transmission of masticatory forces on the zygoma bone. Thus cross-arch stabilization from the prosthesis, just after placement of the implants, could alleviate the load on the anterior implants and could be one of the reasons to explain the loss of only three implants in such atrophied sites. This loss of implants may be related to the fact that they were placed in an area with an extensive bony defect since immediate loading itself does not seem to preclude osseointegration[7].

With the use of zygomatic implants either in combination with or without conventional implants in anterior atrophic fully or partial edentulous maxilla may be considered as the replacement to osseous grafting for providing bone formation for conventional implants. It has been reported that the success and survival rates of the zygomatic and conventional implants are equally same. Zygomatic implants provide short treatment time which would be normally required for osseous graft maturation and until maturation occurs it also subsequently delays the implant placement. Therefore, the treatment costs are also lowered as the complex grafting procedures are eliminated. As the use of CBCT, virtual planning, and surgical guides' progresses, it is anticipated that these implants may be utilized more readily and would result in the reduction of potential complications associated with prior placement techniques.[4]

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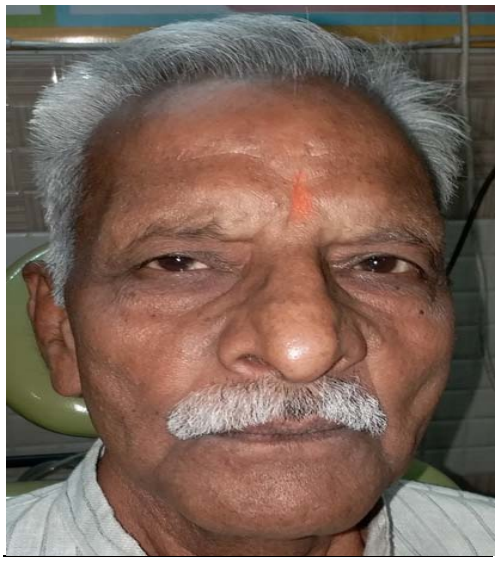


Figure 1: Shows Preoperative profile of patient

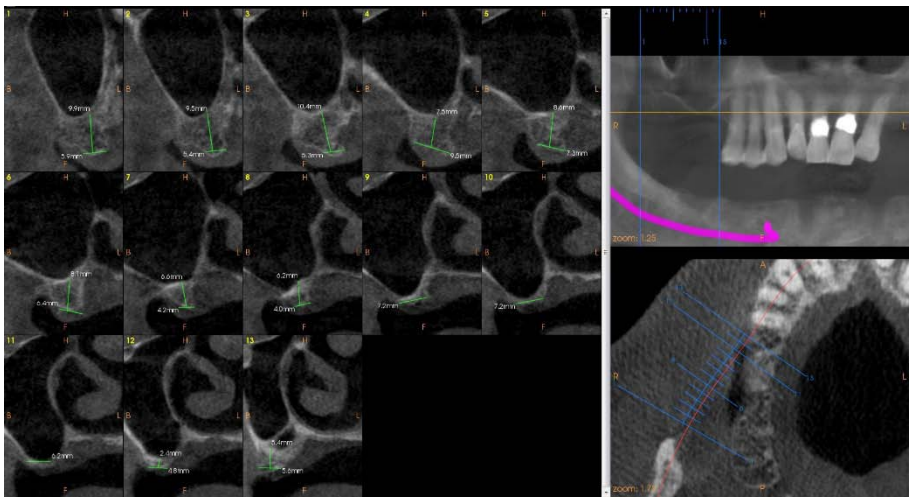


Figure 2: Shows the CBCT scan of maxilla preoperatively

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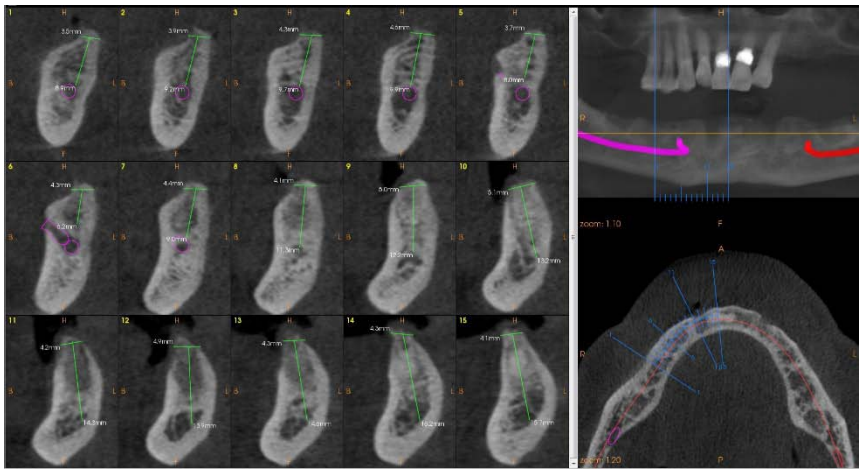


Figure 3: Shows the pre operative CBCT scan of mandibular arch with measurements



Figure 4: Shows fine bur with lateral osteotomy of the right maxillary sinus.



Figure 5: Shows osteotomy in the zygomatic complex with long zygomatic implant drill

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Figure 6: Shows +50 torque on placement of zygomatic implant.



Figure 7: Shows bilateral zygomatic implants insitu.

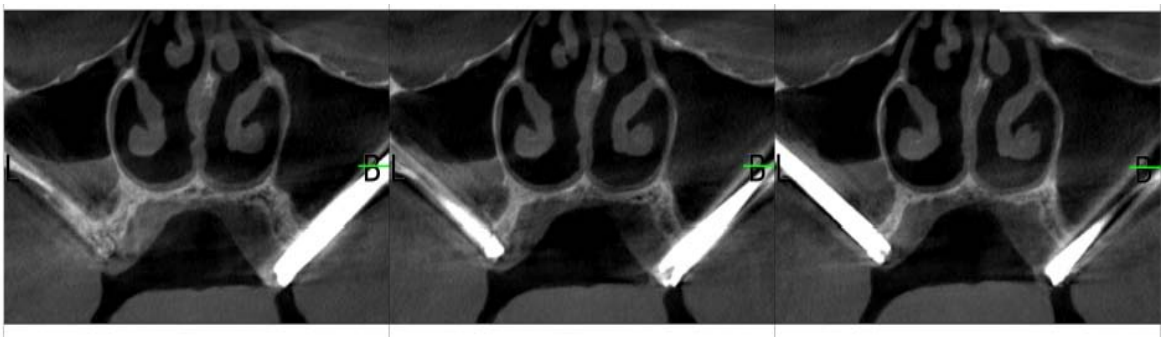


Figure 8: Shows the fully oseteointegrated zygomatic implants bilaterally.

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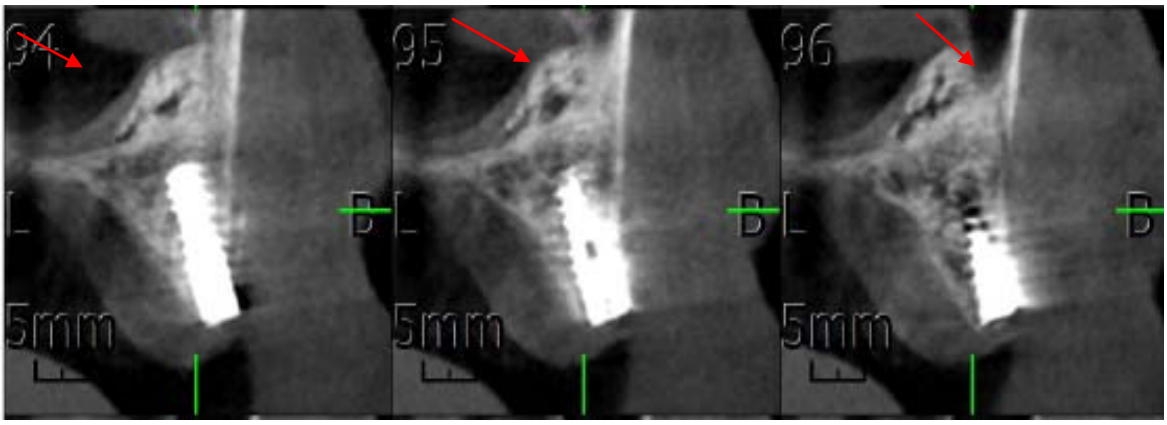


Figure 9: Shows the osteointegrated implants in the anterior maxillary region with excellent bone formation after nasal floor lift (red arrow)

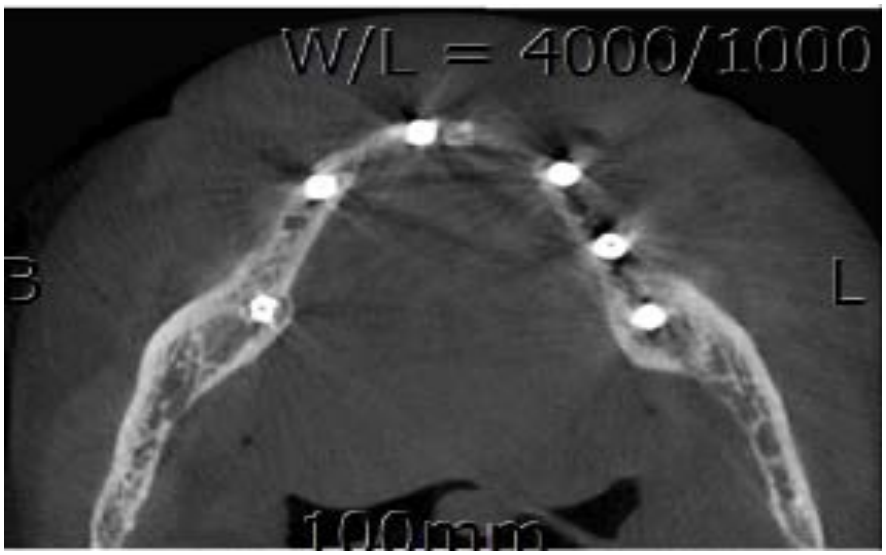


Figure 10: Showing the axial section of CBCT of mandible with osteograted implants.

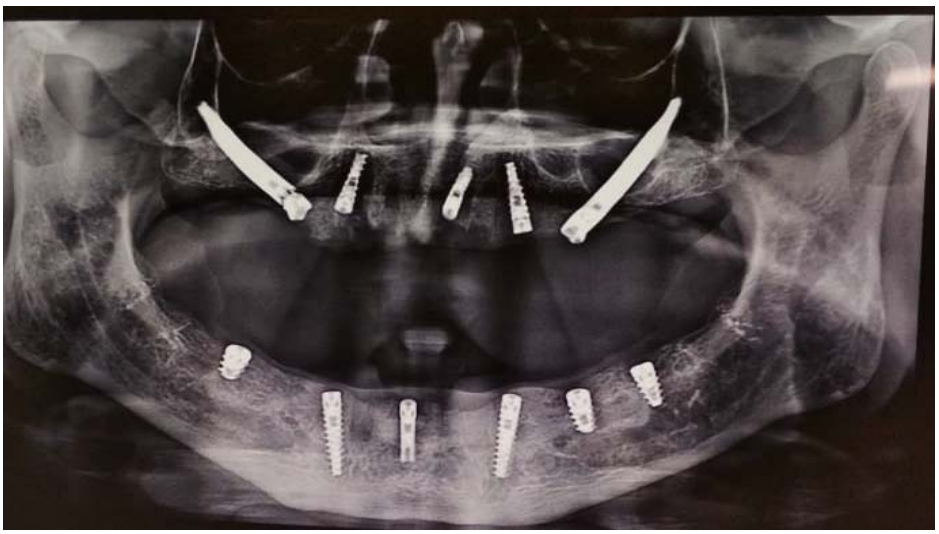


Figure 11: Shows OPG with a total of 11 implants out of which 2 were big zygomatic implants (right : dia 4.2 length 40 left: 42.5 length) and 3 were conventional implants in maxillary arch and rest of the 6 implants were placed in mandible in which 1 implant on the right posterior region was small (5dia 6 length) to avoid nerve impingement.

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Figure 12: Shows intraoral picture with MUA (Multi Unit Abutment)

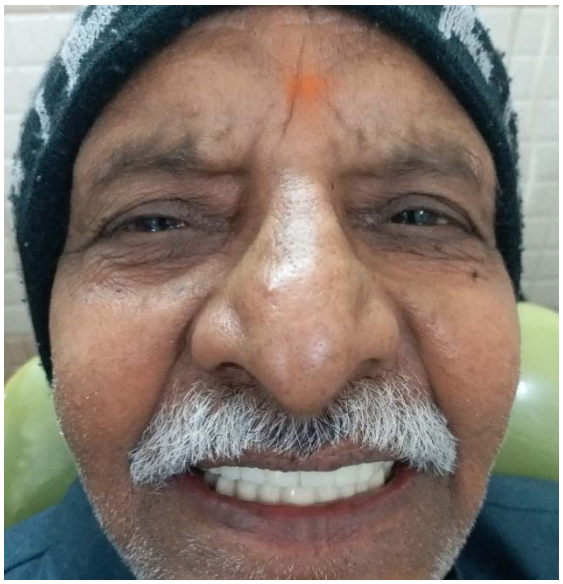


Figure 13: Shows the postoperative profile of patient with prosthesis

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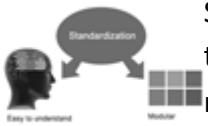


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- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a 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.



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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.



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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.



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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.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

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

Topics	Grades		
	A-B	**C-D**	**E-F**
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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