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Mandibular Fracture Management Using Pre-adjusted Miniplates and 3D Printed Models: A Case Report

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Abstract

When addressing mandibular fractures, achieving precise anatomical realignment and reconstruction proves to be a difficult and demanding task for oral maxillofacial surgeons when relying on conventional devices and methods. Consequently, the integration of advanced techniques becomes imperative to streamline the process and attain a secure and favourable anatomical realignment while minimizing the duration of the operation. The implementation of 3D-printed guides has proven beneficial in ensuring proper bony consolidation in the anatomically correct position, facilitating standard mouth opening, and restoring the pre-trauma occlusion.

In the presented case report involving a 24-year-old male, the preoperative planning commenced with the creation of a 3D printed model following a thorough radiological examination. To facilitate virtual surgical planning and the generation of the 3D model, images obtained from multiplanar computed tomography were converted to Digital Imaging and Communication in Medicine (DICOM) format. A 3D model representing the reduced mandibular fracture segment was then produced, and miniplate pre-bending was performed at both sites. This aided in the precise placement of screws and plates to approximate the fractured segments and guide occlusion during the surgery. The report emphasizes the effectiveness and utility of personalized 3D printed guide models in enhancing reduction accuracy, minimizing surgical challenges, and improving clinical outcomes, all achieved with a reduced operative time in the treatment of mandibular fractures.

INTRODUCTION

Understanding of mandible osteology, various muscle attachments, their impact, the presence or absence of dentition, and whether developing or permanent is vital for the precise treatment of mandibular fractures. The management of these fractures has evolved from traditional methods such as splinting, wiring, and extraoral pins to the more recent adoption of rigid fixation techniques, with a current trend towards semi-rigid fixation using miniplates and 3D plates.^[1] The invention of Stereolithography and 3D printing has further upgraded treatment of mandibular fractures. Utilizing 3D models with preoperative plate adaptation has proven to reduce operative time significantly. Not only does the use of 3D models offer insights into bone anatomy and fracture patterns, but in the specific case discussed, preadjusted 3D plates on surgical models, obtained through 3D printing, are conventionally applied intraoperatively for the management of dual mandibular fractures.^[2]

CASE REPORT

A 24-year-old male presented to our unit with diffuse swelling on the lower third of the face, difficulty in mouth opening, and pain in the lower front tooth region since 2 days. He gave history of fall from bike 2 days back. On extraoral examination swelling was 3x2cm in size extending anteriorly from left corner of lip to posteriorly upto left mandibular angle region and superiorly from left ala of nose to inferiorly upto inferior border of mandible.(Figure 1) Swelling was firm in consistency and tender on palpation. There was no paresthesia. Mouth opening was 25mm. No abnormalities were detected with respect to TMJ bilaterally. Intraorally there was anterior open bite and left posterior crossbite. A step deformity was palpable between the lower right lateral incisor and canine. Sublingual Hematoma was present in the anterior floor of the mouth region. O. P. G was advised which revealed a displaced right parasymphysis and left mandibular angle fracture. Subsequently open reduction with internal fixation, utilizing miniplates for the right parasymphysis and left angle region under local anaesthesia was the treatment plan decided.

The preoperative planning process commenced by generating 3D imaging following a radiographic

examination. To perform virtual reconstruction, data files in DICOM format were obtained from a multiplanar CT scan of the patient, featuring a slice thickness of 1 mm. Utilizing 3D Slicer 4. 11. 0, a virtual 3D volumetric reconstruction was carried out by segmenting fracture fragments and then converted into a Standard Tessellation Language (STL) file format. Once the 3D model of the fractured mandible was obtained in the STL format, it was imported into Blender 3D software. The fractured segments were then separated and then reduced to the best anatomical position.(Figure 2) The reduced segments were then joined back and 3d printed using a Flashforge Creator Pro 2 3D printer. This 3d printed mandible was then used to pre-bend and pre-adapt the miniplates.(Figure 2) These miniplates were then autoclaved for the surgery.

Under aseptic precautions and local anesthesia, routine scrubbing and draping were conducted according to the protocol. A circumlinear vestibular incision was made at both the fracture site, exposing and debridement at the fracture site was done.(Figure 3) Functional and anatomical reduction were achieved, followed by intermaxillary fixation (IMF). The pre-adjusted 2mm, 4-hole with gap miniplate was utilized for rigid internal fixation in the right parasymphysis region, while a similar pre-adjusted 2mm, 4-hole with gap miniplate was employed in the left angle region.(Figure 4) The wound was closed in layers using 3.0 vicryl after thorough irrigation. Postoperative orthopantomogram (OPG) revealed a good continuity of the lower border.(Figure 4)

Postoperative recovery was uneventful with no major complications. Satisfactory wound healing was observed, and maximum occlusal intercuspation was achieved. A CT-scan taken three months postoperatively demonstrated a good anatomical reduction of the inferior and lingual cortex, mirroring the results achieved in preoperative virtual planning.

DISCUSSION

Open reduction and internal fixation (ORIF) is considered to be the gold standard for fixing maxillofacial fractures. Accurate evaluation, diagnosis, and management of mandibular fractures is essential to effectively restore an individual's facial esthetics and function. Understanding of

surgical anatomy, fracture fixation principles, and the nuances of specific fractures with respect to various patient population can aid in adequately avoiding complications such as malocclusion, non-union, paresthesia, and revision procedures.^[3]

The development of a virtual surgery and 3D printing helps in providing enhanced stability against torque forces and simultaneous stabilization at both the superior and inferior borders of the mandible, ultimately decreasing operative time.^[4]

The routine use of 3D STL models, created using 3D printing, has become prevalent among craniofacial surgeons for a range of procedures, including orthognathic surgeries, distraction osteogenesis, dental implant surgeries, and trauma and reconstruction surgeries.^[5]

The difficulties encountered during restoring mandibular fractures involving multiple sites, intricate morphology, muscular attachments, or deranged occlusions can pose challenges even for most experienced surgeons. Over the past few years, 3D printing has gained significant popularity in the field of Oral Maxillofacial Surgery, providing a novel technological approach in maxillofacial trauma management.^[6] This technology facilitates the easy fabrication of various surgical guides and templates, serving multiple applications such as bone graft harvesting, plate bending, customization of bioprosthetic implants, osteotomies guides, and intraoperative occlusal splints. The advantages of 3D printing, is that it provides greater accuracy and reduces operative time when compared to traditional approaches. This further reduces pain and post operative complications.^[7] This has contributed to its widespread usage. In our case also the total duration from incision to plate fixation was 30 minutes total

for both the fractures.No postoperative complication was noted on further follow ups.

The integration of virtual surgical planning and 3D printing technology has provided a definitive advantage in visualizing the mandible in all dimensions. Following virtual reduction, the fabrication of a 3D model allowed the transfer of the reduced mandibular portion to the operating table.^[8] The use of 3D surgery provides a direct and clear view of the fractured sites, morphology by virtually manipulating bone fragments at various angles, ensuring the adequacy of the required reduction process. Additionally, 3D printed customized cast metal guides play a crucial role in transferring this precise reduction intraoperatively.Virtual preoperative surgical planning, facilitated by 3D visualization, allows operators to comprehend the spatial relationships of fracture segments to surrounding structures, leading to optimal restoration of the fractured segments.Overall, the incorporation of 3D technology in surgical planning and execution emerges as a valuable tool in improving accuracy and efficiency in the restoration of mandibular fractures.

CONCLUSION

The case report demonstrates the effectiveness of virtual surgical planning and pre-adjusted 3D plates in mandibular fracture management. The technology allows surgeons to visualize and guide the reduction process, reducing operative time and improving accuracy. The application of pre-adjusted plates is found to be superior to conventional plates, offering a cost-effective approach and better patient outcomes. 3D printing technology continues to gain popularity in oral maxillofacial surgery, providing customized guides and devices for enhanced precision in the 21st century healthcare.

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FIGURE LEGENDS

- Figure 1:** Preoperative picture of patient
- Figure 2** a: 3d printed models and preadjusted/prebended miniplates
b: Reduction of fracture segments done using blender software.
- Figure 3:** a: fracture site exposed at right parasymphysis region.
b: fracture site exposed at left angle region.
- Figure 4:** a: ORIF with prebended miniplates at right parasymphysis region.
b: ORIF with prebended miniplates at left angle region.
c: post operative OPG



Figure 1: Preoperative picture of patient

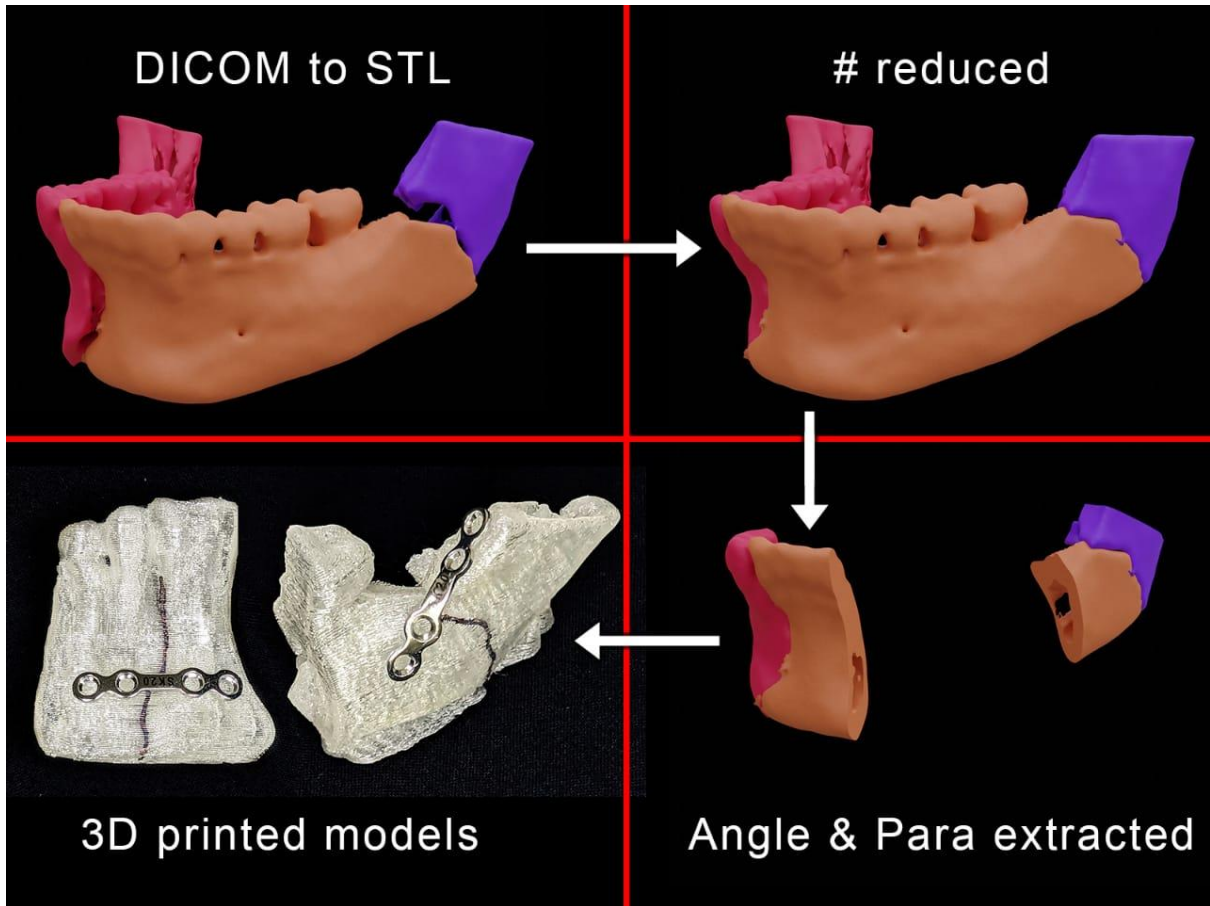


Figure 2 a: 3d printed models and preadjusted/prebended miniplates
b: Reduction of fracture segments done using blender software.



Figure 3 a - fracture site exposed at right parasymphysis region
b - fracture site exposed at left angle region.

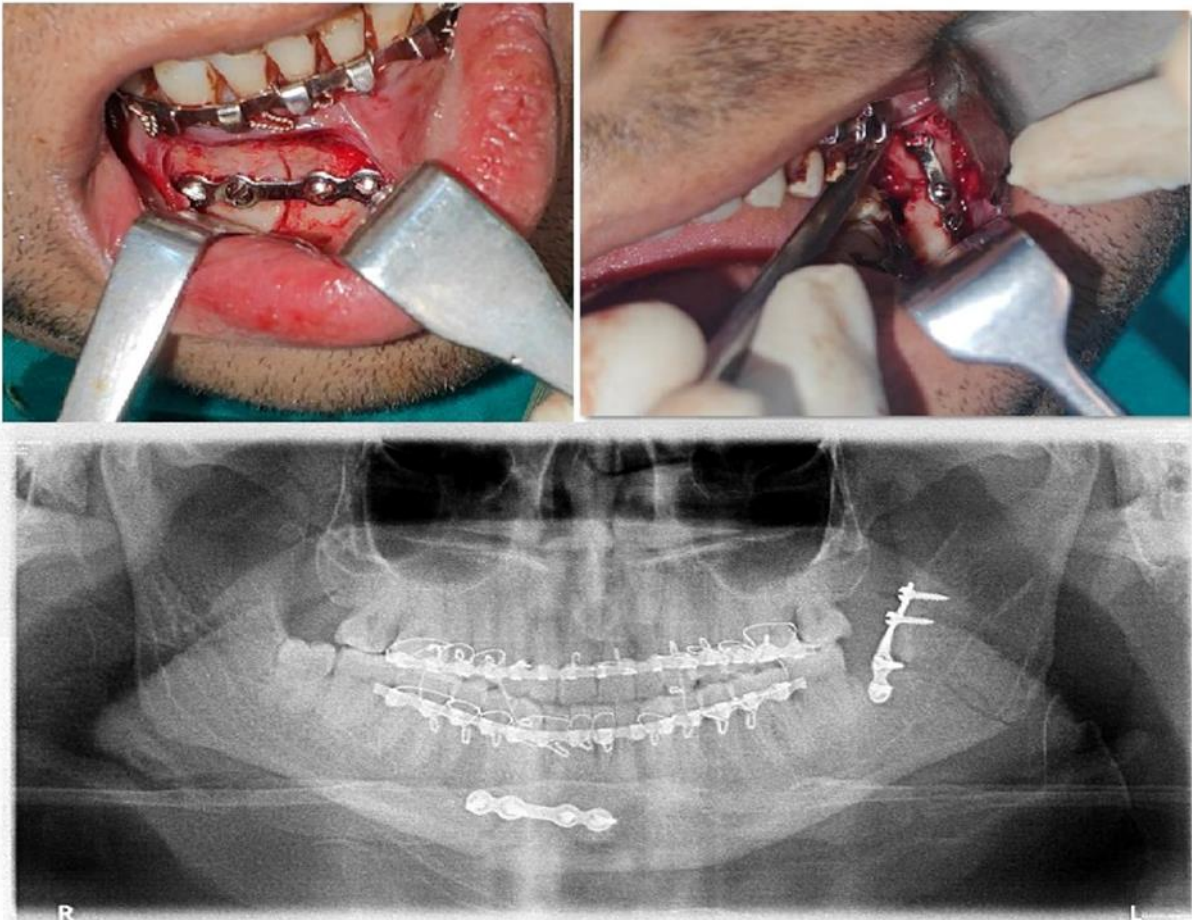


Figure 4: a - ORIF with prebended miniplates at right parasymphysis region. b - ORIF with prebended miniplates at left angle region c: post operative OPG

Dentigerous Cyst Accompanying Maxillary Impacted Canine and Mesiodens: A Case Report

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Abstract

A dentigerous cyst, a form of developmental odontogenic cyst, ranks second only to the radicular cyst in its likelihood of occurrence within the maxillofacial region. The majority of typical dentigerous cysts are observed in connection with third molars and maxillary canines. Merely 5–6% of dentigerous cysts are linked with supernumerary teeth, with a higher incidence noted among young males at a ratio of 1.6 to 1.1. Generally, it is associated with impacted or unerupted teeth. The prevalence of dentigerous cysts associated with additional teeth represents just 5–6% of all cases. This clinical case involves a dentigerous cyst associated with an unerupted mandibular canine and mesiodens in a young male, treated through extraction of both teeth followed by enucleation.

Keywords: Dentigerous cyst, enucleation, Mesiodens, odontogenic cyst

INTRODUCTION

A dentigerous cyst, a type of developmental odontogenic cyst, ranks second only to the radicular cyst in terms of likelihood of appearing in the maxillofacial area.^[1] Follicular cysts are slow-growing, benign odontogenic cysts that are thought to have a developmental origin.^[2] It develops due to the buildup of fluid between the reduced enamel epithelium and the enamel surface of a fully formed tooth. Its formation occurs through the detachment

of the follicle surrounding the crown of an unerupted tooth.^[3] A higher occurrence has been observed in young males, with a ratio of 1.6 to 1.1. Typically, it is linked to impacted or unerupted teeth.^[4] Mesiodens, a supernumerary tooth with a prevalence ranging from 0.15% to 1.9%, are located in the region of the maxillary central incisors. The incidence of dentigerous cysts associated with extra teeth is just 5–6% of all cases.^[4]

In this clinical case dentigerous cyst was reported which is associated with unerupted mandibular canine and mesiodens in young male treated by enucleation.

CASE REPORT

A 26 years male reported to our unit with chief complaint of discomfort and swelling in the upper front tooth region, beginning one month ago. Medical and dental history was negative .On clinical examination 3*3 cm diffuse swelling was present extending anteriorly from right corner of lip to posteriorly upto right zygomatic buttress superiorly from infraorbital margin to inferiorly upto inferior border mandible .On palpation it was tender and afebrile.(Figure1) Overlying mucosa was healthy with no signs of inflammation. On intraoral clinical examination a tilted and displaced right maxillary lateral incisor that was not discoloured, firm, non-tender in the maxillary anterior region on the right side was present. Right permanent maxillary canine was missing. Labial vestibule obliteration was present.(figure 2a) The mucosa covering the palatal and labial areas was normal. No lymphadenopathy was present. Fine needle aspiration cytology (FNAC) was carried out under local anaesthesia. Yellow-coloured fluid with inflammatory cells and sparse cholesterol crystals were obtained on aspiration suggestive of a cystic lesion. (figure 2b) CBCT was advised. It revealed radiolucent lesion in the anterior maxilla involving right maxillary canine and mesiodens, extending from the mesial aspect of the left maxillary central incisor to the mesial aspect of the first permanent molar with sclerotic borders. Evidence of a supernumerary tooth (mesiodens) causing cortical bone resorption was found on the palatal aspect. The lesion was adjacent to the floor of the maxillary sinus and nasal cavity, causing expansion of the maxilla's alveolar cortex. (figure 3) Based on clinical and radiological examination our Differential diagnosis was Radicular cyst, Dentigerous cyst, Adenomatoid Odontogenic tumour, or Nasopalatine cyst and Dentigerous cyst was our provisional diagnosis.

Under local anaesthesia enucleation and curettage was the treatment plan decided. Composite splinting was done prior of the upper anterior teeth. Crevicular incision with distal releasing incision distal to first molar was given.Full thickness mucoperiosteal flap

was raised. (figure 4a) Since the cystic lining was linked to the tooth's neck, the entire cystic lining was removed, together with the impacted canine and mesiodens. (figure 4b) The nasal lining and cystic lining were both separated. Thorough irrigation was done using Betadine solution. Closure was done using a 3-0 black silk suture.(figure 5a)

The excised specimen including several soft tissue pieces and extracted teeth were sent for histopathological examination.

The diagnosis of dentigerous cyst was confirmed by microscopic observation of a cystic lining with three to four layers of nonkeratinized stratified squamous epithelium, which resembled reduced enamel epithelium and had a connective tissue capsule displaying fibrous stroma with collagen fibres, blood vessels, and few inflammatory cells.

After a week, the patient was followed for suture removal. Four weeks later, composite splinting was removed. Lateral incisor was intact. Patient has been followed for 6 months with no evidence of recurrence.(figure 5b)

DISCUSSION

Dentigerous cysts (DCs) have been reported extensively in the literature. The exact cause of this cyst is still unknown, but many theories are proposed. The “Intrafollicular Theory” suggests that dentigerous cyst is a consequence of fluid accumulation between the outer and inner surfaces of the epithelium. This accumulation occurs during the formation of the crown. The second theory is the “Enamel hypoplasia theory”. It suggests the development of the cyst after stellate reticulum degeneration. “Main’s theory” suggests that the cyst is a result of the hydrostatic pressure exerted by an impacted tooth on the follicle which results in the separation of the impacted crown from the surrounding follicle.^[2]

Dentigerous cysts account for approximately 16.6% of all jaw cysts. About 95% of these cysts involve permanent dentition and only 5% are associated with supernumerary teeth.^[4]

Dentigerous cysts associated with mesiodens are easily diagnosed radiographically because of their radiopaque image. CT is necessary and valuable, not only to identify the pathology of the dentigerous cyst and the exact location of the impacted tooth, but also to determine the full extent of the lesion as well as

to identify erosion of cortical bone and invasion into adjacent soft tissues, thus contributing to proper treatment planning as well.^[4]

These cysts are commonly single lesions. Bilateral and multiple dentigerous cysts are very rare although they have been reported in patients with syndromes such as Basal Cell nevus syndrome, mucopolysaccharidosis, and cleidocranial.^[5]

Several treatment options include marsupialization, enucleation and curettage.^[2]Enucleation is the typical treatment for a dentigerous cyst, along with removing the extra tooth connected to it. Marsupialization is advised for larger cysts when a single drainage may not suffice, and total removal of surrounding structures is not preferable. Scolozzi et al. recommended enucleation followed by an

immediate bone grafting procedure.^[4]

Dentigerous cysts have the potential to grow into painful, aggressive lesions in the context of persistent infection. Persistently enlarging dentigerous cyst may result in alveolar bone widening, tooth displacement, severe root resorption, extension of the buccal and lingual cortex, and pain.^[6]

Complications associated with dentigerous cysts include the potential for bone fractures, permanent tooth loss, bone deformities, and the transformation of cyst lining into different types of odontogenic tumours like ameloblastoma or mucoepidermoid carcinoma, as well as the risk of developing malignancies such as oral squamous cell carcinoma.^[7]

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FIGURE LEGENDS

Figure 1: Pre-operative picture of patient

Figure 2:

- a) Pre-operative picture of lesion
- b) Aspiration from lesion

Figure 3: Radiograph

Figure 4: Intra-operative picture a) lesion after flap elevation b) impacted tooth

Figure 5: Intra-operative picture-a) Flap closure b) Post-operative healing of tissue



Figure 1: pre-operative picture of patient



Figure 2: a) pre-operative picture of lesion

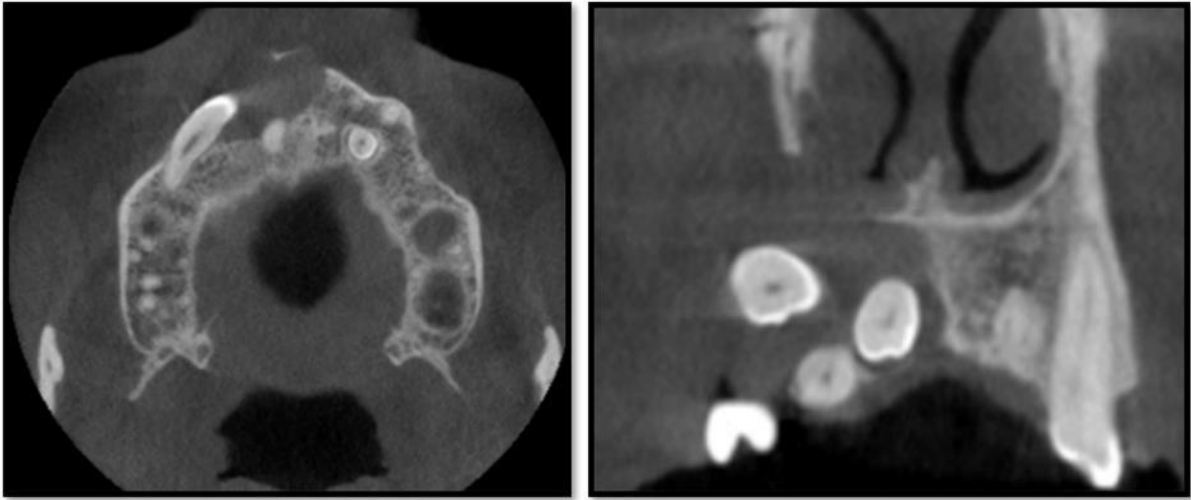


Figure 3: Axial and Sagittal view depicting the lesion along with impacted tooth



Figure 4: intra-operative picture-
a) lesion after flap elevation b) impacted tooth



Figure 5: intra-operative picture-
a) flap closure b) post-operative healing of tissue

Unusual Presentation of Giant Complex Odontome - A Case Report

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Abstract

Odontomas are hamartomatous malformation, most common odontogenic tumours. Usually odontomas are asymptomatic clinically and diagnosed on routine radiographic imaging. However, they may be associated with missing or impacted teeth or delayed eruption of a tooth. A rapid diagnostic assessment, together with an adequate histopathologic verification, is essential to improve the management and the prognosis of this lesion. This paper aims to report and discuss a case of complex odontoma with unusually large size associated with impacted lower first molar which was managed by surgical excision under general anaesthesia. This paper also aims to report and highlight the important information the general dental practitioner must possess to diagnose such lesions at an early stage.

Keywords - complex ,odontoma, mandible, child, odontogenic, tumours, excision

INTRODUCTION

Odontomas are odontogenic hamartomas developmental malformations or lesions of odontogenic origin with variable degrees of organization and mineralization.[¹] They are most common odontogenic tumours and constitute 22% of all odontogenic tumours.[²] Paul Broca in 1867 coined the term "Odontoma".[²] The World Health Organization classifies odontomas as a benign

odontogenic tumor composed of odontogenic epithelium and odontogenic ectomesenchyme with dental hard tissue formation.[³]

CASE REPORT

A 11 year old male reported with chief complaint of pain in left lower back tooth region since 1 year. Pain was dull aching in nature, non radiating and intermittent in character. Pain was accompanied by intermittent episodes of swelling. On extra-oral

examination, there was no facial asymmetry (Figure 1). On Intra oral examination 36 was missing. Pain on palation was present in the same region. There was no breach in the corresponding alveolar mucosa in relation to 36, 37 region (Figure 1). Further there was no regional lymphadenopathy. History of trauma, bleeding or pus discharge was not significant. Medical history was not significant. Routine blood investigations were normal. FNAC was negative. Based on the history and clinical findings our differential diagnosis was presence of an impacted tooth associated with Dentigerous cyst, CEOT, Odontome. O.P.G was advised which revealed a well defined radiopaque mass of 20*25mm in size distal to mandibular left second premolar and overlying the coronal portion of unerupted left lower first molar. A uniform, well defined, radiolucent halo surrounded the radiopacity. CBCT was recommend. Axial section revealed a well-defined homogenously hyper dense lesion wrt posterior mandible. The lesion displaced permanent first molar inferiorly. There was buccolingual expansion of the cortex.(Figure 2). We subsequently arrived at the final diagnosis of odontome associated with impacted 36. Surgical excision of odontoma under General Anaesthesia was the treatment plan decided. The lesion was approached via crevicular incision with an anterior releasing incision. Full thickness mucoperiosteal flap was raised. Overlying bone was removed to expose the lesion. The lesion was sectioned initially into 2 pieces labiolingually and further into multiple pieces (Figure 3). Excised specimen was removed along with 36. Histopathological evaluation revealed sheets of dentine, pulp and cementum along with stratified squamous epithelial lining of various thickness in connective tissue stroma (Figure 4). These findings were confirmative of complex odontoma. Patient is kept on periodic follow-up with no complications reported till date.

DISCUSSION

Odontomas are non-aggressive, hamartomatous malformations of odontogenic origin. They can be ectodermal, mesodermal or mixed in origin.[¹]

The etiology of odontomas remains unknown. Genetic factors like alterations of the genetics components responsible for controlling dental

development, and environmental causes such as trauma and infection can be the possible causes.[²]

World Health Organization (WHO) in 2005 recognises two types of odontomes: compound and complex. Compound odontomas, consist of malformations of all dental tissue types and exhibit orderly pattern without morphological resemblance to normal teeth. Complex odontomas are malformations showing disorganised distribution with no morphological similarity to original tooth.[¹]

Clinically, they are classified as intraosseous (central), extra-osseous (peripheral) and erupted odontomes.[^{3,4}]

Intraosseous odontomas occur inside the bone and may erupt into the oral cavity. Extraosseous or peripheral odontomas occurring in the soft tissues of the jaws. Erupting odontome is the one in which the hamartomatous mass is visible inside the oral cavity clinically.[⁴]

They present in first two decade of life [⁵]. Compound odontomes occur in the canine and incisor region of the maxillary arch [^{3,4,1}] and complex odontomes are commonly found in the posterior mandible.[^{3,4,1}]

They remain asymptomatic and discovered radiographically on routine dental examination. On enlargement they present with alveolar swelling leading to facial asymmetry and expansion of the cortical plates. They often lead to malpositioning, deviation, root resorption or impaction of the adjacent teeth.[⁶]

The mechanism of eruption of odontomas is different in comparison to that of normal teeth. Odontomas lack root formation and pdl fibers.[^{4,5}]

The increasing size leads to resorption of the alveolar bone, with subsequent exposure in the oral cavity [^{4,6}]. Since they are associated with unerupted teeth, the erupting forces of the concerned tooth can lead to their eruption in oral cavity.[⁴]

Rarely, dentigerous cysts may develop along with these lesions. In addition to their capability for attaining large size and destroying the jaw bone, these cysts also leads to neoplastic changes such as ameloblastoma or carcinoma.[⁷]

Radiographically, odontoma shows radiopaque mass with well-demarcated borders of a similar density to calcified dental tissue, surrounded by a thin radiolucent halo. Compound variant usually are of tooth-size or smaller, the complex odontomes occasionally exhibit larger growth and appear as

dense irregular mass.[^{5,6}] In this presentation, similar features were observed.

Histopathologically they show irregularly arranged dental hard tissues including dentine and cementum with areas of pulpal tissue. Mature enamel is lost during the process of decalcification process which is indicated by the presence of Clear spaces and clefts.[⁶]

The differential diagnosis for mixed odontogenic tumours includes ameloblastic fibroma, ameloblastic fibroodontoma, osteoblastoma, cementoma and osteoma. Ameloblastic fibroodontoma presents as a mixed radiolucent-radiopaque lesion. Ameloblastic fibroma presents as a radiolucent lesion.[^{5,6}] The presence of primitive odontogenic epithelium and ameloblastic epithelium are seen more frequently in complex odontomas, whereas the presence of odontogenic mesenchymal tissue is more frequent in the compound type.

The preferred treatment is surgical excision of the lesion. Odontomas within dentigerous cysts in children are less aggressive, therefore, marsupialization is preferred. [⁸] whereas in case of adults it mandates enucleation.[⁸] In our case, the

odontoma was large in size and fused with 36, it carried the risk of jaw destruction or possible carcinomatous transformation. Hence, the patient was treated with surgical excision. Also other challenge which we faced while excision was due to the fusion it was a relatively big mass and it was involving the both lingual and buccal cortex and was close to inferior border of mandible, therefore it was time consuming to separate it from both the cortices and to section it in multiple segments owing to the risk of fracture of lingual cortex as well as mandible.

CONCLUSION

Odontomas are most common benign tumors of both jaws. They generally remain asymptomatic. They usually cause delayed eruption of teeth, cystic changes and jaw destruction. Therefore early detection and treatment of odontomas provides better outcome to the patient.

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Conflicts of interest

There are no conflicts of interest.

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FIGURE LEGENDS

- Figure 1 :** Preoperative Picture of Patient
Figure 2 : CBCT Depicting the odontome In Posterior Mandible along with 36,37
Figure 3 : Surgical Exposure of the Lesion and Excised Specimen
Figure 4 : Microscopic View of Odontome



Figure 1: Preoperative picture of the patient



Figure 2: Radiographic Image of the patient



Figure 3: Surgical exposure of the lesion and excised specimen

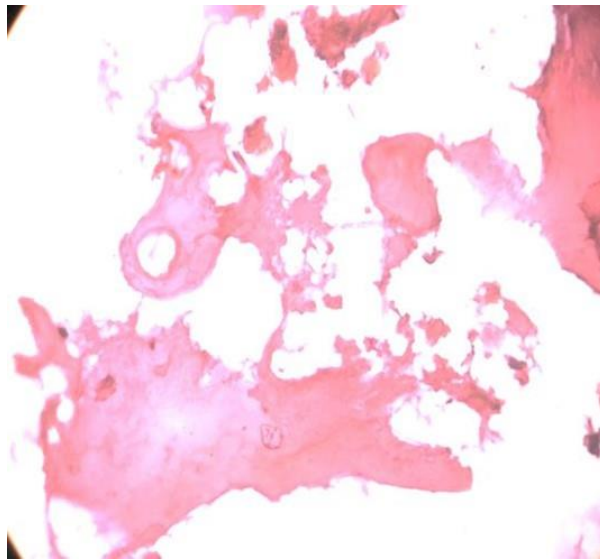


Figure 4: Microscopic view of the lesion

Sub-Mental Intubation in the Management of Pan-facial Fractures

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Abstract

To achieve adequate airway management in maxillofacial procedures, the right intubation technique should be employed. Most maxillofacial injuries involve occlusal derangements, which might require intraoperative occlusal corrections; hence, orotracheal intubation is not ideal. Submental intubation has been advocated as an alternative to tracheostomy for Pan-facial trauma surgeries. In 1986, Altemir first reported the use of submental intubation to avoid tracheostomy in patients with pan-facial and midfacial fractures. In this technique the endotracheal tube is passed through an extraoral incision in the submental region in the floor of the mouth intraorally. The anaesthetic management of a 32-year-old male who presented with multiple maxillofacial injuries sustained during a road traffic accident has been described. He was posted for open reduction and internal fixation of the fractures. As all the conventional modalities to secure airway seemed unsuitable, orotracheal intubation was done via submental route.

Keywords: Submental Intubation, Orotracheal intubation, Pan-facial trauma, Tracheostomy

INTRODUCTION

Panfacial fractures are group of fractures involving the upper, middle, and lower thirds of face simultaneously. These injuries involve the frontal bones, zygomaticomaxillary complex, NOE region, maxilla and mandible.[1] Panfacial trauma management is a challenge for maxillofacial surgeons as well as anaesthetists, not only to achieve the facial contour but also to get the satisfactory functional end results with selection of proper intubation technique. In addition, pan-facial trauma presents with numerous difficulties for airway management when surgical intervention is done.[2] Orotracheal and nasotracheal intubations are the preferred procedures for airway maintenance in maxillofacial trauma patients. Nasotracheal intubation is not suitable when Pan-facial trauma is associated with nasal and skull base injuries.[3] Orotracheal intubation is also unsuitable for temporary intramaxillary and maxillomandibular fixation of teeth done for aligning the fracture fragments.[3] In such cases, the standard method of airway management is tracheostomy, but this is associated with perioperative and late complications.[3] An alternative technique of airway management in pan-facial trauma, the submental intubation can be undertaken. It gives good access to the operative field and it also allows temporary intraoperative intermaxillary fixation without having to resort to tracheostomy.[4]

Thus, the present study aimed to prove that submental intubation is most effective alternative for airway management in patients with pan-facial trauma during general anaesthesia.

CASE REPORT

A 34 years male reported our unit with history of road traffic accident. On clinical examination there was bilateral peri-orbital oedema (raccoon eyes), subconjunctival ecchymosis, deranged occlusion, dish face deformity (Figure 1a). There was no history of loss of consciousness and vomiting, but patient had persisting nasal bleeding. After taking complete history, clinical and radiological examination. The diagnosis of Bilateral le-fort III fractures, Bilateral ZMC Fractures, Left subcondylar fracture with right Parasymphysis fracture was given (Figure 1b, 1c). The Patient was scheduled for open reduction and

internal fixation under general anaesthesia using submental intubation.

Pre-anaesthetic preparations were carried out. A flexo-metallic endotracheal tube with a detachable universal connector was used. The necessary airway with adjuncts, crash cart, intubation aids were readied prior to induction. The tube and connectors were verified in order to help easy removal when changing the tube from intra-oral to extra-oral through the submental route. Initially, regular oro-tracheal intubation was achieved using a conventional laryngoscopy technique. Both extra-oral and intra-oral preparations were carried out. The landmarks for the skin incisions was directly below the lower border of the mandible at the para-median region (Figure 2a). Local Anaesthesia with Adrenaline (1:80,000) was administered at the incision site. MMF was released. A 2-cm para-median incision was given on parasymphysis region. Blunt dissection was carried out through the subcutaneous tissue, platysma using artery forceps, and passed through the mylohyoid muscle upwards through the floor of the mouth (Figure 2b) One finger was positioned inside on the lingual surface to feel the tip of artery forceps. As soon as the forceps reached the lingual mucosa, away from the sublingual duct and its opening blanching of the mucosa was noted. A small incision was given over the blanched mucosa to make a passage of the tube from intra-oral to extra-oral side. With the help of a curved artery forceps, the proximal end of the tube was grasped and pulled through the incision making a tunnel from floor of the mouth to the submental region of the mandible (Figure 2c). The tube was secured with skin sutures (Figure 4c). Exposure of Multiple Fracture Sites, open reduction and Internal fixation was performed without disturbing the tube. Extraoral Incision was closed using silk sutures. The Patient was reviewed on the first, second, and third postoperative days. The patient was later kept on follow-up of one 15 days, 1 month (Figure 3a, 3b) and 3 months. Postoperative period was uneventful. Skin wound healing was aesthetically acceptable. (Figure 5)

DISCUSSION

Injuries to the head and maxillofacial area can easily jeopardize the patient's ability to maintain the airway. The most advanced techniques in managing

facial trauma can be meaningless if attention was not directed to the victim's airway.

In Pan-facial trauma, surgeons have to seek various ways of intubation when surgical access is required in both the nasal and oral cavities. Nasotracheal and orotracheal intubations are the most frequently used techniques.[5] The orotracheal technique hampers intraoperative control of dental occlusion. Nasotracheal intubation is not indicated in cases of cranial base trauma because of the chances of iatrogenic meningitis, accidental intracranial placement, possible cerebrospinal fluid leak, epistaxis, pharyngeal injury, external nares pressure necrosis, recurrent middle ear infections, sinusitis, sepsis and difficulty in passing a nasal tube.[1,5]

Tracheostomy is the preferred option in patients with pan-facial trauma where there is need for prolonged intubation.[1] Despite being one of the most common surgical procedures, tracheostomy has a complication rate of 14% to 45%.[2] Considering the various complications associated with tracheostomy, patients with pan-facial trauma, tracheostomy should be reserved for patients who require prolonged intubation.[2] Hernandez Altemir in 1986 proposed Submental intubations is better alternative to tracheostomy during management of maxillofacial trauma as they temporarily divert the airway away from the surgical field and facilitate access to all maxillofacial trauma. [6][7]

Generally, submental intubation is performed after standard orotracheal intubation.[8]

In performing submental intubation a spiral reinforced ET tube is first placed orally, similar to traditional endotracheal intubation. Using the inferior border of the mandible as a landmark, a 2.0 cm transverse submental skin incision is made medial and parallel to the mandibular border.

Throughout the subsequent soft tissue dissection, care is taken to avoid disruption of the lingual nerve which is a rare complication.[6] Blunt dissection is performed via skin incision, subcutaneous tissue, platysma, deep cervical fascia and mylohyoid muscle. Finally, a small intraoral incision at the junction of the lingual gingiva and the oral mucosa to create a passage from floor of the mouth to external submental region. Various methods are used to facilitate passage of the endotracheal tube through

the submental opening. Once the tube is passed, reconnected to the anaesthesia circuit and confirmed to be in proper position for patient ventilation the tube is sutured in place.[6]

Mean submental intubation time is 8 minutes.[3] Time taken by Thomas et al was 10 minutes.[8] According to Tidke et al. The passage of the endotracheal tube and reattachment of the anaesthetic circuit is short enough without ventilatory support and the risk of hypoxia and its complications are low.[9] In our case the time taken was 10 minutes which is similar to the literature. So, is a minimally invasive procedure, and can be completed in short duration.

infection at the site of incision, bleeding diathesis, disrupted laryngotracheal anatomy and a restricted retromolar space, multisystem trauma can be the contraindications for this technique.[1]

There are various complications associated with submental intubation. The major complication is kinking of tube or accidental tube extubation.[8] Other complications are wound infections, endotracheal tube damage, lingual nerve paraesthesia, bleeding and submental hypertrophic scar. Other associated postoperative complications are oro-cutaneous fistula, traumatic injuries to the submandibular and sublingual glands or ducts.[1,8] No such complications was observed in our case as well.

The procedure is not associated with an aesthetic scar and is relatively easier and inexpensive to perform. This was associated with minimal alteration of the surrounding tissues for passage of the tube. In our study all the patients underwent intraoperative manipulation of maxillofacial bones for the correction of occlusion. Any hindrance during manipulation was not observed. No kinking of tube and no complication during extubation was observed, making submental intubation an ideal alternative method of intubation in comparison to other techniques. By providing antibiotic cover preoperatively, applying effective surgical technique during the procedure, ensuring that the submental incision isn't closed too tightly, and with proper postoperative oral hygiene, the risk of morbidity is reduced significantly.[5]

CONCLUSION

Submental intubation mandates technical skills. In comparison to other techniques it is safe, simpler, easy, and fast. It does not require any specialized equipment, and is cost effective. Submental scarring is lower than that associated with other techniques. Hence this technique is comparatively more convenient for operating pan facial trauma or orthognathic cases requiring constant check on occlusion and functional movements of the jaw.

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CONFLICT OF INTEREST: There are no Conflict of Interest

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FIGURE LEGENDS

- Figure 1 a** : Extra-oral picture of patient
Figure 1 b, 1c : 3D-CT and Axial Section
Figure 2 a, 2b, 2c : Submental Intubation Figure 3a, 3b: 1 Month follow-up

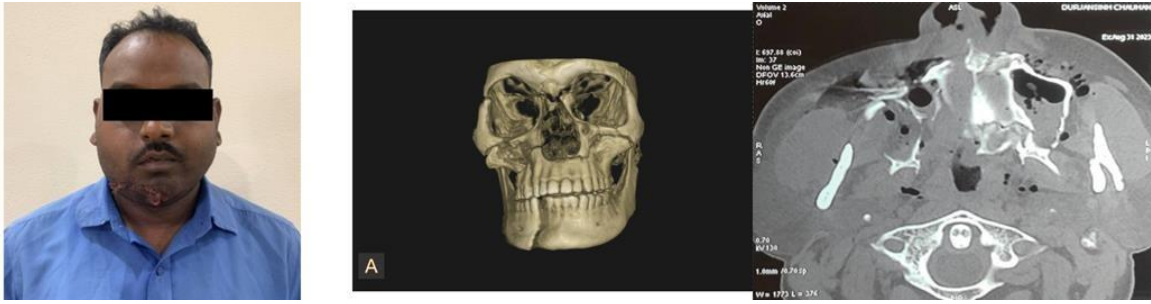


Figure 1 a - Extraoral picture **b.3** - D CT of the patient
c. Axial section showing Bilateral le-fort III fractures, Bilateral ZMC Fractures, Left subcondylar fracture with right Parasymphysis fracture



Figure 2a, 2b, 2c: Submental Intubation (Extra oral incision and Technique)



Figure 3a, 3b: 1 Month follow-up

A Study on Comparison of Various Morphological Types of Cemento-Enamel Junction in Ground Section of Deciduous Teeth: A Research Article

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Abstract

Aim: To assess the most common morphological types of Cemento-enamel junction (CEJ) in deciduous teeth.

Materials and Methods: A total number of 40 deciduous teeth were selected. The cemento-enamel junctions of prepared ground sections was then analyzed and studied.

Results: Edge to edge pattern of cemento-enamel junction is most common pattern observed which is followed by gap, cementum over enamel and enamel over cementum respectively.

Conclusion: In the present study, out of 4 patterns of cemento-enamel junction, edge to edge pattern is most commonly seen followed by gap and cementum over enamel pattern and enamel over cementum pattern.

Keywords: Cemento-enamel junction, Deciduous dentition, Edge to edge contact

INTRODUCTION

Cemento-enamel junction (CEJ) is considered as important morphological and anatomical structure which divides the enamel of the tooth and the cementum¹. Investigations or study regarding the anatomy of Cemento-enamel junction is advantageous in demonstrating the pathological activities that appears in this region. Gingival fibers are associated to the Cemento-enamel junction which confer the strength of tooth. Investigating the Cemento-enamel junction is a favourable clinical framework to determine periodontal diseases^{2,3}. The Cemento-enamel junction is positioned at cervical region where coronal enamel and root

cementum unite. This junction is recognized after the formation of last part of enamel. The inner enamel and outer enamel epithelial cells when comes together, they will manifest into Hertwig's sheath, which further leads to the formation of the cementum⁴.

AIM

The aim of the present study is to determined the most common pattern of cemento-enamel junction in deciduous teeth.

MATERIAL AND METHODS

A total number of 40 deciduous teeth were selected for this study, which was divided in table below:

Dentition	Site	Sample size
Deciduous Dentition	Anterior teeth	40

Immediately after extraction, tooth were kept in 10% formalin until the preparation of ground section of tooth. The teeth were cleaned with special care to avoid destruction of cervical region of tooth.

For preparing ground sections, initially the tooth were grossly reduced mesio-distally on a lathe machine till the tooth reaches to a thickness of 1-2 mm. After achieving suitable thickness, the sections were then grounded on Arkansas stone until a suitable thickness of 25-30 microns were achieved. Finally, the ground sections of teeth were cleaned with xylene and mounted on glass slides.

Later, the ground sections of teeth were divided into groups and studies under light microscope to analyze the following relationship of cement-enamel junction

1. Gap between enamel and cementum (group 1)
2. Enamel overlapping cementum (group 2)
3. Cementum overlapping enamel (group 3)
4. Edge to edge contact (group 4)

RESULTS

After analyzing and recording, the data was sent for statistical analysis. The sample consisted of 40 deciduous anterior teeth.

The most common pattern observed were edge to edge (57.5 %) (Figure-1), which was followed by

gap between enamel and cementum (32.5 %) (Figure-2), cementum over lapping enamel (10 %) and enamel overlapping cementum (0.00 %). (Table number-1)

DISCUSSION

The anatomy as well as arrangement of Cemento-enamel junction of teeth possesses huge significance because of its association with various factors, for example various pathological changes like abrasion, cervical erosion, root surface caries, resorption etc.

In the present study, a total number of 40 deciduous teeth were selected and ground section of all teeth are prepared. Later, the data were prepared and subjected to statistical analysis.

Most of the data available regarding the Cemento-enamel junction demonstrate the presence of three morphological pattern i.e. edge to edge, gap between the cementum and enamel and cementum overlapping the enamel^{5,6,7,8}. Fourth type of morphology i.e. enamel overlapping the cementum was defined by Neuvald and Consolaro and by Ceppi et al in 2000 and 2006 respectively in their research on permanent as well as deciduous teeth^{9,10}.

A study done by Arambawatta² found that edge to edge contact was more common in occurrence. In

the present study, we observe that edge to edge contact was more common in deciduous teeth.

Bevenius⁸ conducted the study using eight recently extracted premolars and observed that edge to edge contact was the most common type of cemento-enamel junction. Similar results are found in our study in deciduous teeth.

In their study, Nenad¹¹ Stosic also observed that the most common pattern of cemento enamel junction is edge to Edge type. They also observed that in 33.3 % cases shows cementum overlapping the enamel pattern and 16.7 % cases shows enamel overlapping the cementum pattern. but in our study, we observed that 57.5% cases shows edge to

edge pattern of cement enamel junction and 10% of cases shows cementum overlapping the enamel pattern.

CONCLUSION

The present study shows various types of Cemento enamel junction which is an important anatomical and morphological structure in ground section of teeth. In our study, Edge to edge pattern of Cemento-enamel junction is most common pattern observed which is followed by gap, cementum over enamel and enamel over cementum respectively. Additional study with more number of samples will be helpful to get more accurate data.

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TABLES

Table number 1: Overall distribution of various cemento-enamel junction [sample size (n)= 40]

Position of teeth	Types of cemento-enamel junction			
	Gap between enamel and cementum (Group 1)	Enamel overlapping cementum (Group 2)	Cementum overlapping enamel (Group 3)	Edge to edge contact (Group 4)
Anterior	13 (32.5%)	00 (00%)	04 (10%)	23 (57.5%)

FIGURES

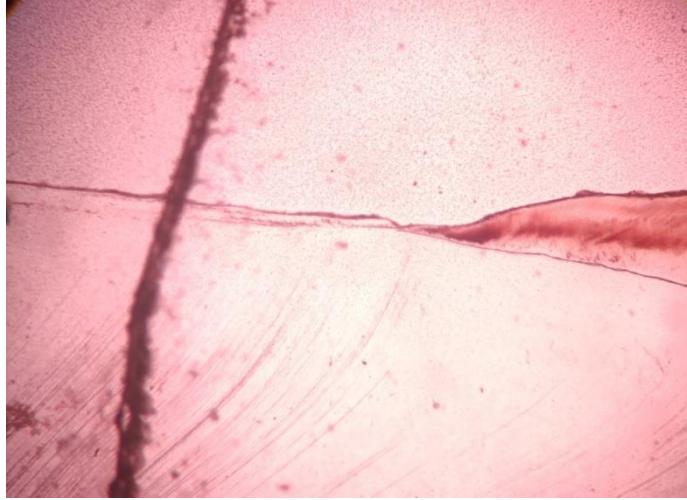


Figure Number 1: Edge To Edge Contact

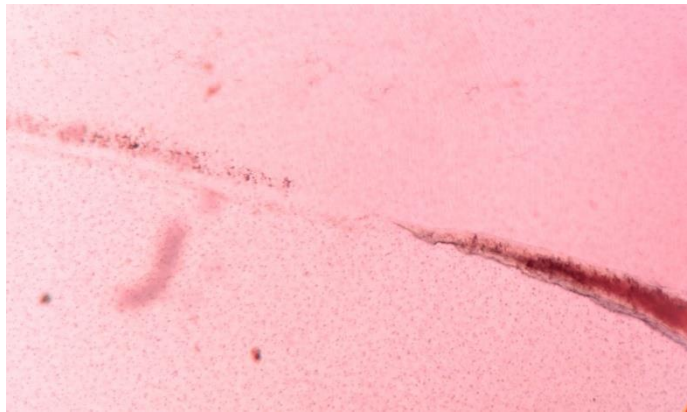


Figure Number 2: Gap Junction

Efficacy of Intraligamentary Injections Vs. Inferior Alveolar Nerve Blocks in Dental Anesthesia: A Comparative Study

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ABSTRACT **Background:** The inferior alveolar nerve block (IANB) is commonly used for mandibular extractions but has notable drawbacks. Intraligamentary injections (ILI) may be a preferable alternative, especially for patients with bleeding disorders.
Objective: To compare the efficacy of ILI and IANB for mandibular posterior tooth extractions.
Methods: Thirty patients received ILI on one side and IANB on the other. Pain levels and complications were assessed.
Results: ILI caused less pain during injection and operation compared to IANB. No significant differences were found in the need for repeated injections, hematoma, or dry socket.
Conclusion: ILI is a safer and less painful alternative to IANB for mandibular extractions and is particularly suitable for patients with bleeding disorders.
Keywords: Intraligamentary Injection, Inferior Alveolar Nerve Block, Local Anesthesia

INTRODUCTION

Providing effective local anesthesia is crucial for gaining patient trust and cooperation, and for ensuring successful dental treatment¹. Tooth extraction is one of the most common dental procedures requiring local anaesthesia. In the upper jaw, teeth are usually extracted under local infiltration anaesthesia as the bony anatomy of the upper jaw enables the diffusion of the local anaesthetic solution in sufficient amounts into its working site. In adults, the bony anatomy in the

posterior part of the mandible allows, however, no adequate diffusion of the anaesthetic solution. Until today, the inferior alveolar nerve block (IANB) is the most commonly used technique for providing local anaesthesia in the posterior mandible². However, this technique is painful and has a relatively high failure rate³. Some of the complications like, haemophilia and other bleeding diatheses have long been of special concern to the dentist⁴. In patient with haemophilia requiring mandibular extractions, there is 80% chance that

hematoma will develop following the administration of an inferior alveolar nerve block injection without prior factor VIII infusion⁵. Consequently, there is an increase demand for alternative local anaesthetic technique with higher success rate and minimal risk of complications.

Debating on this demand, the question arises, whether intraligamentary injection (ILI) can be considered as valid alternative to the conventional IANB for simple extractions of mandibular posterior teeth, in patients suffering with bleeding diathesis. Thus, this study was conducted in an attempt to test the efficacy of intraligamentary anaesthesia (ILA) as compared to IANB to anaesthetise mandibular posterior teeth for the purpose of extraction.

MATERIALS AND METHODS

A total number of 30 patients were considered for this study requiring bilateral extractions of mandibular posterior teeth. All patients were given written informed consent after being informed about all procedures and possible discomfort. Patients were evaluated as per inclusion and exclusion criteria.

Inclusion criteria

1. Patients' age ranges from 15 to 55 years
2. Subjects willing to participate in the study
3. Teeth not involved in periapical pathologies

Exclusion criteria

1. Patients with any systemic and local conditions associated with poor bone health
2. Patients with uncontrolled local infection
3. Patient's unwilling to participate in this study

Armamentarium

1. 5ml syringe with a 26 gauge 1.5-inch needle for IANB
 2. Intraligamentary injection system with 30-gauge needle for ILI
 3. Lignocaine with 1:80000 adrenaline
- Right-sided extractions received ILI (Group A), and left-sided extractions received IANB (Group B). IANB was given following proper landmarks and 1.8 ml of solution was deposited. For ILI, the needle was inserted 1-2 mm into PDL on all four sides- mesial, distal, buccal and lingual. About 0.2 ml solution was injected on all sides.

All of the injections, teeth extractions, and data collection in this study were performed by only one operator, to make the results unbiased.

Clinical Parameters

1. Pain: According to Visual Analogue Scale (VAS) and Verbal Response Scale (VRS) scales. Prior to administration of local anaesthetic, each patient was provided with a thorough explanation of VAS & VRS. The VAS has markings of numbers 0 to 10; with '0' being no pain to '10' being hurts worst Fig 1. The VRS was additionally employed for pain assessment. It also has markings of 0 to 10; with the range of '0' being no pain, '1 to 3' being mild, '4 to 6' as moderate and '7 to 10' as severe Fig 1. Pain was recorded during injection and intraoperatively.
2. Frequency of repeated injections
3. Frequency of hematoma occurrence in either of injection techniques
4. Presence of dry socket post operatively

RESULTS

Data was presented as mean values and standard deviations. Analysis of variance (ANOVA) was used to compare the differences among the two groups.

Pain during injection: VAS value for group A was 1.40 ± 1.10 and for group B was 3.60 ± 0.56 ; with a highly significant result as $P < 0.001$. The mean value in group A was 1.4 and that of group B was 3.6. VRS value for group A was 1.37 ± 0.96 and for group B was 3.60 ± 0.50 ; with a highly significant result as $P < 0.001$. The mean value in group A was 1.37 and that of group B was 3.6 (table 1).

Pain intraoperatively: VAS value for group A was 2.0 ± 0.83 and for group B was 2.75 ± 0.97 ; with a significant result as $P = 0.02$. The mean value in group A was 2 and that of group B was 2.57 (table 1). VRS value for group A was 1.93 ± 0.83 and for group B was 2.50 ± 0.90 ; with a significant result as $P = 0.01$. The mean value in group A was 1.93 and that of group B was 2.5 (table 1).

Frequency of repeated injections: For group A the value was 0.13 ± 0.35 and for group B it was 0.20 ± 0.41 ; with no significant result as $P = 0.50$. The mean value in group A was 0.13 and that of group B was 0.2 (table 1).

Frequency of hematoma occurrence and presence of dry socket: No significant finding was observed in both the techniques.

DISCUSSION

I ANB is the most commonly used anesthetic technique for restorative and surgical treatments of posterior mandibular teeth⁶. IANB has a relatively high rate of anaesthetic failures and carries imminent risks of accidental injection into the vessels of pterygomandibular space, which can terminate into severe systemic symptoms. In patients who are receiving anticoagulation therapy and those with bleeding disorders, the infringement of blood vessel can result in serious bleeding into the medial pterygoid muscle or the pterygomandibular space and the surrounding soft tissue⁷. Amongst the other lesser known complications, one of them is nerve damage. Pogrel and Thamby⁸, conducted a prospective study of patients referred to a tertiary care centre with permanent alteration in sensation of the inferior alveolar nerves, lingual nerves or both that could have resulted only from an inferior alveolar nerve block.

To overcome these unforgiving complications, we carried out this study of comparison of ILA with IANB for extractions of mandibular posterior teeth in a clinical routine setting. The results obtained in this study indicate that ILI is as efficient as IANB for this indication. In accordance, data showed no statistically significant differences between the success rates and the profoundness of local anaesthesia obtained with the two anaesthetic techniques. In certain aspects, ILI was found to be even superior to IANB. Hence, ILI was significantly less painful to the patients, required a significantly smaller amount of local anaesthetic solution, did not require repeated injections in a larger scale and provided equally profound anaesthesia in comparison to IANB.

So far, there are only few comparative studies of low evidence comparing ILA and IANB anaesthesia in the extraction of mandibular posterior teeth. These studies showed that intraligamentary anaesthesia is at least not inferior to nerve block anaesthesia for this indication^{7,9,10}.

Lin et al¹¹ evaluated the success rate of ILI using a two or four site injection technique. The results of

this study indicate that the use of the four sites ILI as a primary anaesthetic technique should be considered a favourable alternative to the common IANB in asymptomatic molars. This was practiced in our current study also.

Berlin et al¹² conducted a double-blind study to compare the anaesthetic efficacy of the intraligamentary injection of 4% articaine with 1:100,000 epinephrine and of 2% lidocaine with 1:100,000 epinephrine, administered with computer controlled local anaesthetic delivery system, in mandibular posterior teeth. They concluded that efficacy of 4% articaine with 1:100,000 epinephrine was similar to the efficacy of 2% lidocaine with 1:100,000 epinephrine for intraligamentary injections.

Moore et al¹³ presented two alternative techniques to provide local anaesthesia in mandibular teeth: the PDL injection and the intraosseous injection. They concluded that the PDL injection and the intraosseous injection are effective anaesthetic techniques for managing nerve block failures and for providing local anaesthesia in the mandible. Kammerer et al¹⁴ evaluated the impact of experience whilst using different devices for intraligamentary anaesthesia. They tested clinical anaesthetic efficacy of a mechanical and a computer-controlled application system in restorative patients. They concluded that both PDL techniques showed a good success for routine dental treatments. Although, compared to the mechanic device, the computer-controlled application system might need more clinical daily experience.

Few other studies^{15,16} compared the efficacy of ILI with conventional IANB for extraction of mandibular posterior teeth. They concluded that ILI fulfils the requirements of a minimal invasive and patient friendly local anaesthetic technique. In accordance, it represents a reliable alternative to IANB for extraction of mandibular posterior teeth. We have also assessed any hematoma occurrence in either of the anaesthetic techniques to validate the claims of these studies as ILI being a safer and dependable technique as compared to IANB.

On observing the routine dental practice, we assume that there are an increasing proportion of elderly patients and patients with cardiovascular

diseases taking anticoagulants. Thus, the number of risk patients in the daily dental practice increase. ILI should be considered as the anaesthetic method of choice for these patients.

CONCLUSION

Intraligamentary injection is a safe and effective alternative to the inferior alveolar nerve block for mandibular posterior tooth extractions. Moreover, it does offer several advantages for the patient and surgeon over the conventional IANB, such as less painful than IANB, the lesser amount of injection

needed. Hematoma formation with ILI can practically be excluded.

Considering the potential complication of the inferior alveolar nerve block, ILI can be considered as a preferred anaesthetic technique especially for single tooth treatment, while IANB can be limited only to cases in which ILI failed to provide the sufficient anaesthesia and in cases of dentoalveolar surgical procedures requiring a longer time or for treating many teeth in the same quadrant.

ACKNOWLEDGEMENTS - None

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	N	GROUP A		GROUP B		P value
		Mean	SD	Mean	SD	
Pain in nerve block (VAS)	30	1.40	1.10	3.60	0.56	<0.001 (HS)
Pain in nerve block (VRS)	30	1.37	0.96	3.60	0.50	<0.001 (HS)
Pain Intraop procedure (VAS)	30	2.00	0.83	2.57	0.97	0.02 (S)
Pain Intraop procedure (VRS)	30	1.93	0.83	2.50	0.90	0.01 (S)
Frequency of repeated injection	30	0.13	0.35	0.20	0.41	0.50 (NS)

Table 1- Pain perception while injecting, during intraoperative procedure and frequency of repeated injections

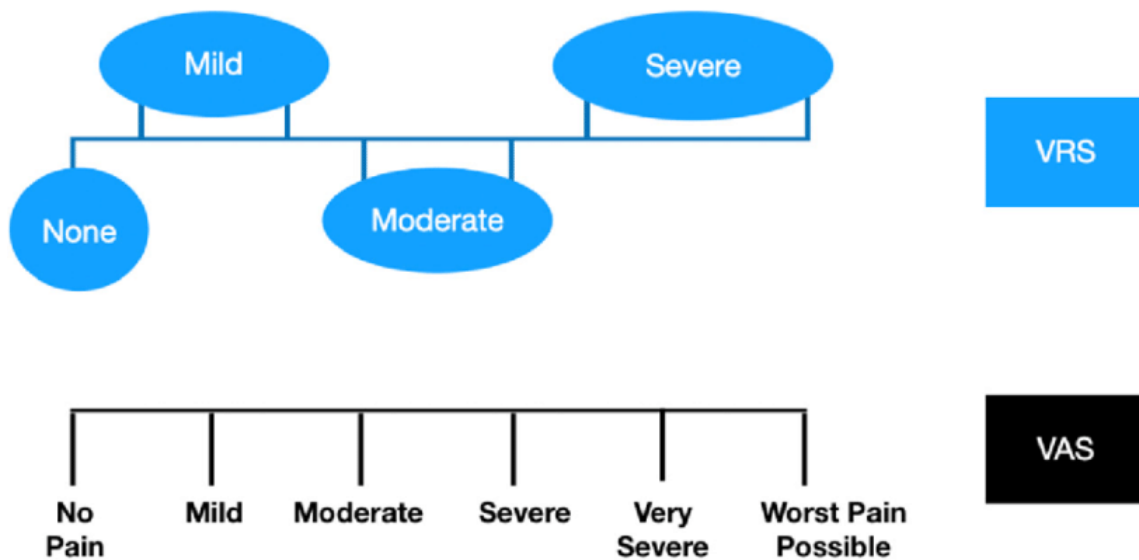


Fig. 1 - VAS & VRS Scale

Hemisection and Restoration of Multirooted Teeth: A Conservative Management - Case Report Series

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Abstract

Hemisection is sectioning of multi-rooted teeth with its crown portion, with the loss of periodontal attachment and is performed to retain the original tooth structure and attain the fixed prosthodontic prosthesis. This article describes and illustrates case series of different prosthetic options for a hemi sectioned tooth in which the decayed terminal abutment was part of a fixed prosthesis. Hemisection and prosthetic rehabilitation yielded a satisfactory result.

Keywords: hemisection, prosthodontic option, root section, endodontic

INTRODUCTION

Recent advances in dentistry provide the opportunity for patients to maintain a functional dentition for lifetime. Hemisection refers to removal or separation of root with its accompanying crown portion of two-rooted teeth most likely mandibular molars. It is a conservative way of preserving tooth. The term “hemi section” or “root amputation” are synonyms for “root sectioning” or “bisection” and is a treatment modality, which allows the preservation of tooth structure, alveolar bone and cost savings over other treatment options.[1]

Indications:

Weine [2] has listed the following indications for tooth resection.

Periodontal Indications

1. Severe vertical bone loss involving only one root of multi-rooted teeth.
2. Through and through furcation destruction.
3. Unfavourable proximity of roots of adjacent teeth, preventing adequate hygiene maintenance in proximal areas.
4. Severe root exposure due to dehiscence.

Endodontic and Restorative Indications

1. Prosthetic failure of abutments within a splint: If a single or multirooted tooth is periodontally involved within a fixed bridge, instead of removing the entire bridge, if the remaining abutment support is sufficient, the root of the involved tooth is extracted.
2. Endodontic failure: Hemisection is useful in cases in which there is perforation through the floor of the pulp chamber, or pulp canal of one

of the roots of an endodontically involved tooth which cannot be instrumented.

3. Vertical fracture of one root: The prognosis of vertical fracture is hopeless. If vertical fracture traverses one root while the other roots are unaffected, the offending root may be amputated.
4. Severe destructive process: This may occur as a result of furcation or subgingival caries, traumatic injury, and large root perforation during endodontic therapy.
 - a. Strong adjacent teeth available for bridge abutments as alternatives to hemisection.
 - b. Inoperable canals in root to be retained.
 - c. Root fusion-making separation impossible.

Contraindications

- Strong adjacent teeth available as bridge abutment available as an alternative to hemisection.
- Inoperable canals in the root to be retained.
- Root fusion making separation impossible.
- When bony support for the remaining root is insufficient for the restoration.

CASE REPORTS

Case Report 1

A 35-year-old patient reported with a chief complaint of pain and mobility of left mandibular first molar. on examination, the tooth was sensitive to percussion. the probing depth was 12mm deep around the distal root of the tooth. on radiographic

examination, severe vertical bone loss involving the furcation area and deep root caries was evident on the distal root of the tooth. the bony support of the mesial root was completely intact (Fig.1). A conservative approach was decided for the patient, the distal root was hemisectioned after completion of endodontic therapy of the tooth. once the endodontic procedure was completed, under local anesthesia a full thickness flap was reflected upon reflection of the flap, the bony defect along the distal root became quite evident. all granulation tissue was removed using the Gracey curettes to expose the bone. the vertical cut was made using a long shank tapered fissure carbide bur (Fig.2). A fine probe was passed through the cut to ensure separation. The distal half was extracted and the socket was irrigated adequately with sterile saline. Scaling and root planning of the root surfaces, which became accessible on removal of distal root was done. The extraction site was irrigated and debride. The crater like bony defect was grafted with Perioglass. Then the flap was repositioned and sutured with 3/0 black silk sutures (Fig.3,4). The occlusal table was minimized to redirect the forces along the long axis of the mesial root. after healing of the tissues, a fixed bridge was planned. in this case a full coverage three unit was given with a small size pontic, in the shape of a premolar was given (Fig. 5 ,6).



Fig.1



Fig.2

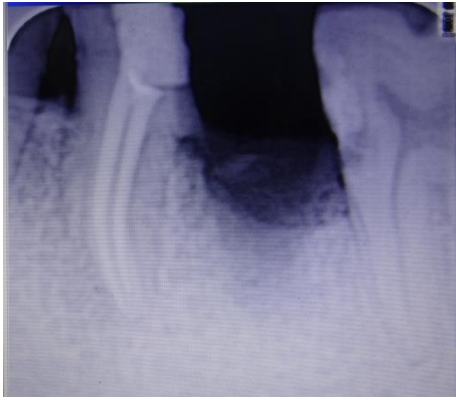


Fig.3



Fig.4



Fig.5



Fig.6

Case Report 2

In the similar case as above, the hemisection of the mesial root of left mandibular first molar was done (Fig.7, 8) and after healing a 3 unit fixed partial

denture partial veneer crown on the anterior abutment (distal half) and a full veneer crown on the posterior abutment (i.e. the distal root of the tooth) was planned (Fig. 9).



Fig.7



Fig.8



Fig.9

Case Report 3

In another case, (Fig.10) the hemisection of the mesial root of left mandibular first molar was done and after healing a cast post was fabricated on the distal root and a fixed partial denture with a partial veneer crown on the anterior abutment (three fourth coverage) i.e. the second mandibular premolar and

a full veneer crown on the posterior abutment (i.e. the distal root of the tooth) was planned (Fig. 11). In this case the pontic was made with the retainer was a single unit in a shape of a mandibular first molar and joined with the anterior three fourth coverage retainer as a part of the fixed partial denture (Fig. 12, 13).



Fig.10



Fig.11



Fig.12



Fig.13

DISCUSSION

Hemisection has been used successfully to retain teeth with perforation involving furcation. Many factors determine choosing one treatment plan over another when confronted with a furcation invasion

of a mandibular molar. These may be enumerated in three areas. [3]

- a. Local factors — tooth anatomy, tooth mobility, crown root ratio, severity of attachment loss, inter-arch and intra-arch

occlusal relationship, strategic dental value for retention or removal.

- b. Patient factors — health of a patient, importance of the tooth to the patient, costs, and time factor.
- c. Clinician factors — a good case selection, diagnostic and treatment planning skills, awareness of therapeutic options and clinical insight or skill in providing service.

It is important to consider the following factors before deciding to undertake any of the resection procedures for the success of the procedure.

- Advanced bone loss around one root with acceptable level of bone around the remaining roots.
- Angulation and position of the tooth in the arch. A molar that is buccally, lingually, mesially or distally tilted, cannot be resected.
- Divergence of the roots - teeth with divergent roots is easier to resect. Closely approximated or fused roots are poor candidates.
- Length and curvature of roots - long and straight roots are more favourable for resection than short, conical roots.
- Feasibility of endodontics and restorative dentistry in the root/ roots to be retained.

Implant therapy is a predictable option with good functionality [4]; however, in this case the patient

chose an alternative treatment because of financial consideration and her desire to retain the teeth.

Hemisection allows for physiologic tooth mobility of the remaining root, which is thus a more suitable abutment for fixed partial dentures than an Osseo integrated counterpart.[5] The smaller size of the occlusal tables, under-contouring of the embrasure spaces and ensuring that the crown margin encompasses the furcation are all factors in the high success rates observed with hemisection therapy.[6]

CONCLUSION

Modern advances in all phases of dentistry have provided the opportunity for patients to maintain a functional dentition for lifetime. Therapeutic measures performed to ensure retention of teeth vary in complexity. This case report shows the treatment and various treatment options to restore a compromised tooth by multidisciplinary treatment approach. The success of the tooth with hemisection depends on the supporting bone, the restorative treatment plan, and the oral hygiene of the patient. Regular periodontal maintenance and sufficient coronal restoration of the root resected teeth are important precondition for long term survival. Hemisection is an important treatment in the field of dentistry which will help in increasing desire to retain natural teeth.

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Association of Helicobacter Pylori Infection with Potentially Malignant and Malignant Lesions: An Observational Study

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Abstract

Background: Oral potentially malignant disorders like Oral leukoplakia, Oral submucous fibrosis, Erythroplakia and Oral lichen planus have statistically increased risk of progression to cancer. Of all oral cavity malignancies, oral squamous cell carcinoma accounts for 94% cases. Globally 20% of cancers are related to infectious agents, several microorganisms such as Helicobacter pylori have oncogenic potential. It is proposed that the oral cavity is the primary extra gastric reservoir of the same.

Aim: To evaluate the association of Helicobacter pylori in oral potentially malignant disorders and oral cancer patients.

Materials and Method: A total of 60 subjects comprising 15 each of normal controls, leukoplakia, oral submucous fibrosis, and oral squamous cell carcinoma were included. Blood samples, biopsy procedure, rapid card test, and polymerase chain reaction analysis was carried out.

Results: There was negative association of H.pylori with potentially malignant disorders and Oral Squamous Cell Carcinoma.

Conclusion: Thus it signifies that there was no relationship between H.pylori infection in Controls, PMD and OSCC patients.

Keywords: Oral potentially malignant disorders, Oral leukoplakia, Oral submucous fibrosis, Erythroplakia, Lichen planus, Oral squamous cell carcinoma, Helicobacter pylori.

INTRODUCTION

Oral potentially malignant disorders (OPMDs) have statistically increased risk of progression to cancer, but the risk varies according to patient or lesion-

related factors. Commonly encountered OPMD are Oral leukoplakia (OL), oral submucous fibrosis (OSMF), erythroplakia and lichen planus. Factors associated with increased malignant transformation

of OPMD include sex, size, type of lesion, habits such as smoking, and alcohol consumption and presence of epithelial dysplasia on histologic examination.(1) Oral squamous cell carcinoma (OSCC) is the most frequently occurring malignancy in the oral cavity, bookkeeping for 94% of all oral cavity malignancies. OSCC is more likely to occur in middle and older people, predominantly occurring in men as compared to women in the 4th-5th decade of life. Many factors are causing OSCC, globally 20% of cancers are related to infectious agents, and several microorganisms with oncogenic potential stimulate cell proliferation leading to cancer in animals and humans.(2, 3) *Helicobacter pylori* (*H.pylori*) is one such gram-negative, microaerophilic, spiral/rod-shaped bacterium, that resides primarily in the gastric mucosa without invading the gastric epithelium. This bacterium is responsible for causing persistent mild gastric inflammation, peptic ulcer, and gastric cancer(4-6) and has been designated as a group 1 carcinogen by the International Agency for Research on Cancer of the World Health Organization (WHO).(7)

In addition to gastrointestinal diseases, recent data seem to suggest a possible association of this microorganism with other conditions, such as benign oral disease, recurrent aphthous stomatitis, mucosal inflammation, glossitis, halitosis, gingivitis, chronic periodontitis,(8, 9) anaemia, altered-serum levels of lipoproteins, and coronary atherosclerosis.(10, 11) Few studies suggested that periodontal disease may also favour colonisation of dental plaque by *H.pylori*.(12) With this it is proposed that the oral cavity is the primary extra-gastric reservoir for *H.pylori*.(13) Mode of transmission of *H.pylori* in the population remains unclear. Still, it has been shown that iatrogenic, faecal-oral, oral-oral and through food and water transmission are possible. Due to this, there may be a chance of reinfection and recolonisation of *H.pylori* in the oral cavity and gastric mucosa.(14)

A limited number of therapeutic regimes are available along with antimicrobial agents which are effective in the eradication of *H.pylori* infection. Most of the time combination form of therapy is required to treat gastric infection like an antibiotic, proton pump inhibitor and gastroprotective drugs, however, the recurrence rate of the infection with

H.pylori in developing countries is very high.(15, 16) The gastric mucosa is the continuation part of the oral and upper aerodigestive tract mucosa. There are many studies, depicting the relationship between colonization by the *H.pylori* microorganisms in the stomach and oral cavity.(6, 17) Souto R, et al., showed that *H.pylori* was directly colonized in the oral cavity.(18) Important progress from the past few years has been made in endoscopic methods which allow clinicians to predict the presence of *H.pylori* based on characteristics of gastric mucosa and from the obtained targeted biopsies which are based on physical principles.(19)

There are also important developments in molecular methods with various techniques to know the specific antibodies derived from standard polymerase chain reaction (PCR) to Real-time PCR applied for both tissue biopsies and blood specimens. Other tests that are available to diagnose *H.pylori* infections are the Urea Breath Test, Antigen Test, Serology, etc.(19) All above-mentioned observations regarding colonization and relation of *H.pylori* infection with gastric and oral cavity not only suggest the *H.pylori* as a risk factor for gastric cancers but also provides little clues for its role in oral cancer. However, till now many conflicting results are available and no definite conclusion has been drawn on the correlation between *H.pylori* infections with OSCC.(6, 20, 21) Hence the present study was performed to evaluate the association of *H.pylori* in normal individuals, potentially malignant disorders and OSCC patients based on molecular analysis by performing *H.pylori* antibodies (IgG) sensitivity test, rapid card test and PCR from the blood sample of enrolled subjects.

MATERIALS AND METHODS

This study was carried out at Out-Patient Department, Institute of Dental Sciences, Bareilly. A total of 60 subjects comprising 15 each of normal controls, Leukoplakia, Oral Submucous Fibrosis, and Oral Squamous Cell Carcinoma were included. The age and sex-matched healthy normal controls included were without adverse habits and any obvious oral mucosal lesions. Clinically and histopathologically confirmed cases of oral potentially malignant disorders like Leukoplakia & Oral Submucous Fibrosis and OSCC were included. Subjects with peptic ulcer, gastric problems,

abnormal systemic conditions related to immunity, metabolism, etc. were excluded. The ethical clearance was obtained from the institutional ethics committee for human experimentation before the beginning of the study. All the included subjects were briefed regarding the procedure and signed informed consent was obtained. The demographic data of all subjects were recorded on a customized case history performa.

A detailed oral examination of all the individuals was carried out using diagnostic instruments. According to Jain AK, venepuncture fasting Blood was collected from all the enrolled subjects followed by the separation of serum and cellular part. The serum was used for rapid card test detection specific to H.pylori IgG antibody. However, the cellular part of the blood was used for genomic DNA extraction for 16S ribonucleic acid (RNA) gene of H.pylori by specific forward (F) and reverse (R) primer sequences through a polymerase chain reaction.(3) The incisional biopsy was carried out for histopathological confirmation and grading of potentially malignant and malignant lesions. Collected venous blood was allowed to clot at room temperature for one hour. The serum was separated from the clot and immediately the H.pylori antibodies were assessed by the HelicoCheck™ rapid card test and cellular part was transferred and stored in an Eppendorf tube at -20°C until DNA extraction. B. Rapid Card Test for H.pylori: HelicoCheck™ is a rapid card test, a double antigen sandwich immunoassay for the detection of antibodies to H.pylori in serum obtained from the blood sample. It has the sensitivity and specificity of 92.3%, and 90.5% respectively.(91) According to Zephyr Biomedical, HelicoCheck™ kit manual leaflet the procedure was performed and to be recorded.

Polymerase Chain Reaction: PCR was considered as two steps event. In the first step, the DNA was extracted from the collected cellular blood sample. In a second step, the amplification of the extracted DNA with specific primers for H.pylori was carried out in a PCR machine. Step 1: Genomic DNA from the collected peripheral blood sample, stored at -200C was extracted by Favorprep blood genomic DNA extraction mini kit. (Favorgen Biotech Corp.) Initially, 200 µl of blood sample was collected in 1.5

ml of sterile Eppendorf tube followed by addition of 500 µl RBC lysis solution and allowed to stand for 5 min. Later the small pellet of sediment was obtained by centrifuging Eppendorf tube at 5000 rpm for 5 min. Discard the supernatant from the centrifuged tube and repeat the same procedure by following the same protocol until the white pellet is formed at bottom of Eppendorf tube. Add 20 µl of Proteinase K and 200 µl FavorPrep™ blood genomic (FABG) Buffer into the obtained white pellet and mix thoroughly with a pulse-vertexing machine to get a homogenous separation of pellet strands. The tube was incubated in the water bath at 60°C for 15 minutes to obtain a uniform lysed sample. 200 µl of absolute ethanol was added to the sample and mixed thoroughly by pulse vertexing for every 10 seconds until drops from the inner surface of lid were removed. After this procedure, the samples were transferred from the Eppendorf tube into the FABG Mini Column with the help of micropipettes and were placed into the collection tube which was provided along with the kit and Centrifuged at 6,000 rpm. Then the FABG Mini Column into a new Collection Tube and 400 µl W1 Buffer was added to the FABG Mini Column and centrifuged at full speed at 15,000 rpm and the obtained flow-through. Add 750 µl Wash Buffer to the FABG Mini Column and centrifuge at full speed for 30 sec again discard the obtained flow-through. According to instruction manual, the column was centrifuged at full speed for an additional three minutes to get a dried column, to remove even the tiny amount of residual liquid which was going to inhibit subsequent enzymatic reaction.

At last FABG Mini Columns were placed into an Elution Tube and 40 µl of Elution Buffer was added to the membrane at the centre and allowed to stand for three minutes for complete absorption. The mini Columns was centrifuged at full speed for one minute to elute DNA. (33) The Quantitation of the obtained DNA was measured utilizing the nanodrop reading of spectrophotometer concentration of the genomic DNA. An Elution Buffer was used to dilute samples and calibrate them on the spectrophotometer. The absorbance was measured at 260 nm using a quartz microcuvette. The significance of an absorbance of 1.0 at 260 nm corresponds to approximately 50 µg/ml of DNA. If

the A260/A280 ratio is 1.6-1.9, then the isolated DNA sample is considered to be pure. If a higher A260/A280 ratio is observed it indicates the possibility of RNA contamination. The extracted DNA samples were maintained at -20 °C until the samples were used for amplification in PCR machine. Step 2: In 2ml of Eppendorf tube 7 µl of obtained DNA template from the sample and 75 µl of master mix was added, 7 µl of forward and 7 µl reverse primer (16S ribosomal RNA gene of H.pylori, the forward and reverse primer sequences for PCR 50-CGTTAGCTGCATTACTGGAGA-30 and 50-GAGCGCGTAGGCGGGATAGT C30 respectively), Taq. DNA polymerase up with 55 µl distilled water to make up the required volume. Later on, divide the whole mix into 12 PCR mini tubes. The PCR was run by placing mini tubes in a machine and adjusting the program at 95°C (5 min) for initial denaturation, followed by 40 cycles of denaturation at 94°C (60 sec), annealing at 60°C (60 sec) and extension at 72°C (60 sec) and ended with a final elongation at 72°C (10 min).

The quantitation of PCR-amplified DNA was then studied by Agarose gel Electrophoresis method. Preparation of 1X Tri-acetate-EDTA (TAE) from 50X TAE Buffer by adding sterile distilled water. Preparation of Agarose gel was done by using 0.4 g agarose to 50 ml 1X TAE buffer in a glass beaker or flask. Later by heating the mixture on a microwave until agarose dissolves completely, then the mixture was allowed to cool at about 55-60°C. Add 0.5 µl of good view II instead of Ethidium bromide which is powerful mutagenic and is very toxic followed by pouring the gel solution into the gel tray. The gel was allowed to solidify for about 30 minutes at room temperature. DNA was loaded into the well of gel by mixing with pipetting of 2 µl of loading buffer as a dye marker and 10 µl DNA samples. The electrophoresis procedure was carried out by connecting the power cord to the electrophoretic power supply according to conventions like Red Anode and Black Cathode. Electrophoreses at 100-120 volts and 90 mA until dye markers have migrated an appropriate distance, depending on the size of DNA to be visualized. Finally, visualize the DNA bands using an ultraviolet (UV) Transilluminator and calculate the yield and purity using a UV Spectrophotometer. Sequence analysis

was carried out to confirm the presence of H.pylori if any of the PCR amplified products showed positive band at 295-bp fragment level.

For Vein Puncture, Tourniquet, Alcohol Swabs, Vacutainer without anticoagulant (J. K. Diagnostics, Rajkot, India), and Eppendorf tube of 1.5ml and 2ml (Laboratory systems, Mumbai, India). For Biopsy Procedure, Rapid Card Test, Permanent black marker pen, H.pylori antibody kit (HelicoCheck™ kit, Zephyr Biomedical, Goa, India)

For Polymerase Chain Reaction Glass Wares: Conical Flask, Measuring Cylinder, Beaker (Borosil, India), Favorprep, Blood Genomic DNA Extraction Kit (Favorgen Biotech Corp.) Forward and Reverse Primer for H.pylori (Bioserves Biotechnologies, USA), Eppendorf Tube 1.5ml and 2ml. (Laboratory Systems, Mumbai, India), Refrigerator (Godrej, Mumbai, India), Deep Freezer (Vestfrost, Esbjerg), Reagents - RBC lysis buffer (Qiagen, Germany), Ethanol 96-100%, (EMD Millipore Corporation, Germany), Ethidium Bromide (10 mg/ml), PCR Apparatus (Biometra, Tpersonal), Spectrophotometer Nandrop Apparatus (Thermo scientific, Washington, USA), Table Top Temperature Controlled Centrifuge (Hermle, Germany), Electrophoresis Apparatus (GeNei, Mini Sub System, India), 50 X TAE buffer (Himedia India), UV Transilluminator (Alphaimager, Alpha-Infotech Corp., USA), Micropipettes (Transferpette S), Vortex Mixer (Spinix, Tarson, India), Refrigerated Hot Water Bath (PMI, India), Microwave (Sanyo, India)

Biopsy Procedure: Incisional biopsy was obtained from all the clinically diagnosed potentially malignant disorders and OSCC subjects.

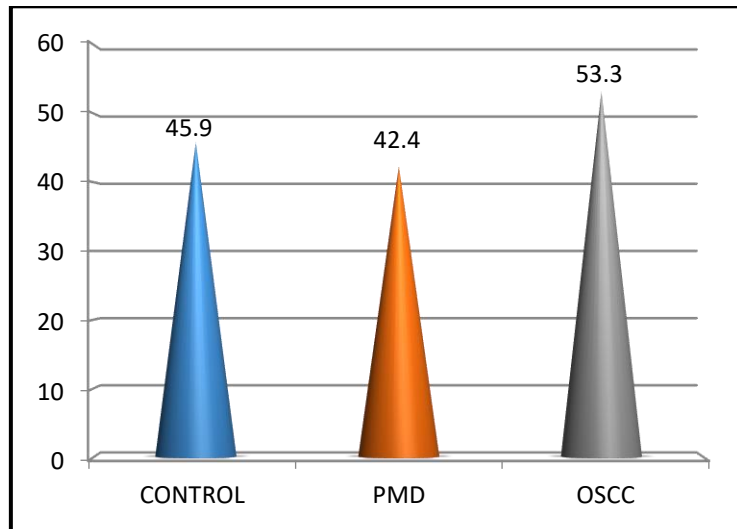
Statistical Analysis: Obtained data was formulated in the form of a master chart on a Microsoft Excel sheet and further processed for statistical analysis using Statistical Package for Social Sciences (Version 23.0, USA) software. Descriptive analysis of quantitative data was expressed as mean and standard deviation (M±SD). Discrete variables were represented as frequencies and percentages. Categorical/Ordinal data was expressed as numbers and percentages. Cross tables were generated and a chi-square test was used for comparisons & associations. The Way Analysis of variance ANOVA test was used for the comparison of means

of more than two groups. Association between variables was considered statistically significant if the p-value was < 0.05.

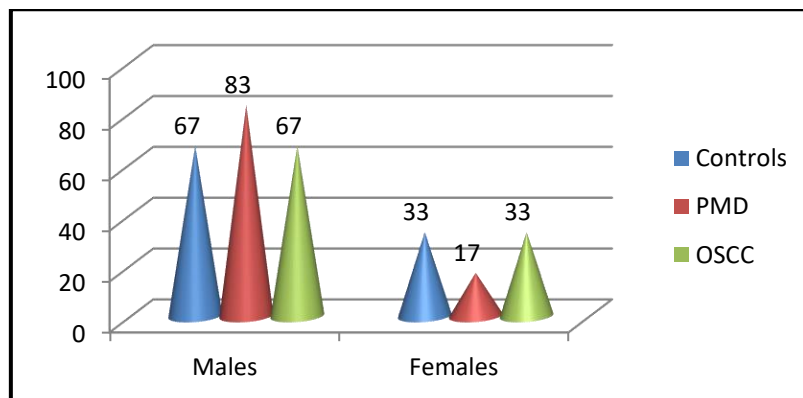
RESULTS

The mean age of controls was 45.9 years, PMD was 42.4 and for OSCC was 53.3 years. (Graph 1) The

sex distribution in controls, PMD and OSCC concerning males were 10(67%), 25(83%) and 10(67%) individuals, whereas females integrated 5(33%) individuals each, respectively. (Graph 2)



Graph 1: Evaluation of mean age among the study Groups.



Graph 2: Sex Distribution among the study groups

The commonest site of occurrence of PMD and SCC was buccal mucosa. The most common habit associated with PMD was betel nut chewing and in OSCC patients was tobacco chewing. The duration of habits with >20 years was reported in 8 (30%) cases of PMD and 7 (47%) cases of OSCC. When frequencies of habits were evaluated in PMD and OSCC showed maximum cases were in the interval of 3-4 times/day. The distribution of enrolled OSCC subjects, based on clinical staging showed

maximum cases belonging to T2N1M0. Based on histopathological grading of epithelial dysplasia in PMD, 15 (50%) cases showed no dysplastic changes, whereas 11 (37%) cases showed mild dysplasia (Figure 1) followed by moderate, severe and ca in situ in 1 (3%), 2 (7%) and 1 (3%) cases respectively. However, histopathological grading, moderately differentiated squamous cell carcinoma showed 10 (67%) cases followed by well differentiated (Figure 2) with 5 (33%) cases.

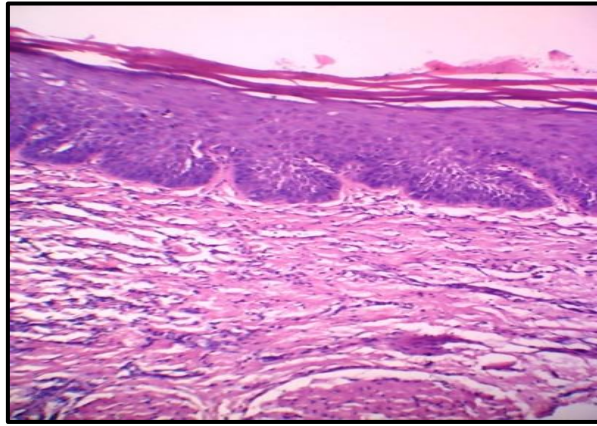


Figure 1: Photomicrograph of hyperkeratotic epithelium with mild dysplasia showing dysplastic features extending up to basal third of epithelium. (H&E X100)

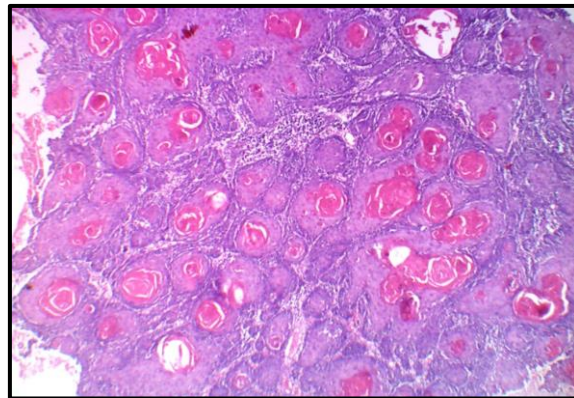


Figure 2: Photomicrograph of well-differentiated squamous cell carcinoma showing numerous keratin pearls and tumour cells arranged in the form of sheets. (H&E X40)

The HelicoCheck™ rapid card test for IgG antibodies revealed negative results in all the enrolled study subjects. Upon statistical evaluation, a non-significant p-value with >0.05 was obtained. The PCR result (Figure 3) was found to be negative

with no band seen at 295 bp (Figure 4) in all the enrolled study samples. Upon statistical evaluation, a non-significant p-value >0.05 was obtained. Thus it signifies that there was no relationship between *H.pylori* infection in Controls, PMD and OSCC.

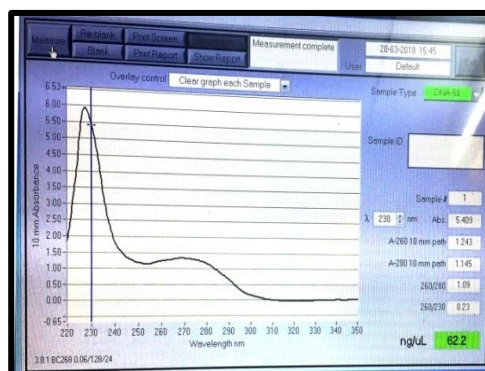


Figure 3: Spectrophotometer nanodrop reading showing the yield and purity DNA as 62.2 ng/ul

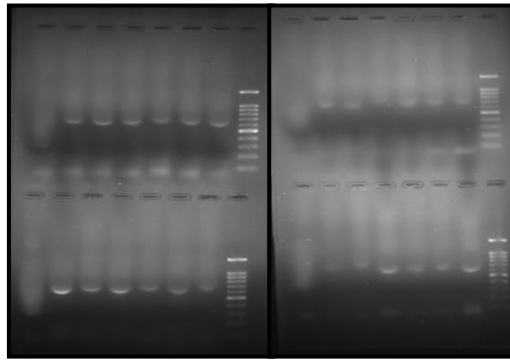


Figure 4: UV Transilluminator of DNA bands of amplified PCR products.

DISCUSSION

The occurrence of oral potentially malignant disorders and OSCC has been established to transpire by multiple stages and various factors such as the use of tobacco, alcohol, areca nut, irritation by mechanical or chemical means, Human Immunodeficiency Virus, Herpes Simplex Virus, HPV, H.pylori, etc. have been implicated.(36) H.pylori is concerned with causing gastric cancer principally, but it is also associated with other diseases of the human body including oral cavity.(37) As the mucosa of aerodigestive tract is in continuation with the gastric mucosa, numerous studies have detected H.pylori in oral cavity where they inhabit more than 700 bacterial species.(3, 38) Several studies have reported similar genotypes of H.pylori strains between oral and gastric mucosa based on histopathologic diagnosis or by using PCR method.(26, 39)

There are several methods to detect H.pylori in humans. In the stomach, the culture technique has been considered “the gold standard, but in the oral cavity, the organisms are present in coccoid forms which are non-culturable. The second one is the urease test, but in the oral cavity, there are other bacteria producing urease, including Streptococcus species, Haemophilus species and Actinomyces species, (40) therefore, the prevalence of H.pylori may be underestimated. The third one is Polymerase chain reaction (PCR) technique, which is an accurate method for detecting H.pylori; however, because of different genomic primers used, the results may be variable. In addition, it may give false-positive results, partly due to the detection of cDNA from non-H. pylori organisms,(41,42) as well and it is not clear whether the gene found belongs to live or non-viable bacteria.(43)

Ito et al. used reverse transcriptase PCR to detect H.pylori DNA in the histologic sections and compared the results with those obtained using Immunohistochemically (IHC). They found that IHC was specific but less sensitive than PCR.(44) There were two proposed mechanisms for H.pylori pathogenesis. Firstly, H.pylori interacts with surface epithelial cells, developing direct cell damage or producing pro-inflammatory mediators.(45) Secondly, H.pylori reaches the underlying mucosa to stimulate an immune response, leading to the release of different cytokines and oxygen radicals that transform chronic gastritis into gastroduodenal ulcers and gastric carcinoma.(46) According to previous reports, H.pylori produces extracellular products that trigger local and systemic immune responses, which can result in tissue damage.(47) Previous studies on the gastric mucosa indicated the presence of H.pylori in the lamina propria, the intercellular space as well as in the gastric lumen. H.pylori was also detected inside the blood vessels, which may explain H.pylori bacteraemia, resulting in a systemic response.(48) In harmony with this hypothesis, the role of infectious agents like H.pylori in the pathogenesis of PMD and OSCC was evaluated.

The present study was carried out by investigating the blood sample through the HelicoCheck™ rapid card test based on a double antigen sandwich immuno-assay technique with the sensitivity and specificity of 92.3% and 90.5% (32) respectively. Test results were negative for all the enrolled subjects. Further for confirming and supplementing this, a more sensitive and accurate technique of PCR was conceded and final results obtained were also found to be negative. This was consistent with the study carried out by Kanda et al., (2005) who

reported 100% absence of association between OSCC and H.pylori infection by using culture and PCR technique.(49) However, serological technique carried out by Fernando N, et al., (2009)(50), Nurgalieva ZZ, et al., (2005)(51), Grandis JR, et al., (1997)(52), Rubin JS, et al., (2003)(53) and Aygenç E, et al., (2001)(54) showed 74%, 68%, 43%, 38%, and 27% negative association with OSCC respectively.

Chen WU, et al., (2009)(24) evaluated the Cytotoxin associated gene-A status for H.pylori infection in Taiwan-Chinese populations using an immunochromatographic serology test and found a 47% positive association with oral cancer. Similarly, various investigators like Souto R, et al., (2008)(18) and Anand D, et al., (2011)(13) found the association between H.pylori infection and oral diseases with equal sensitivity in both culture and PCR techniques. Grimm M, et al., (2014)(55) and Irani S, et al., (2013)(40) evaluated immunohistochemical expression of H.pylori in OSCC tissue and found reduced disease-free survival in a large patient cohort.

There are several explanations for such unpredictable results, firstly, probably the different races and living conditions may affect H.pylori in the human body.(55) Secondly H.pylori is a transient part of the normal oral microflora that forms 'ammonia clouds' through the decomposition of urea which is produced by metabolism of urease and this environment is conducive to the survival of H.pylori. According to Hooper et al., most living bacteria isolated from the surface and deep OSCC tissue represented saccharolytic as well as aciduric species. These bacteria might destroy the environment balance and contribute to development of OSCC.(23) Lastly, although H.pylori has potential to cause disease in stomach, lungs, arteries and pancreas (56), some studies focus beneficial effects of H.pylori in humans by reducing the risk of oesophagus cancer (24, 57), asthma, allergic rhinitis and diarrheal disease.(58-65) H.pylori infection is now considered a systemic disease, however, the release of antibodies and protein can resist some materials to reduce the risk of OSCC.(3, 64) The oral cavity still could not be confirmed as a common place for H.pylori colonization and this bacterium may be present as a transient organism because of

the unfavourable surviving environment.(6) Therefore, the role of H.pylori in oral cavity may be more similar to that in the oesophagus, larynx, and throat as these parts are located in the upper portion of stomach and demonstrate similar squamous epithelial cells. The blood specimen was the only investigative sample utilized in the present study to evaluate the relationship of H.pylori in PMD and OSCC. The presence of H.pylori in blood bloodstream can be established only when bacteria infect systemically or enter into the bloodstream rather than infecting the lesion site locally. Hence, a lesional site should be ascertained with more appropriate techniques to identify H.pylori infection and to establish its relationship

SUMMARY AND CONCLUSION

Fasting Blood was collected from normal controls, potentially malignant disorders and oral squamous cell carcinoma patients, followed by the separation of serum and cellular parts. The serum was used for rapid card test detection, specific for H.pylori antibodies IgG. However, cellular part of the blood was used for genomic DNA extraction followed by a polymerase chain reaction. The incisional biopsy of the clinically diagnosed potentially malignant and malignant lesions was carried out for histopathological confirmation.

The results of the present study are summarized as HelicoCheck™ rapid card test, double antigen sandwich immunoassay for detection of H.pylori antibodies showed negative value and Polymerase Chain reaction, a more sensitive and accurate technique for DNA analysis of H.pylori also showed negative results in all the test samples evaluated. Histopathological grading of potentially malignant disorders and oral squamous cell carcinoma showed no relationship with H.pylori.

Until specific genetic markers for the risk of H.pylori associated cancer are identified, familial aggregation due to shared environmental exposures, tobacco habits and other multiple factors cannot be ruled out as an explanation for cancer causation. Further studies using large sample sizes, different geographic locations, local lesional biopsies along with other molecular analytical methods may be essential to draw a definite conclusion between the association of H.pylori with potentially malignant disorders and Oral Squamous Cell Carcinoma.

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Comparative Evaluation of Effect of Simulated Gastric Juice on Surface Roughness & Microhardness of Two Different Heat Polymerized Denture Base Resins - An In-vitro Study

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Abstract

Aim and Objectives: The purpose of this study is to evaluate and compare the long-term effects of simulated gastric juice on the alteration of surface roughness and microhardness of conventional denture base resin with high impact denture base resin i.e. DPI and Lucitone 199 for the fabrication of complete and removable partial denture prosthesis.

Method: A total sample size of 84 heat polymerized denture base resin samples were fabricated using DPI and Lucitone 199 i.e. 42 samples each. The samples were immersed in simulated gastric juice for 45 hours (representing six months of exposure) and 91 hours (representing one year of exposure). Before immersion (baseline) and at periods 45 hours and 91 hours, the specimens were analysed for surface roughness and microhardness test. Intragroup and Intergroup comparison between individual groups were done using Paired 't' test and Independent 't' test respectively.

Results: The independent 't' test showed p value of surface roughness and microhardness for both DPI and Lucitone 199 at all the time intervals were statistically significant. The surface

roughness of DPI was consistently higher than that of Lucitone 199, whereas Lucitone 199 consistently exhibited higher micro-hardness values compared to DPI.

Conclusion: Lucitone 199 stands out for its higher physical and mechanical properties, which may contribute to enhanced durability and longevity of dental prostheses, particularly in individuals prone to acid exposure.

Keywords: Simulated gastric juice, heat polymerized acrylic resin, DPI, Lucitone 199, surface roughness, microhardness

INTRODUCTION

Acrylic denture base resins have remained a cornerstone in the realm of removable denture prosthesis fabrication for decades, owing to their inherent advantages such as ease of manipulation, cost-effectiveness, and satisfactory aesthetics. Particularly, heat-cured acrylic resin, a subtype within the acrylic resin family, has emerged as the material of choice for denture base construction due to its commendable mechanical strength, durability, and dimensional stability over time. ⁽¹⁾ However, despite its many advantages, heat-cured acrylic resin exhibits a notable drawback: high permeability. This characteristic renders it prone to water absorption, a gradual process wherein water molecules penetrate the resin, leading to the dissolution of polymer chains and an increase in porosity. Consequently, the resin's hardness diminishes, making it susceptible to scratches and abrasions, compromising its longevity and performance. ^(2,3)

Polymer degradation, influenced by factors such as acidic exposure from gastric juices and oral fluids, significantly impacts the long-term performance of denture base resins. ⁽²⁾ The interaction between acidic substances and acrylic resin surfaces accelerates chemical destruction, resulting in increased surface roughness, microhardness reduction, and compromised physico-mechanical properties and aesthetics of the prostheses, potentially exacerbating conditions like denture stomatitis, especially in individuals with gastroesophageal reflux disease (GERD) or bulimia nervosa. The average daily exposure time of teeth to gastric acid in a patient with bulimia is 15 minutes. This means that immersion in simulated gastric acid for 45 hours and 91 hours represents gastric acid exposure in a patient with bulimia for 6 months and 12 months. ^(4,5)

In this context, advanced techniques such as 2D contact surface profilometry and Vicker's hardness

testing offer invaluable insights into the surface properties of denture base resins. By subjecting two distinct heat polymerized denture base resins, DPI and Lucitone 199, to simulated gastric juice in vitro, this study aims to simulate the acidic conditions encountered in patients with gastroesophageal reflux disease (GERD) or bulimia nervosa. Through comprehensive analysis, the study seeks to characterize the changes in surface roughness and microhardness induced by acidic exposure and discern any discrepancies between the two materials. By contributing to the advancement of dental prosthetics research, this study endeavours to foster the development of more resilient and durable denture materials capable of withstanding the challenges posed by acidic oral environments, thereby improving patient outcomes and enhancing oral health care practices.

MATERIALS AND METHODOLOGY

A) PREPARATION OF THE ACRYLIC SAMPLES

According to ADA specification no. 12, square aluminium dies of uniform size measuring 10mm × 10mm × 2mm were used to fabricate molds to obtain 84 heat-cured PMMA samples. The metal die which was used for wax pattern fabrication, contained 3 metallic plates and screws for tightening the plate from engineering workshop (Vikas Engineering Workshop, Udaipur). Cold mold seal (DPI, India) was applied over the metal plates. After screwing these plates, modelling wax (Y dent, MDM Corporation, India) was melted and poured into the holes, after cooling the modelling wax, the plates were unscrewed and wax blocks of dimensions 10mm × 10mm × 2mm were removed. Flasking of wax blocks were done in Varsity Flask (JABBAR) and pouring was done with Dental stone. The flask and clamp assembly were kept in dewaxing unit (Unident, India) for 30 minutes and then the flask was opened and was kept under running hot water.

The Cold mold seal was applied over the both mould space of dental flask. DPI Heat cure acrylic resin (Bombay Burmah Corp Ltd., India) and Lucitone 199 (Dentsply Sirona, USA) was mixed in 2 silicone jars in ratio of powder liquid ratio of 3:1 by volume. Short curing cycle was followed in this procedure, for which the temperature was maintained to 74° for 90 min and then raised to 100°C for additional 30 min in acrylizer unit (Unident, India). After the polymerization, samples were obtained from the flasks and excess of the polymerized specimen was trimmed and polished by hand piece and acrylic trimming burs. Sample uniformity was checked and those which did not meet the dimension criteria were discarded. (Figure 1, Figure 2)

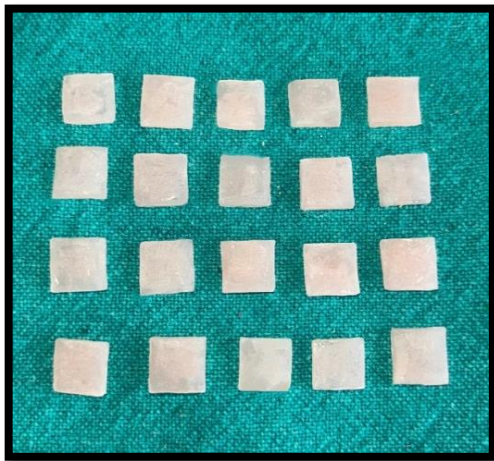


Figure 1: Acrylized DPI blocks

B) PREPARATION OF SIMULATED GASTRIC JUICE

Simulated gastric juice was prepared by dissolving 2.0 g of Sodium chloride (Merck, India) and 3.2 g of Pepsin (Oxford lab, India) in 7.0 mL of Hydrochloric acid (Labogens, India) and distilled water which make up 1,000 mL of solution of gastric juice (Figure 3). After preparation, each specimen was separately submerged in gastric juice in glass beaker of 25 ml and kept at room temperature for the time period of 45 hours and 91 hours respectively in a dark environment (Figure 4). The prepared gastric juice was changed regularly every day. After the specimens were removed, it was washed thoroughly under running water accompanied by drying with an absorbent paper.

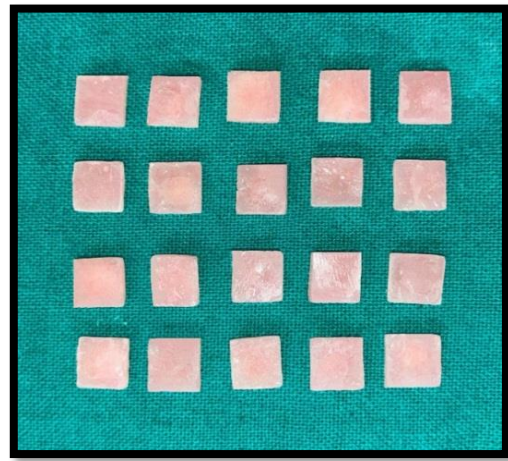


Figure 2: Acrylized Lucitone 199 blocks



Figure 3: Prepared simulated gastric juice

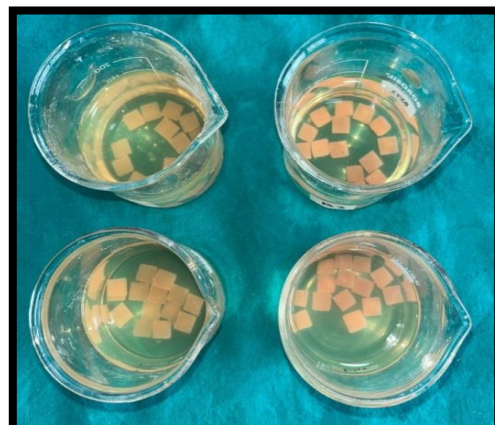


Figure 4: Dipping of samples

C) SURFACE ROUGHNESS MEASUREMENTS

Surface roughness of the specimen was assessed using a surface roughness tester (Mitutoyo, Japan. Model: SJ 210 Speed of stylus: 0.5 mm/s ISO1997) (Figure 5). To measure roughness profile in micrometers (μm), the diamond stylus (5- μm tip radius) was moved across the surface under a constant load of 3.9 mN at a speed of 0.12 mm/s over a range of 600 μm . This procedure was repeated three times at three different locations on each specimen to obtain the general surface characteristics of the specimen. The instrument was calibrated using a standard reference specimen.

D) MICROHARDNESS MEASUREMENTS

Hardness was determined using the indentation technique with a microhardness tester Vicker's Microhardness Tester (Reichert, Austria make. Sr. No. 363798) (Figure 6) under a load of 50g for 10s. Three indentations were made on each specimen using a Vicker's diamond indenter to determine the mean microhardness value for each specimen. Indentation dimensions were measured using the eyepiece of a microscope, and hardness values were obtained from standard tables.



Figure 5: Surface roughness test by Profilometer



Figure 6: Microhardness test by Vicker's Microhardness tester

RESULTS

The two heat-polymerized denture base resins were compared with respect to surface roughness (μm) and microhardness (VHN) over time (baseline, 6 months and 12 months) using independent 't' test and paired 't' test. The mean surface roughness value of DPI at time 0 = 0.135, 45 hours = 0.152 and at 91 hours = 0.186 whereas, the average value of Lucitone 199 at time 0 = 0.053, 45 hours = 0.085 and at 91 hours = 0.134. The independent 't' test revealed p value of surface roughness for both the groups at all the time intervals were statistically significant i.e. 0.000 ($p < 0.05$). At all measured time intervals (0, 45, and 91 hours), the surface roughness of DPI was consistently higher than that of Lucitone 199. (Table 1, Figure 7)

Similarly, the independent 't' test comparing the micro-hardness of both DPI and Lucitone 199 revealed decreased microhardness values with increased exposure time, indicating a deterioration in material hardness. The p value of micro-hardness for both the groups at time intervals: 0, 45 and 91 hours was statistically significant i.e. 0.000 ($p < 0.05$). Lucitone 199 consistently exhibited higher micro-hardness values compared to DPI across all time intervals. (Table 2, Figure 8)

Table 1: Independent ‘t’ test comparing surface roughness of DPI and Lucitone 199 at different time intervals: 0, 45 and 91 hours

Surface Roughness		N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	't'	p value
0 hour	DPI	14	0.135	0.035	0.009	0.082	8.473	0.000
	Lucitone 199	14	0.053	0.011	0.003			
45 hours	DPI	14	0.152	0.035	0.009	0.067	6.857	0.000
	Lucitone 199	14	0.085	0.012	0.003			
91 hours	DPI	14	0.186	0.045	0.012	0.051	4.001	0.000
	Lucitone 199	14	0.134	0.016	0.004			

Table 2: Independent ‘t’ test comparing micro-hardness of DPI and Lucitone 199 at different time intervals: 0, 45 and 91 hours

Micro-hardness		N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	't'	p value
0 hour	DPI	14	14.464	0.249	0.075	1.986	19.818	0.000
	Lucitone 199	14	16.450	0.250	0.067			
45 hours	DPI	14	12.621	0.163	0.043	3.700	52.408	0.000
	Lucitone 199	14	16.321	0.208	0.056			
91 hours	DPI	14	12.193	0.127	0.034	3.336	41.117	0.000
	Lucitone 199	14	15.529	0.176	0.074			

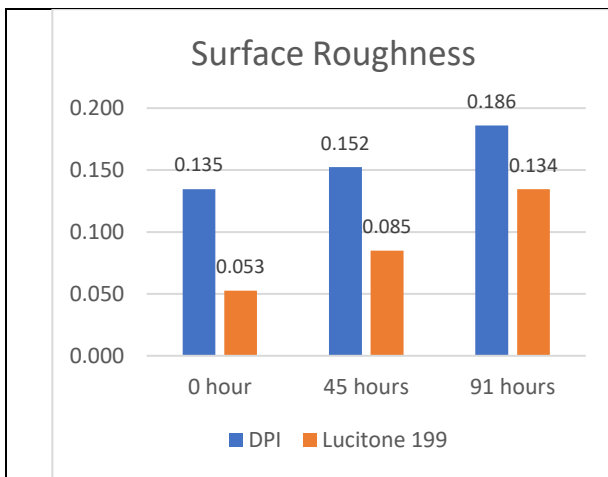


Figure 7: Surface roughness of DPI & Lucitone 199 at time: 0, 45, 91 hours

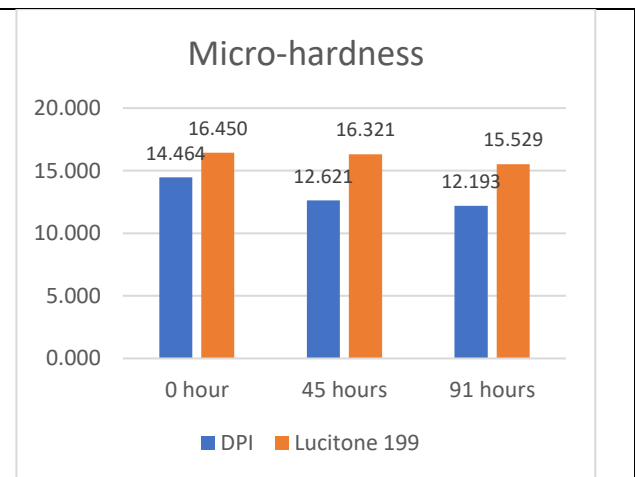


Figure 8: Microhardness of DPI & Lucitone 199 at time: 0, 45, 91 hours

The paired 't' tests revealed that while the surface roughness of DPI remained consistent from 0 to 45 hours, it increased exponentially at 91 hours, suggesting a progressive degradation of the material. Similarly, the micro-hardness of DPI decreased over time, indicating a weakening of the material's structure.

For Lucitone 199, surface roughness increased significantly at different time intervals, indicating material degradation. However, the micro-hardness did not show significant changes from 0 to 45 hours, suggesting that exposure during this period did not substantially affect micro-hardness. Nonetheless, a significant decrease in micro-hardness at 91 hours indicated a notable impact on material hardness with longer exposure.

Table 3: Paired ‘t’ test for DPI for comparing the surface roughness and micro-hardness value changes at time intervals: 0, 45 hours; 0, 91 hours and 45, 91 hours

DPI		Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	't'	p value
Surface Roughness	0 hour	0.135	14	0.035	0.009	0.018	4.191	0.001
	45 hours	0.152	14	0.035	0.009			
Surface Roughness	0 hour	0.135	14	0.035	0.009	0.051	4.117	0.001
	91 hours	0.186	14	0.045	0.012			
Surface Roughness	45 hours	0.152	14	0.035	0.009	0.034	3.136	0.008
	91 hours	0.186	14	0.045	0.012			
Micro-hardness	0 hour	14.464	14	0.249	0.075	1.843	22.024	0.000
	45 hours	12.621	14	0.163	0.043			
Micro-hardness	0 hour	14.464	14	0.249	0.075	2.271	28.845	0.000
	91 hours	12.193	14	0.127	0.034			
Micro-hardness	45 hours	12.621	14	0.163	0.043	0.429	10.087	0.000
	91 hours	12.193	14	0.127	0.034			

Table 4: Paired ‘t’ test of Lucitone 199 for comparing the surface roughness and micro-hardness value changes at time intervals: 0, 45 hours; 0, 91 hours and 45, 91 hours

Lucitone 199		Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	't'	p value
Surface Roughness	0 hour	0.053	14	0.011	0.003	0.032	6.925	0.000
	45 hours	0.085	14	0.012	0.003			
Surface Roughness	0 hour	0.053	14	0.011	0.003	0.082	18.897	0.000
	91 hours	0.134	14	0.016	0.004			
Surface Roughness	45 hours	0.085	14	0.012	0.003	0.050	10.402	0.000
	91 hours	0.134	14	0.016	0.004			
Micro-hardness	0 hour	16.450	14	0.250	0.067	0.129	1.451	0.170
	45 hours	16.321	14	0.208	0.056			
Micro-hardness	0 hour	16.450	14	0.250	0.067	0.921	11.238	0.000
	91 hours	15.529	14	0.176	0.074			
Micro-hardness	45 hours	16.321	14	0.208	0.056	0.793	8.947	0.000
	91 hours	15.529	14	0.176	0.074			

DISCUSSION

The primary goal of prosthetic dentistry is to replace missing teeth and its underlying structures using materials that mimic the physical properties and mechanical behaviour of natural teeth and surrounding structures. Dental prosthesis, particularly made up of acrylic denture base resins for partial and complete denture patients, must withstand the diverse and dynamic oral environment they are exposed to over their lifespan. Selecting a

denture base resin material capable of enduring gastric juice's deteriorative effects is crucial. ⁽⁷⁾

In this study comparing the effects of simulated gastric acid exposure on DPI and Lucitone 199 over 0, 45 and 91 hours, surface roughness increased significantly over time for both groups, indicating surface quality deterioration due to acid exposure. This degradation is linked to gastric juice's acidic nature, which promotes oxidation of organic compounds within acrylic resin, leading to rougher surfaces. Additionally, cracks on the resin surface, caused by exposure to acidic content, disrupt

polymer chain bonding and increase surface irregularity. ⁽²⁾ This phenomenon has been documented in studies by **Pocut Aya Sofya**. ⁽²⁾

However, throughout the study, DPI consistently demonstrated higher surface roughness compared to Lucitone 199 across all time intervals except at the 45 to 91-hour interval, the difference in surface roughness between DPI and Lucitone 199 was not statistically significant, with a p-value of 0.186 ($p > 0.05$). This suggests that after 45 hours of exposure to gastric juice, the surface roughness of both groups converged, indicating similar levels of surface degradation. This convergence may suggest that both materials reached a state of equilibrium or stabilization in response to prolonged exposure to gastric acid. However, further investigation is warranted to elucidate the underlying mechanisms driving the observed differences and similarities in surface roughness between DPI and Lucitone 199 over time. Overall, these findings highlight the importance of considering material susceptibility to acid-induced surface alterations when selecting denture base materials. While both DPI and Lucitone 199 experienced surface deterioration over time, DPI exhibited greater susceptibility to acid than Lucitone 199. A study by **Ma and Johnson** ⁽⁸⁾ corroborated these findings, demonstrating Lucitone 199's superior color stability and low surface roughness even after prolonged exposure to disinfectants. Similarly, research by **Nidhi Dinesh** ⁽⁹⁾ highlighted Lucitone 199's superior dimensional stability compared to DPI, emphasizing material composition's role in resistance to environmental stressors.

Likewise, the micro-hardness of both groups decreased significantly with as exposure time to gastric acid increased. This decline in micro-hardness suggests a reduction in the materials' ability to resist indentation and mechanical stress, likely due to chemical degradation induced by the acidic environment. However, the paired t-test results reveal some interesting insights. Despite the observed decrease in micro-hardness over time for both materials, the p-value for the 0 to 45-hour interval was not statistically significant ($p > 0.05$). This suggests that exposure during this period did not have a substantial effect on micro-hardness. On the other hand, the p-values for the 0 to 91-hour

interval and the 45 to 91-hour interval were both highly significant ($p < 0.05$), indicating a significant decrease in micro-hardness at these time points. This suggests that longer exposure to gastric acid had a notable impact on the hardness of the material. Similarly, in the study by **Gandhi and Daniel** ⁽¹⁰⁾, observed no significant change in micro-hardness when the acrylic resin teeth were subjected to chemical disinfection initially but under prolonged exposure there were significant decreases in micro-hardness. Studies by **Gondim & Laisa** ⁽¹¹⁾ and **Kukiattrakoon, Hengtrakool & Leggat** ⁽¹²⁾ varied exposure durations to acidic agents, demonstrating the time-dependent nature of material degradation. This temporal aspect is crucial in understanding the progression of degradation and predicting long-term material behaviour.

The differences observed between both the groups may be attributed to variations in material composition and structure, with Lucitone 199 possibly containing components that provide greater resistance to acid-induced degradation. High-impact resins contain copolymers of low-molecular-weight butadiene styrene-b copolymer. The exact nature of this inclusion is manufacturers' trade secret. The presence of this polymer in Lucitone helps in reinforcing the material, reducing polymerization shrinkage, and also adding strength and hardness to the material.

Limitations and Future Research

It's essential to acknowledge some limitations of the study, such as the use of simulated gastric acid instead of actual patient samples. While simulated gastric juice provides controlled conditions for testing, it may not precisely mimic the composition and behaviour of gastric reflux in vivo. Additionally, the study focused on short-term exposure intervals, and further research is needed to assess the long-term effects of acidic exposure on denture base materials. Future research could explore additional factors influencing material degradation, such as variations in pH levels, temperature, and mechanical loading, to provide a more comprehensive understanding of material behaviour in acidic environments.

CONCLUSION

Within the limitations of the present in-vitro study, the following conclusions are reached:

1. The surface roughness of DPI denture base resin was found to be higher compared to Lucitone 199 denture base resin. However, both the materials exhibited surface roughness values below 0.2 μm , which is considered acceptable at a clinical level.
2. The microhardness of Lucitone 199 denture base resin was found to be higher than that of DPI denture base resin. This higher microhardness in Lucitone 199 suggests that it may offer better durability and resistance to wear, particularly in individuals who are prone

to frequent acid exposure. Consequently, it is concluded that Lucitone 199 has the potential to minimize the risk of material deterioration and prolong the lifespan of dental prostheses in patients with such conditions.

To conclude, while both DPI and Lucitone 199 denture base resins are deemed safe for use in patients with acidic conditions. Lucitone 199 stands out for its higher physical and mechanical properties, which may contribute to enhanced durability and longevity of dental prostheses, particularly in individuals prone to acid exposure.

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Assessment of Morphogenic Correlation of Intercanthal, Interalar and Intercommissural Distance with Maxillary Anteriors in Udaipur City Population – An In-Vivo Study

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Abstract

Background: The field of prosthetic dentistry emphasizes primarily on restoring function and comfort but it is imperative to pay close attention to esthetics. Due to a lot of emphasis being placed on esthetics for edentulous patients and no pre-extraction records available, selecting the proper anterior teeth size for edentulous patients can be arduous. The significance of facial measurements in the selection of anterior teeth has been advocated since centuries but no single predictor was accurate enough for clinical application.

Aim: To assess the morphogenic correlation of intercanthal, interalar and intercommissural distance with mesiodistal width of maxillary anteriors in Udaipur city population and to evaluate the reliability of these parameters as guides in anterior teeth selection.

Methods and Material: A total of 125 dentulous subjects meeting the inclusion and exclusion criteria were selected and facial measurements were recorded using a digital Vernier caliper. The recorded value was computed and Pearson's correlation was applied.

Results: There was a positive correlation between interalar distance, intercommissural distance and intercanine width and the values were highly significant. The intercanthal distance values were statistically non-significant.

Conclusion: Based on this statistical data, the interalar and intercommissural width can serve as useful guidelines for the selection and replacement of anterior teeth for edentulous patients.

Keywords: Anterior teeth selection, interalar width, facial measurements

INTRODUCTION

The significance of facial aesthetics in prosthetic dentistry has long been acknowledged, with Leonardo da Vinci emphasizing the beauty of the face compared to other anatomical features. Esthetics, encompassing beauty, harmony, naturalness and individuality, plays a crucial role in determining the success of dental restorations, particularly in the aesthetic zone.^[1] Tooth loss in this region can have profound psychological impacts, often attributed to genetics, caries, and trauma^[2,3].

Modern prosthodontists face the challenge of not only restoring function but also achieving natural-looking results that blend seamlessly with the patient's appearance^[1]. Smile designing for edentulous patients requires careful consideration of various factors including form, size, colour and material selection for artificial denture teeth. Historical methods of teeth selection have evolved from dimensional measurements to more sophisticated techniques considering facial proportions and aesthetics.^[4]

Despite advances in materials, technology and the widespread adoption of dental implants, the art of teeth selection has become somewhat lost in the abundance of guides and methods^[3]. Various approaches have been proposed, including geometric classifications of face form, biometric ratio methods and correlations between facial measurements and tooth dimensions^[5,6].

Pre-extraction records such as photographs and radiographs play a pivotal role in selecting appropriate teeth for edentulous patients, but in their absence, a systematic approach utilizing facial measurements has been suggested^[7]. However, conflicting views and limited accuracy have been reported regarding the significance of facial measurements in predicting tooth size.

Ethnic characteristics further complicate the matter as relationships between facial dimensions and

tooth size may vary among different populations [8,9]. Studies specific to the Indian population, are scarce, highlighting the need for further research to establish correlations between anatomical landmarks and maxillary anterior teeth.

To address this gap, a study was proposed to assess the correlation between intercanine width and various facial measurements including intercanthal distance, interalar width, and intercommissural distance.

In summary, the quest for achieving optimal facial aesthetics in prosthetic dentistry involves navigating through historical methods, contemporary techniques, and ethnic considerations. While advancements have been made, further research is needed to refine predictive models and tailor treatments to specific populations, ultimately enhancing the esthetic outcomes and psychological well-being of patients undergoing dental prosthetic procedures.

METHODS

STROBE^[10] guideline was followed for material and methodology.

1. Study design

An in-vivo cross-sectional study was conducted among the residents of Udaipur city to find the association between the proposed anatomical landmarks and maxillary anterior teeth.

2. Setting

In the present study, measurements of facial form were taken for the subjects after obtaining an informed consent. Each parameter was measured three times and the mean value was computed and recorded.

3. Participants

Inclusion criteria

1. All cases were above 18 years of age so that growth of the face is essentially complete.
2. Residents of Udaipur city.
3. Angle's class I molar relation.
4. No missing maxillary or mandibular teeth.

Exclusion criteria

1. Evidence of gingival alteration or dental irregularities.
2. Loss of tooth structure due to attrition, fracture, caries, or restorations.
3. Spacing or crowding of maxillary anterior teeth.
4. Individuals with congenital or developmental deformities.
5. Individuals with history of orthodontic treatment.

4. Variables:

In the statistical analyses, factor considered potential confounder was the position of maxillary anterior teeth and predetermined anatomical landmarks (exposure) as independent variable and the relation among them (outcome) as dependent variable. Factor considered as potential effect modifier was the accuracy of measurement device.

5. Data sources/measurement:

- A total of 125 subjects meeting the inclusion and exclusion criteria were evaluated for this study.
- Informed consent was obtained from all the participants prior to their participation.
- Each subject was seated in a dental chair with the head upright supported by the headrest, so the occlusal plane of the maxillary teeth was parallel to the floor.
- Different measurements relevant to this study were recorded by one operator.
- Each parameter was measured three times and the mean value was computed and recorded.
- The mean values for all parameters were carefully recorded in a predesigned proforma and the data was statically analyzed.

Recording the intercanthal distance: - (Figure 2)

- The patient was asked to sit in a dental chair in an upright position with the head straight and close the eyes and relax before the intercanthal distance was measured with the help of a digital caliper.
- The distance between the median canthi of the palpebral fissure was measured by bringing the recording parts of the caliper just in contact with the medial angle of the palpebral fissure.

Recording the interalar distance: - (Figure 3)

- Two points were marked on either side of the nose with a fine tipped marking pen indicating widest points on the outer surfaces of the alae of the nose.
- The distance between these two points was measured using a digital vernier caliper without the application of pressure by bringing the recording parts of the caliper just in contact with the outer surface of the nose.

Recording the intercommissural distance: - (Figure 4)

- With the individual in a relaxed state, the distance from one angle of the mouth to the other angle of mouth was measured at the commissure in its passive state using digital Verniercaliper.
- Extreme care and attention are mandatory to prevent any change in position of commissure resulting from changes in facial expression.

Recording the maxillary intercanine width: - (Figure 5)

- The distance between the distal contact points of anterior teeth was measured with the help of dental floss passing through distal surface of the canine at the greatest curvature of the maxillary teeth.
- A mark on each side was placed on the distal surface of the canines.
- Dental floss was sectioned, made straight with the help of an adhesive surgical micropore tape and the distance was measured between the marks using a digital caliper.

6. Bias

- Instrument bias was observed.
- Investigator's bias was observed.

7. Statistical analysis

- Statistical analysis was performed using Statistical Product and Service Solution (SPSS) version 21 for Windows (SPSSInc, Chicago, IL).
- Descriptive quantitative data was expressed in mean and standard deviation respectively.
- Data normality was checked by using Independent t test.

- Confidence interval was set at 95% and probability of alpha error (level of significance) set at 5%. Power of the study set at 80%.
- Correlation of intercanthal, interalar and intercommisural distance with maxillary

anterior was done using Pearson or Spearman 'r' correlation coefficient test based on normality of data obtained.



Figure 1: Armamentarium

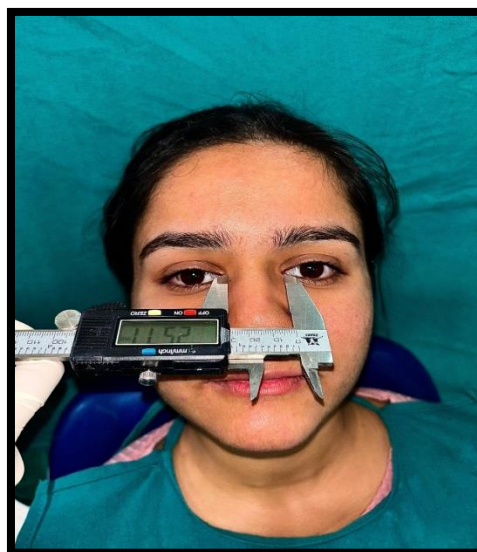


Figure 2: Measuring the intercanthal distance using a digital Vernier calliper



Figure 3: Measuring the interalar distance using a digital Vernier calliper



Figure 4: Measuring the intercommissural distance using a digital Vernier calliper



Figure 5: Marking the intercanine width using a fine tipped marking pen on dental floss

RESULTS

An in vivo cross-sectional study was conducted in Udaipur city population to determine the correlation of intercanthal, interalar and intercommissural width to the combined width of maxillary anterior teeth. A total of 125 subjects, including 79 males and 49 females, were selected for this study. Among them, the maximum of participants (35.2%) were aged between 30-41 years and a minimum (11%) were aged above 53 years. The mean values for all the aforementioned parameters were carefully recorded in a predesigned proforma and the data was statistically analysed.

No significant differences were found between males and females with respect to all the facial and dental measurements. There was a positive correlation between interalar distance and intercommissural distance, and intercanine width and the values were highly significant. The obtained p values were 0.03 for interalar width (Table 3) and 0.001 for intercommissural width

(Table 4) which were found to be statistically significant depicting strong correlation to the intercanine width.

The same pattern was observed for both the sexes. The statistical data obtained from this study along with other studies done in past concludes that intercommissural and interalar distance are of utmost importance when it comes to measuring widths of anteriors or canines even by repetitive changes in methodology section by different dentists and can serve as useful guidelines for the selection and replacement of anterior teeth for edentulous patients. (Table 5)

On the contrary, the Pearson's correlation coefficient for the intercanthal distance was 0.68 (Table 2) which was not statistically significant even when considered separately for men and women. Hence, according to this study, the intercanthal distance cannot be used as anatomical landmark to select the size of maxillary anterior teeth in edentulous patients.

Table 1: Comparison of various parameters among males and females

Variables	Male Mean ± SD	Female Mean ± SD	t-value	p-value
Mean intercanthal width	30.34 ± 2.21	30.55 ± 2.50	0.495	0.62
Mean interalar width	30.96 ± 3.77	30.20 ± 4.62	0.99	0.32
Mean commissural width	52.25 ± 4.24	54.33 ± 4.18	2.66	0.009*
Mean intercanine width	48.74 ± 7.80	48.89 ± 3.10	0.12	0.90

Test applied: Independent t test * p-value < 0.05 statistically significant.

Table 2: Correlation between intercanthal distance and mesiodistal width of maxillary anterior among the study population

Intercanthal distance Mean ± SD	Mesiodistal width of maxillary anterior Mean ± SD	Peason correlation "r"	p-value
30.42 ± 2.31	48.80 ± 6.46	0.03	0.68

Test applied: Pearson Correlation; * p-value < 0.05 statistically significant

Table 3: Correlation between interalar width and mesiodistal width of maxillary anteriors in Udaipur city population

Interalar width Mean ± SD	Mesiodistal width of maxillary anterior Mean ± SD	Pearson correlation “r”	p-value
30.68 ± 4.10	48.80 ± 6.46	0.19*	0.03*

Test applied: Pearson Correlation; * p-value <0.05 statistically significant.

Table 4: Correlation between intercommissural distance and mesiodistal width of maxillary anteriors in Udaipur city population

Intercommissural distance Mean ± SD	Mesiodistal width of maxillary anterior Mean ± SD	Pearson correlation “r”	p-value
53.56 ± 4.31	48.80 ± 6.46	0.33	≤ 0.001*

Test applied: Pearson Correlation; * p-value <0.05 statistically significant.

Table 5: Reliability of intercanthal, interalar and intercommissural distance as guides in anterior teeth.

Various parameters	Mesiodistal width of maxillary anterior	p-value
Intercanthal distance	0.03	0.68
Interalar distance	0.19*	0.03
Intercommissural distance	0.33*	≤ 0.001

Test applied: Pearson Correlation; * p-value <0.05 statistically significant

DISCUSSION

Oral rehabilitation of a completely edentulous patient is essential to improve the patient's self-esteem and self-confidence through the fabrication of dentures that not only restore all the functions but also the aesthetic expectations which are in close resemblance to the person's previous natural dentition.

The intercanthal width (ICD) shows 93% of growth at 5 years of age and maturity is reached between 8 and 11 years which makes it a reliable anatomic dimension that may provide a valid approach to anterior tooth selection.^[5] Abdullah et al.^[8] studied

ICD in Saudi population and showed that it may serve as a useful additional factor in tooth selection. Asli et al ^[11] found a significant relationship between intercanthal distance and intercanine width with biometric ratio of 1 to 1.13 . In this study, the mean of intercanthal distance was found to be 30.34 mm for males and 30.55 mm for females, and multiplication factor was 1.6 for to get a combined width of maxillary six anteriors.(Table II)

Gerber's embryogenic philosophy posits that the nose and upper incisors share an embryonic origin, suggesting their size and arrangement should harmonize by aligning the incisal edges of the

upper incisors with the baseline of the nose to achieve aesthetically pleasing dental outcomes [5]. Scandrett et al.^[12] also reported a significant correlation between interalar width (IAW) and the width of maxillary anterior teeth. Smith^[13] however, reported a low relationship between radiographic measurement of the IAW of the nose and the distance between the maxillary canine's tips. Hoffman et al^[9] obtained the combined width of the maxillary six anterior teeth by multiplying the interalar width by a factor of 1.31. while 1.57 was the multiplication factor in the present study.

Silverman stated that "the distal surface of the maxillary cuspid is 4mm distal or medial to the commissure of the mouth,"^[14]. In 1982, Forrest R. Scandrett et al^[12] showed inter-commissural width had the highest correlation, 0.44, with the width of the maxillary anterior teeth. This was in agreement with the study by Lieb et al., who found a significant correlation of +0.45. Contrary to these findings, in the current study, the inter-commissural width was not significantly higher than other predictors. In present study, correlation with inter commissural width was 0.33 (**Table IV**) which was statistically significant and was in accordance with the study done by Scandrett^[12] and MW Hussain ^[15] in Saudi female participants.

SUMMARY

The observations indicated the existence of correlation between facial measurements and the combined width of maxillary anterior teeth. Hence, it can be recommended that these parameters can be used as a guideline in selecting the width of anterior artificial teeth in absence of pre-extraction records. Additional studies are required to replicate the present findings in Indian sub-population groups, so as to confirm the relationship among the anthropometric parameters investigated.

Clinical implications

This study along with other studies done in past concludes that intercommissural and interalar distance are of utmost importance when it comes to measuring widths of anteriors or canines even by repetitive changes in methodology section by different dentists. Given the significant individual variations in human physiognomy and morphological parameters, inaccurate standards in

selecting maxillary anterior teeth could result in unsatisfactory outcomes in complete denture therapy. Hence, the specific relationships between facial landmarks and anterior teeth width should be regarded as unique to the studied population, emphasizing the need for personalized approaches in dental treatment planning.

Limitations

1. Measurement bias can create errors in determining actual relation of the facial anatomic landmarks to intercanine width.
2. As sample size was less, generalizability of study is difficult.

Suggestions for further prospective

1. Study can further be improved by considering more sample size.
2. Research can be performed only among larger population of more specific agegroup to get more external validity of study.

CONCLUSION

Within the limitations of the present study, the following conclusions were drawn:

1. No significant differences were found between males and females with respect to all the facial and dental measurements.
2. There was positive correlation between interalar distance and intercommissural distance, and intercanine width and the values are highly significant. The same pattern was observed for both the sexes.
3. The Pearson's correlation coefficient for the intercanthal distance were not statistically significant even when they were considered separately for men and women. Hence, according to this study, the intercanthal distance cannot be used as anatomical landmark to select the size of maxillary anterior teeth in edentulous patients.
4. The multiplication factor for intercanthal distance, interalar distance, intercommissural distance was 1.6, 0.8 and 1.4 in order to obtain the mesiodistal width of maxillary six anteriors respectively, in males and females.
5. Although various methods of selection of teeth are used, the applicability can vary due to the ethnic differences between populations.

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