Review Article

HUMAN PAPILLOMA VIRUS INFECTION AND ITS ORAL MANIFESTATION

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Abstract

Papilloma viruses, member of papillo-viradae family of virus, are tissue and host specific. Thus, the cross infection between species is rare. Papilloma viruses infect the outer surface of tissue and replicate exclusively in the cells of basal layer of the epithelium. Human papilloma virus (HPV) which is a double stranded DNA (ds DNA) virus has 200 subtypes. These viruses are epitheliotropic and can infect and cause lesions in various epithelial tissues of different anatomic sites such as the skin, anogenital areas and mucosa of upper aerodigestive tract. HPV infection could be asymptomatic and self-limiting, or it can manifest as a simple wart to malignancy. RT-PCR is considered as gold standard method to diagnose HPV presence in any lesion. Recent introduction of novel surgical methods and technique improved the prognosis of the HPV lesions as well as reduced the morbidity and disfigurement which were reported in past. Now HPV vaccines are implemented for prevention of HPV infection.

INTRODUCTION:

One of the most primitive viruses includes Human Papilloma virus (HPV) which started developing around 330 million years back in paleozoic era with. These viruses acquired the ability to harvest complete cellular machinery and protein infrastructure for reproduction and avoid immunity by hijacking cellular and immune system at different levels.[1] HPV believes to be the most common virus infecting humans; in some endemic population it can affect the whole population. Almost every person on the earth is infected by HPV once in a lifetime. HPV is the most common sexually transmitted virus in the world but 90% of HPV infections are asymptomatic and resolves spontaneously within two years.[2] HPVs are transmitted either by direct contact i.e. sexual intercourse or oral contact with the mucous membranes of an infected subject or by indirect contact with infected medical instrument or contaminated utensils. In both the mode of transmission, transportation of virus is facilitated to the basal layer of epithelium through microlesion in the intact surface.[3]

THE HPV GENOME:

The genetic component of HPV is non-enveloped, circular, Double stranded (Ds) DNA genome. HPV has a size of about 8000 base pairs, constituting 8 open reading frames (ORFs).[4, 5] The HPV genome constitutes 3 main segments. **1). The Early Region (E)** – encodes the proteins of virus which are numbers as E1 to E7. E1 region controls the transcription of viral DNA, E5, E6, E7 codes for the oncogenic property of the virus and leads to cellular immune-editing.[6] **2). Late region (L**)- The late region, covering almost 40% of the virus genome and codes for the capsid proteins. **3). A non-coding long control region (LCR**)- it plays a vital role in regulating the viral RNA polymerase-II and initiates transcription from viral promoters.

CLASSIFICATION OF HPV:

Phylogenetically, HPVs are classified into different genera, species and types. In Genera classification HPVs are categorised into alpha, beta, gamma, mu, nu. L1 gene of HPV is most evolutionary conserved gene of HPVs. The sequence analysis of these L1 genes is the basic principle behind the classification of HPV types.[7]

THE HPV LIFE CYCLE

HPV is a tissue-trophic virus and shows selective affinity for keratinocytes. HPV infects the basal cells of squamous epithelium of the different anatomical areas of the body. Micro-lesions in the outer and most superficial surface of epithelium facilitate the entry of virus particle into the basal layer of the epithelium. Viruses infects the basal cells at first then it undergoes viral DNA synthesis and DNA is linked to capsid proteins as the keratinocytes matures and transforms in different epithelial layers. Viruses released from the stratum corneum and granulosum directly infect the basal layer and repeat the cycle.[8]

Once a virus penetrates the basal cell, it replicates by three major mechanisms namely: plasmid, vegetative, and productive replication. Cellular modification from basal layer and upward, provide suitable micro-atmosphere for HPV to replicate and reproduce. **Vegetative stage**: Epithelial cells differentiate from basal cell into keratinocytes, with the cell differentiation viruses inside the basal cell replicate and express the viral genes. **Productive stage: C**ytopathic effects of virus manifest in productive stage, these changes include

acanthosis, dyskeratosis, multinucleation of keratinocytes, and koilocytosis i.e. thickening of peripheral cytoplasm and stellate nucleus. Koilocytosis is considered pathognomic in HPV lesions.

EPIDEMOLOGY

Human Papillomavirus (HPV) infection is one of the most common sexually transmitted infection (STI). Every year 6 million people are diagnosed positive for HPV. About 9 - 13 % of the population of world is infected with HPV [10] whereas oral HPV infection prevalence is approximately 5-10%. The incidence of cervix infection is much higher than the oral infections. HPV positive head and neck squamous cell carcinoma is more prevalent in younger patients (< 50 years) in comparison to typical head and neck malignancies.

HPV's ONCOLOGICAL ACTIVITY:

Oncological activity of HPV is primarily due to E6 and E7 oncoproteins of HPV. As the expression of E6 and E7 genes increases, increase in cellular proliferation is reported. Integration of the viral genome is considered as a critical step in pathogenesis of HPV related cancer. E6 gene target the p53 gene, a tumor suppressor gene, and inhibit it causing decrease in apoptosis and cause cell cycle arrest. E7 gene protein degrade and inactivates pRb, which in turn prevents inhibition of the E2F transcription factor hence leading to loss of cell cycle control. Loss of cell cycle control and inhibition of physiological apoptosis in HPV infected cells leads accumulation of genetic damages and could cause mutation leading to malignant change. [11]

IMMUNE RESPONSE TO HPV

HPV evades both innate and humoral component of immunity in number of ways, as:

1. HPVs avoid antigenic reaction by replicating within the cells without cytolysis, thus avoiding antigenic presentation and hence cellular immune-survellience.[12]
2. HPVs avoid detection of capsid protein by Langerhans cells by limiting expression of their capsid protein to superficial differentiated epithelial cells.
3. HPVs are also known to disturb the function of interferons, E6 & E7 proteins can prevent immunoregulation by interferon-α and β. High risk genotypes could down-regulate INF-α inducible gene expression.[13]
4. E7 gene expression can evade or supress normal immunological response of host.[11]

DIAGNOSTIC TOOLS FOR HPV:

Diagnostic tests for HPV aim for detection of HPV DNA or RNA in tissue samples. These tools are broadly classified as: target amplification method or signal amplification method. **(i) Target Amplification Method**: **Polymerase Chain Reaction (PCR)** is most commonly used method for HPV detection. **Real Time PCR** amplifies HPV sequences and gives a quantitative result and HPV viral load which are clinically important. **(ii) Signal Amplification Methods**: In situ hybridization assay involve the hybridization of nuclei acids from virus with target specific probes and are visualized in-situ. ISH could visualize HPV DNA directly within the nuclei of cells of sample tissue. Low sensitivity and being technique sensitive are the demerits of ISH.[14] **(iii) Viral mRNA Detection**: It is the gold standard test for transcriptionally active HPV infection where frozen tissue is tested for E6 and E7 mRNA. This test has demerits of being very technique sensitive and requires significantly more tissue.[14] **(iv) Immunohistochemical staining for p16:** IHC for p16 protein is used for high risk subtype of HPV. It is cost-effective and reliably applied which is about 100% sensitive but specificity is only 79%. [15]

BENIGN LESIONS CAUSED BY HPV:

Several benign oral lesions are caused by low-risk HPV such as squamous papilloma, condyloma acuminatum, verruca vulgaris etc.

ORAL SQUAMOUS PAPILLOMAS: It occurs commonly in the oral cavity. Clinically, papillomas generally measure 1 cm in size and are pink to white in colour, exophytic or cauliflower-like in appearance. They are generally asymptomatic. OSP are classified into two types: Isolated-solitary are found in adult oral cavity and multiple-recurring in children. Immuno-compromised HIV positive patients often have multiple papillomas at a time.[16]

CONDYLOMA ACCUMINATUM: It is a sexually transferable, proliferative lesion which could affect both genital and oral regions. Subtype 6 and 11 of HPV are most common strains which cause condylomas. Condylomas have warty appearance, but larger in size with blunted surface projections and can coalesce into a larger lesion. When large tumour like mass covers the entire anogenital area then it is known as Buschke-Lowenstein tumor, and it could have malignancy potential. Oral condylomas are commonly present on the tongue and lip. Oral condylomas appear as raised, skin coloured, fleshy papule, which varies in sizes from 1 mm to 5mm.

VERRUCA VULGARIS also known as common warts and are most commonly seen in children. They are exophytic cutaneous lesion and can also be found on mucous membranes. Warts are common and affect approximately 10% of the human population. They are more common among immunosuppressed patients and meat handlers (Butcher's warts). Warts are twice as common in Whites as in Blacks or Asians.[18] **Clinically**, verrucae are either solitary or multiple. They generally appear as small, white and well demarcated

lesions over vermillion borders, labial mucosa and anterior tongue region.[18]

FOCAL EPITHELIAL HYPERPLASIA also known as Heck's disease or multifocal papilloma. It is a rare benign lesion caused by HPV subtypes 13 or 32. 1t can be mostly found in children or young adults. FEH is more frequent in immuno-compromised and in lower socio-economic status. FEH show specificity toward some ethnic population and are seen more frequently in aboriginal population of Native Americans, Eskimos and South African.[19] Genetic predisposition of the disease is explained by familial occurrence of FEH. Clinically, FEH presents as clusters of flat-topped nodules or "cobblestones". It can be characterized by multiple, painless, soft, sessile papules, plaques or nodules, measuring 1 to 10 mm in diameter, lesions may coalesce to give rise to larger lesions. These lesions are painless and tend to disappear spontaneously. Lesions are predominantly found on the lower lip, buccal mucosa and tongue.[19]

HISTOLOGICAL FEATURES: The histopathological examination of these lesions in general reveals stratified squamous hyper-parakeratinized epithelium with multiple papillary projections and a fibrovascular connective tissue core. The epithelium usually has few clear cells in the superficial layer suggestive of "koilocytes". This cell is thought to be indicative of a virally altered state. The surface of the epithelium has few hornlike projections suggestive of "chevron". Few scattered lymphocytes could be present in the stroma of the stalk, body, and projections of the lesion. Chronic inflammatory cells are also common. Histologically, FEH is characterized by fusion and horizontal outgrowth of epithelial ridges, can be denoted as club or battle-axe shaped rete ridges.

TREATMENT: In most of the cases, in a healthy young patient, HPV warts or lesions resolves spontaneously in few months to years. Treatment is needed for lesions which are either symptomatic or which persist for more than 2 years. Surgical excision is the treatment of choice. Podophyllotoxin 0.5% solution and Imiquimod cream 5% are two topical drugs which could be used for treatment of papules. Cryotherapy is inexpensive, minimally painful and is safe during pregnancy.

HPV's ASSOCIATION WITH PREMALIGNANT LESIONS:

Carcinogenetic effect of HPV in premalignant lesion is still doubtful and is a debateable topic. Some researchers believe that HPV could have carcinogenetic effect in premalignant lesions whereas others reported that premalignant lesions which are HPV positive shows better prognosis with respect to HPV negative premalignant lesions. HPV as a cause or contributor in cause of premalignant lesion are completely rejected. Hence it is unclear, whether an analogous relationship exists in the oral cavity or not.[20]

HPV's ASSOCIATION WITH HEAD AND NECK SQUAMOUS CELL CARCINOMA:

HPV infection is evident to play causative role in etiopathogenesis of squamous cell carcinoma on oral as well as anogenital areas. About 20% of oral squamous cell cancers and 60% - 80% of Oro-pharyngeal carcinomas are related to HPV infection. The International Agency of Research of Cancer (IARC) in 2012 declared the association of HPV subtype 16 with oral squamous cell carcinomas. Thus, now it is well established that high risk HPV, in particular subtype 16, plays a causative role in the development of oral squamous cell carcinomas.[21] HPV positive carcinomas shows distinct epidemiologic, molecular and risk factor profile in comparison to HPV negative carcinomas. According to V. Candotto, the risk of HPV infection in oral squamous cell carcinomas is about four times when compared to patients with healthy mucous membranes.[20]

Immunohistochemistry (IHC): HPV positive malignancies show p16 overexpression whereas expression of p53 and bcl-2 is not associated with HPV positive oral squamous cell carcinoma and mutations in p53 are rarely seen in HPV positive cases. Hence, genetic signatures of HPV positive oral squamous cell carcinoma is different from those of HPV negative oral squamous cell carcinoma.[22]

TREATMENT: unlike other viral infections, clinically no drug is available which could eradicate or regress HPV infection. As HPV infection does not respond to any pharmacological therapy, the treatment option left is predominantly surgical. The surgical treatment is the excisional treatment with cold-bladed scalpels, quantum or laser resonance scales, which allows the histological examination of the sample. There is no evidence to indicate that treatment is different from that with other cancers arising in this area.

HPV VACCINE:

HPV vaccines are based on the principle that major capsid antigen L1 of HPV could assemble into virus like particles (VLP) which are devoid of viral DNA. These virus like particles could induce antibody formation hence cause immunity against HPV. At present US FDA approved two cervical cancer vaccines namely, Gardasil, a quadrivalent vaccine and Cervarix, a bivalent vaccine.[23] Gardasil is composed of VLPs from major L1 capsid proteins of subtypes 6,11,16,18 of HPV, hence it is active against these subtypes of HPVs. HPV vaccines are recommended for 11 to 26 years of female and adolescent males in several countries.[24] Around 40 countries have introduced HPV vaccines in their immunisation program. Due to the vaccination drives against

HPV, prevalence of oral HPV infection in middle aged adults has decreased.[25]

CONCLUSION:

HPV is one of the most common viral infection, but general population has a little knowledge about clinical presentation and transmission of HPV infection. Mostly patients sought homeopathic remedies, which could lead to more spread. Hence proper information campaigns, awareness program about its contagious nature and availability of vaccines is the need of the hour.

For clinicians and researchers, as the information about the HPV infection and its carcinogenetic potential has increased considerably and with newer advances in molecular biology techniques, they have new challenges to device better measures of infection control and formulate more definitive therapeutic protocols.

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REVIEW ARTICLE

CONCEPTS AND PRACTICE OF MODERN ENDODONTIC SURGERY

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Abstract

Colossal improvements have been seen in the regimen of endodontics in clinical techniques and technology over the gone many years. The space amid biological ideas and capability to attain clinically effective outcomes has reduced by using ultrasonic & microsurgical instruments, dental operating microscope & new retrograde materials. Advantages & disadvantages with modern method for endodontic microsurgery will be discussed and in this article.

INTRODUCTION

Apical periodontitis can be forestalled by endodontic therapy as it makes an environment where periradicular healing can occur through controlled asepsis or disinfection of the root canal. Despite that, where non-surgical root canal therapy is not feasible or symptoms continues after root canal therapy also, endodontic surgery might be important in rescuing the teeth.[1]

Surgical Endodontics is the part of Dentistry that deals with the diagnosis and treatment of lesions of endodontic source that does not react to traditional endodontic therapy. The 1. motivation behind Surgical Endodontics is to accomplish the 3-D cleaning, shaping and obturation of the apical bit of the root canal system which isn't treatable through an access cavity, but just accessible by means of a surgical flap.[2]

Endodontic microsurgery, including the triad of high magnification, ultrasonic root-end preparation, and biocompatible root end filling materials, was introduced in the 1990s and solidly settled over the previous decade. Endodontic microsurgery is observed as tough as the surgeon frequently estimated the area of anatomical structures like large mental foramen, blood vessels & maxillary sinus. However, harm to these structures is minimal, conventional endodontic microsurgery doesn't have a confident image in the dental career in light of its offensive nature & uncertain outcome. Illumination & magnification given by the microscope and correct utilization of miniature instruments are used so that periapical surgery can be done with exactness & predictability that takes out the suspicions which are inherited with conventional surgical methodoligies.[3]

Indications for endodontic surgery-

1. Rectification of induced faults.

2. Root canal treated teeth where peri-apical pathology has not been resolved.

3. At a point when surgical & non-surgical method both are needed.

4. The necessity of biopsy for exploring apprehensive lesion/where medical examination is needed.

5. Retreatment is impractical/not successful.

Contraindications for endodontic microsurgery-

1. Tooth which are not restorable, poor periodontal support / insufficient root length.

2. Surgical aspects for example limited opening of mouth.

3. When traumatic occlusion cannot be corrected

4. Acute infection which is nonresponsive to the treatment

5. Patient factors, for example, psychological issues or systemic diseases such as leukemia, uncontrolled diabetes, anemia, thyrotoxicosis, etc.

6. Clinician factors which incorporate the ability, knowledge and availability of suitable apparatus and level of training of operator.[4]

STAGES OF ENDODONTIC SURGERY

PRE-OPERATIVE CONSIDERATIONS

Clinical assessment Prior to endodontic surgical procedure should include;

1. Medical history: general medical condition of the patient, history of MI, angina, hepatitis, infective endocarditis.

2. Dental history: history of trauma, pain, swelling, root canal filling, pus discharge.

3. Clinical examinations:

a. Intraoral: caries, quality of coronal restoration, periodontal status, pocket, mobility, occlusal function of tooth, oral hygiene, tenderness, vitality of affecting teeth and adjacent teeth.

b. Extraoral: by inspection, palpation, auscultation of any swelling or sinus discharge.[5]

4. Radiographical evaluation -A precise fine radiograph is needed prior to starting off surgical endodontics. The radiograph must display all roots, foreign bodies, the whole degree of any related lesion and local anatomical structures, for example, mental foramen, the inferior dental canal, maxillary sinus or incisive canal. Radiographs at two different angles may give additional information.

5. In recent times with the emergence of imaging modalities including digital, densitometry methods, radiography, computed tomography (CT), ultrasound, magnetic resonance imaging (MRI), and cone beam computed tomography (CBCT), variation in density may allow more precise preoperative diagnosis.[6]

6. After two to four hours post-surgery, inflammatory mediators are highest so non-steroidal anti-inflammatory drugs taken pre-operatively over 60-120 minutes of surgery can improve post-operative pain relief. Intake of paracetamol as well as NSAID have proved in providing enhanced control of pain than any single drug used. Due to this reason, the investigators suggest shifting back and forth among ibuprofen and paracetamol four to six hourly 'by the clock' to prevent excessive utilization of any analgesic.[1]

7. Anxiolytics or psycholeptics are drugs causing calming effects, ensuing in sleepiness. These medications might also act in excitability, agitation, depression, anxiety, apprehensiveness neurosis state and psychosis.

8. Pre-operative evaluation foresee & limit healing or technical difficulties. Patient must be informed about the possible dangers, challenges & inconvenience before surgery while taking the consent.

9. To lessen the microbial load in the surgical field, rinsing preoperatively with chlorhexidine gluconate (0.12%) is endorsed because it reduces 85% of bacterial flora in remaining last 4 hrs.

PERI-OPERATIVE CONSIDERATIONS

ANAESTHESIA

To do endodontic surgery, significant sedation and desirable haemostasis are crucial. Lignocaine, mixed along with vasoconstrictor, frequently 1:80,000 epinephrine in the LA solution ought to satisfy the above-mentioned targets. The anaesthetic solution must be given inside the connective tissue of alveolar mucosa close to the root apex. Conscious sedation or general anaesthesia may be required sometimes, apart from local anaesthesia if the surgical procedure is difficult, if the patient is nervous or considerable uneasiness or distress is expected.[7]

SOFT TISSUE ACCESS

Smile line, periodontal probing depths, local anatomical features like frenal attachments, margins of crown, bony prominences, attached gingivae width, bone level at margins and the probability of recession after surgery should be considered while deciding the incision type.[8]

Flap Design

The cortical bone should be exposed with the aid of giving incision & full thickness flap reflection including gingival, tissue & mucous membrane while doing endodontic surgery. The previously well-known semilunar flap introduced by Partsch in 1890 isn't suggested or advised anymore, as it doesn't allow sufficient access to the root apex which leads to extreme scarring.[9]

Figure 11: Semilunar flap design.

The full sulcular flap for posterior region & submarginal (Ochsenbein-Leubke) for anterior region are the two flaps designed for apical microsurgery which are advised nowadays.

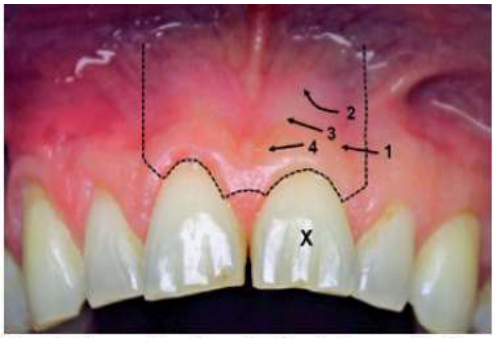

Fig. 9 Flap reflection. Begin at the vertical relieving incision at the level of the alveolar mucosa (1); the flap is slowly undermined (2) and reflected (3, 4)

The full sulcular flap (full thickness marginal flap) incorporates an initial incision inside the gingival sulcus which follows the tooth contour. It is rectangular when there

are two relieving incisions and triangular when single vertical relieving incision is given.

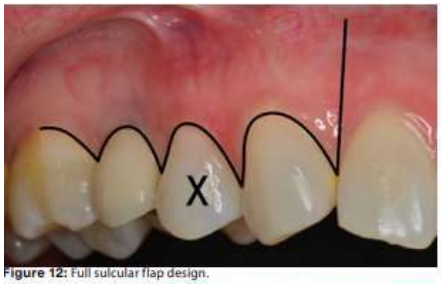

Figure 12: Full sulcular flap design.

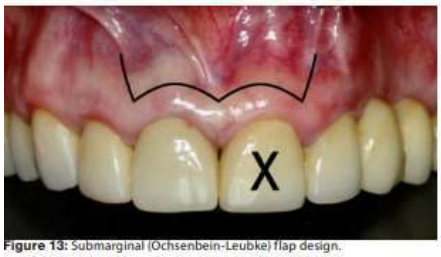

Figure 13: Submarginal (Ochsenbein-Leubke) flap design.

Submarginal flap consists of 2 vertical incisions & scalloped horizontal incision inside attached gingiva which follows gingival margin contour (about 3 mm from it). Atleast 2 mm thickness of attached gingiva is a primary requirement for giving the submarginal flap.

After achieving the access, surgical area must be examined cautiously to analyze the remaining bone size and inspect the root if some fracture outline is present. The tooth should be considered unrestorable and should be extracted if a longitudinal root fracture is been detected.

HARD TISSUE ACCESS

Sufficient bone ought to be detached to finish the surgical endodontic procedure & reedy boundaries of bone must be rounded to lessen the threat of sequestration. After preparing the cavity, at least 2-3mm of strong undamaged crestal bone must be endured to lessen the threat of recession & give sufficient periodontal backing to teeth.

Root end access is forthright, in case bony dehiscence exists over the apex of root. If this isn't the case, a cavity should be prepared in the bone to gain access to the root end. The position of the root apex must be analyzed by using preoperative radiograph and the local anatomy. Radiographic markers can be advised in some cases.[10]

Air rotors are not advised due to the potential threat so bony crypt should be eliminated by sharp curettes. Immediate granulation tissue elimination would assist in vision & lessen hemorrhage.

ROOT END MANAGEMENT

- **Resection of root end**

75% of teeth have canal abnormalities in the apical 3 mm of the root, accessory canals are eliminated 93% of the time and canal ramifications are removed 98% of the time so on this ground the apical 3 mm of the root is generally taken out. In any case, a more length of root can be taken out if there are, separated instruments, anatomical variations, transposed canal apices or where access to a second, more lingually or palatally positioned root is must.[11]

The root tip should be resected perpendicular to the long axis of the tooth giving a 0° bevel. This takes into consideration a 90° cavosurface margin for the root end filling and guarantees that lingual anatomy is obtained. Giving bevel to the root tip isn't suggested, as this undercover greater dentine tubules, which permit the entry of residual extra radicular nutrients and intra-radicular microorganism. If the tooth has received previous apical endodontic surgery, it may not be necessary or possible to remove 3 mm of the root end and nevertheless preserve a sufficient crown to root ratio. Similarly, it could no longer be viable to resect 3 mm of the root end beyond a post and still preserve adequate space for a root end filling.[12]

- **Crypt Management**

The bony crypt needs to be kept dry and clean to permit management and visualization of the root end after doing resection of the root apex and curettage of soft tissue. Sufficient haemostasis limits blood loss, surgical time, and post-operative swelling and haemorrhage. A local anaesthetic consisting a vasoconstrictor need to be used to enhance haemostasis. Electrosurgery / cautery isn't encouraged due to the fact that it may lead to necrosis and defer healing, relying on period of application and the temperature. Curetting the cavity and the bony walls to take off of any remaining adhesive haemostatic agent used and then causing bleeding of the bone, after doing the placement of a root end filling, makes a blood clot which is correct for healing.[13]

- **Root End Preparation**

The apical 3 mm of the root canal system should be set up to encourage a satisfactory apical seal after doing the root end resection. The preparation should follow the anatomical canal space and establish sufficient retention form. It is been found that if there are two canals in a root at the 4 mm level, there gonna be a partial or complete isthmus 100% of the time. If 2 root canals within a root are present, the isthmus between the canal must be prepared to a depth of 3 mm because there are possibly to be communications in this area. So atleast 6 mm of root length apical to a post is needed for acceptable cavity preparation and root resection. For root end cavity preparation, ultrasonic instruments are preferred because they are easy to manoeuvre, small and allow deeper preparation of root end as compared to a round bur.[14]

- **Root End Conditioning**

No proof exists to assist the declaration that smooth root ends encourage improved healing though a smooth surface permits improved evaluation of ramifications and cracks. Elimination of the smear layer by conditioning gives a surface that can be more conducive to cellular mechanisms for growth and attachment as well as for the mechanical because it exposes the collagen matrix and retained biologically active

components like growth factors. Burs which produce a smooth end may be more comfortable for the patient and generally produce less vibration.

A Stropko irrigator can be securely used air and sterile water or with air solitary to clear the retrograde cavity preparation. A 25gauge needle can be used, bent for improved regulator of the spray. The water pressure must be condensed and the air pressure should also be reduced to 4-7 lbs/in2.[15]

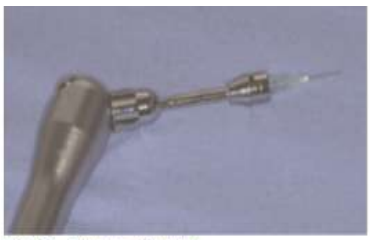

Fig. 11 Stropko irrigator

- **Root End Fillings**

The root end is ready to be sealed once the root is resected and cavity prepared. Increasing the depth of the apical filling lessens leakage. The preparation depth desirable for a satisfactory seal under perfect circumstances enhances with increasing bevel thus the least depth needed for a 0° bevel is 1 mm, that for a 30° bevel is 2.1 mm and for a 45° bevel is 2.5 mm. An apical filling of 3 mm is endorsed.

MTA has been revealed to provision nearly wide-ranging regeneration of the apical periodontal tissues with a new periodontal ligament. The placement of MTA is enabled by the use of an MTA carrier or a Lee block and satisfactory haemostasis. To achieve a homogenous apical seal without voids, ultrasonic activation can be used.[16]

Fig. 21 Lee Block, useful for forming pellets of MTA

New bioactive materials such as Biodentine have newly been marketed as materials with dentine-like properties that may be used as root end filling materials. Claimed advantages comprise, regenerative potential, biocompatibility, comfort of use, antimicrobial properties and long-standing sealing ability.

POST-OPERATIVE CONSIDERATIONS

CLOSURE OF SURGICAL SITE:

A radiograph must be taken former to concluding the surgical site to determine the status of the root end filling in addition it guarantees that all foreign objects have been removed. The crypt must be carefully irrigated with saline to eliminate any packing materials haemostatic agents. The crypt must formerly be scraped with a sharp curette to reassure bleeding and the establishment of a blood clot.

Tension may lead to necrosis at the incision site with successive scarring or recession so the flap must be judiciously changed and sutured without tension. Small diameter sutures (5/0 or smaller) are suggested as they have smaller needles, lead to less thread breaking and trauma. Non-resorbable monofilament sutures are suggested, as they are less supportive of bacterial growth. Mild compression of the flap for 1minute post closure confirms fibrin adhesion and might avert haematoma development.[17]

Post-operative antibiotics are not regularly prescribed except surgery has been extremely long or the patient is immunocompromised. Removal of sutures at three days post operatively is suggested as epithelial bridging and collagen crosslinking is believed to happen within 21-28 hours.

In most cases where oral surgery has been performed, patient should be counselled to have simple analgesia. Avert additional swelling via ice packs for 1-2 days, CHX gluconate (0.12%) mouthwash should be used twice a day at least for 3 days post operatively & lukewarm saline mouth washes four to five times per day for 7 days & keep decent oral hygiene.

DISCUSSION

Cases which are not amenable to non-surgical endodontic treatment have to be treated surgically. In this context, endodontic surgical procedures and its concepts, assume importance. Earlier endodontic microsurgery is not considered imperative in endodontist's field which transformed when micro-instruments, ultrasonic tips, microscope & better biologically tolerable filling elements were announced. Simultaneous development of improved techniques has led to greater treatment success, better understanding of the apical anatomy and an added propitious patient response.

Compared to conventional endodontic surgery, micro-endodontic surgery has achieved greater percentage of success. Siqueira J et al stated that endodontic surgery is a characteristic of comprehensive root canal treatment that can handle problems that cannot be removed by nonsurgical methods.[18]

Micro-endodontics endeavors to carry out all the steps, at a lower scale of dimension. The idea behind this concept is that since only the involved area is encroached and operated upon, the healing rate is faster. Since the adjoining healthy tissues are preserved, extended prognosis of the involved teeth is improved.

In the microendodontic surgical procedures, the instruments used are specialized, with the emphasis on instruments that are smaller in size and have easier access to the involved tissues. Magnification is another important

aspect which provides enhanced visualization, thus more precise and focused approach to the area. According to Rubinstein R et al developments in instruments, endodontic equipment and materials have established this procedure, as a state-of-the-art surgical endodontic technique, with a expectable result. One of the main benefits is the use of magnification devices such as dental operating microscopes.[19] This allows better visualization of root apex, resulting narrower resection angles and smaller osteotomies, confirming conservation of surrounding bone, root length and dental structures.

The once popular semilunar flap design and the Luebke-Ochsenbein flap design are no longer recommended. According to Luebke, the wider base of the flap produces a permanent scar across the fiber lines in both muco-gingival flap designs and sulcular full-thickness flap.[20] According to Von A et al flap base and top should be of same width & vertical incisions must follow the position of blood vessels. Scar-free healing is achieved and it also provide sufficient surgical site access. Recession & shrinkage of papilla in sulcular full-thickness flap design are the chief disadvantages.[21]

Usually, endodontic microsurgery process includes buccal bone elimination to precisely find the apex of roots of a diseased tooth, that embrace the intact bone exclusion. After that, pathological peri-radicular tissue is surgically debrided, then root-end resection is eliminated. Atleast 3 mm preparation depth is needed for sealing the additional canals which may be present. In micro-endosurgery removal of bone is partial and more exact thus resulting in improved healing.[22]

Smaller bevel angle is the utmost significant advantage of microsurgery. The steep bevel angle of 45-60° was suggested with the conventional rotary bur. The aim of this steep bevel was simply for visibility and access. According to Creasy, root tip bevelling isn't suggested, because more dentine tubules will be exposed, and that will permit the way to the remaining extraradicular nutrients & intra-radicular bacteria. Shearer J stated that for root end cavity preparation, ultrasonic instruments are preferred as they can be easily managed, small & permit deep root end preparation as compared to rounded bur.[24]

The root end is ready to be sealed once the root is resected and cavity prepared. Amalgam was considered the root-end filling material of choice until the 1990s. Later various materials like Super EBA, IRM, GIC, Retroplast, Geriostore, mineral trioxide aggregate, are used as root-end filling material. Regan J et al stated that new bioactive materials such as Biodentine have been promoted as materials that have properties similar to dentine which can be used as root end filling materials. Claimed advantages comprise, regenerative potential, biocompatibility, comfort of use, antimicrobial properties and long-standing sealing ability. The preparation depth desirable for a satisfactory seal under supreme environments upsurges with increasing bevel. An apical filling of 3 mm is suggested. [25]

Guided tissue regeneration improves and directs cell growth to repopulate specific parts of the periodontium that have been damaged by, tooth diseases, periodontal diseases /trauma. Sculean A et al confirmed that guided tissue regeneration by using membrane barriers and bone grafting materials, induces new attachment of damaged periodontium. [26] Mellonig J et al found alloplast, like hydroxyapatite, beta-tricalcium phosphate, non-ceramic, polymer, or bioactive glass to be only osteoconductive. [27]

Before the advent of microsurgery, 4-0 silk sutures were the standard for endodontic surgery, but they are no longer recommended. Banche et al concluded that smaller width sutures of size 5/0 or smaller have been suggested because it encloses small needles, lead to fewer thread breaking & trauma. [28] Cyanoacrylates are the most hopeful among the various adhesive biomaterial used.

CONCLUSION

Endodontic surgery was considered as a troublesome method in the past as it leads to random consequences. Partial knowledge of diseases of root canal space and treatment fiasco was also the issues for not considering it. It is now an expectable treatment choice to save a tooth with apical pathology that cannot be achieved by conventional, non-surgical endodontics. Following all the above suggested steps and materials, the microendodontic surgery tends to attain a higher success rate resulting in faster and more uniformed healing.

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Review Article

Application of Robotics in Oral & Maxillofacial Surgery: Literature Review

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Abstract:

Robots are being used in various fields since decades but their use in the field of medicine and surgery has been very limited. With the introduction of robots in the field of surgery, the procedures that were once associated with morbidity can be done with less blood loss and minimal complications. The previous literatures have mentioned the advantages and disadvantages of using robotics if field of surgery.

The current literature review includes the studies on the use of robotics in the various fields of surgery, published between 1988 and 2017. This review study is focused on the use of robotics in field of oral and maxillofacial surgery including the applications of robotics in various procedures, their advantages and disadvantages.

The results of this literature review suggested that there are several advantages of using robotics in oral and maxillofacial surgery mainly in terms of precision of surgical procedures, reduced man power and duration of the surgery, reduced hospital stay and complications. High installation charges being the major disadvantage has been the reason of limited use of robotics in oral and maxillofacial surgery.

Keywords: Transoral Robotic Surgery, TORS, daVinci, RobaCKa, Robotic Surgery

Introduction:

Robot: "A mechanical device that can be programmed to carry out instructions and perform complicated tasks usually done by people". (**World English Dictionary)**[1]

A robot is a powered device that is computer-controlled manipulator and has artificial sensing. This can be reprogrammed in order to move and position the tools so that a wide range of functions can be carried out. [2]

The term "robot" was derived in 1921 from *Czech robota* which meant slave labour and was introduced by the playwright *Karel Capek*. He introduced them in satirical drama 'Rossum's Universal Robots'. In this drama, the robots were created to do the banal work, whereas man was free to carry out more creative works. The robotic technology has become widely developed after this first fictionalized introduction of robots by *Karel Capek.* [3]

Later, in 1938, the term "robotics" was first coined by *Isaac Asimov*. He coined it in one of the short stories "Runaround" that was published in the magazine named 'super science stories'. This was followed by the stories where the robots were shown to have conflicts with the human masters. This collection was published in the year 1942 under the title 'I Robot'. 3 laws for the robot behavior were described by him: [1]

i. A robot may not cause any harm to humans or through inaction allow to come to harm.

ii. A robot should follow the orders that are given to it by the humans except in cases where doing so will conflict with the 1st law.

iii. Robot should take care and protect and its own existence. It should be done as long as the 1st and the 2nd laws are not conflicted.

Kwoh et al, in 1985, introduced the first surgical robot. Since then, their development in order to provide more accuracy and efficiency during surgeries has been slow but steady. According to *O, Malley* and *Weinstein et al, Transoral Robotic Surgery (TORS)* have a potential for the management of tumors of upper aerodigestive tract. Further, they have stated that their use in humans is also safe.[4]

In the year 2005, there was a surgical technique that was reported in canines and cadaveric models. This was later termed as *Transoral Robotic Surgery* (TORS). This *TORS* technique was used for resection of tongue base in three patients in 2006. The main advantage of using this technique was reported as improved vision of the cranial nerves IX and XII, lingual nerves and arteries. [5]

Procedures that were once associated with morbidity, are now being performed with reduced levels of blood loss and fewer complications than the conventional open techniques. Also, the intra-operative time, stays for intensive care and duration of hospitalization has been reduced. All these have been seen after the introduction of robotics in the field of surgery. [6]

In Oral and Craniomaxillofacial surgery the robotic devices are used for drilling of holes, for milling of the bone surfaces in field of plastic surgery, for performing osteotomies, for drilling of bed for implants, for pre-operative automatic selection of osteosynthesis plates; for bending of these plates according to the surface they are being applied and for their placement during the intra-operative procedures. [7]

Transoral Robotic Surgery (TORS) can also be used in management of cases such as radical tonsillectomy. It provides an excellent access to resect the carcinomas present in the tonsil with acceptable acute morbidities. [8]

Recently, the investigators have worked for the role of *TORS* in management of head and neck tumors. According to the works conducted by them, *TORS* is safe and has a potential to be useful for managing the carcinoma of base of tongue and supraglottic region. [4]

Currently, the *daVinci* robot is the only FDA approved surgical robotic system that is available for surgeries in the head and neck region.[5]

Material and Methods:

An online search of the databases for studies related to use of robotics in Oral and Maxillofacial Surgery between 1988 to 2017 was done and studies including the uses, advantages and disadvantages of using robotics in field of surgery were selected.

Discussion:

Transoral robotic surgery (TORS), is a minimally invasive method. It is useful to provide a more precise surgery with lower morbidity. The reason for same is that it is caried out through the oral cavity and the extraoral incision is not required.[9]

Robotic Devices in Oral and Maxillofacial Surgery:

In field of oral and maxillofacial surgery, the robots find their use while milling the surface of the bone, drilling holes, making osteotomy cuts, selecting the plates and bending them for adaptation on the surface to be applied and while planning for orthognathic surgeries. Tongue based adenoid carcinomas are also being treated with robotic technique/*TORS* (Transoral Robotic Surgery). Another indication for the application of surgeries assisted by robots/*TORS* in field of maxillofacial surgery are the open and aggressive surgeries which can produce adverse effects on speech and swallowing. [10]

Weihe et al in 2000, did the initial work in craniofacial domain by evaluating the practicability of intra-operative instrumentation using the navigation system and robotics for reconstruction of fronto-temporal bone resection in a single step using computer aided facilities. From this they concluded that resection done with the help of template proved to provide more precision and practicability.[11]

In 2002, *Terris et al* used the procine models to carry out the endo-robotic surgery and found it to provide improved precision and efficiency for problems associated in neck region. They also reported advantages such as 3-D imaging, flexibility, versality, precision and coordinated procedures. According to them the complications associated with cervical

endoscopy such as emphysema and pneumothorax were overcome with the introduction of endo-robotic surgery.[12]

In the same year, in 2002, another robot was assessed by *Engle et al*. This was called *RobaCKa,* and was developed by IPR University. It was assessed for accuracy in milling in field of craniofacial surgeries that were associated with the vital structures. They found that there was an accuracy of 1.0mm starting from planning to the execution of the procedure. Optical navigation system was used to counteract the micromovements of the patients. [13]

In 2003, *Tamer Theodossy et al* carried out a study on orthognathic procedures where surgeries on 21 patients performed manually were compared with the model surgeries performed by the robots. In their study they observed the surgeries that were performed using the robotic arms provided more accuracy and precision in the antero-posterior and the vertical planes as compared to those performed manually. [14]

Robotic system to place dental implants were first introduced by *Auranuch et al* in 2009. Based on the homogenous transformation algorithms, they developed the dental implant surgical navigation system. The anatomy was assessed first by making use of CT and the computer aided surgery system. After that 3D images with real time monitoring were assessed intra-operatively. Implants were placed with a deviation of less than 1.0mm and the mean error of the navigation system was found out to be 0.35mm.[15]

Gregory S Weinstein worked with the *daVinci* robot. He performed *Transoral Robotic Surgery (TORS)* at university of Pennsylvania. Surgeries such as partial laryngectomies, submandibular gland ablations and selective neck dissections were performed. *TORS* proved to be beneficial and it provided better visualization. Moreover, it provided access to tumors via minimally invasive, less morbid approach which further resulted in overall functional results.[16]

Transoral nasopharyngectomy was performed in 2010 by *William I. Wei.* It was performed in a patient who was diagnosed with recurrent carcinoma of nasopharyngeal region. Split palatal approach was used to expose the entire nasopharynx and pathology was removed using two robotic arms along with camera. [17]

It was in the year 2010, that the 1st description of using surgical robots for removing the salivary stones was presented by *Rohan R Walvekar, et al.* The *daVinci Si* system was used to perform a *Transoral Sialolithiotomy* along with sialoendoscopy. The total duration for the surgery came out to be approximately 120 minutes. Further, they stated the advantages of the *daVinci* surgical system in terms of excellent visualization, improved magnification and dexterity for removal of stone trans-orally while preserving the lingual nerve and submandibular duct. [10]

In 2011, the limitations of using robotics in field of head and neck surgery were listed by *Dallan, et al.* According to them due to the narrowed area of work, the arms of the robotic system should work parallelly which will further prevent the chances of conflict. The advantages of robotic skull base surgeries were discussed which included frameless neuro-navigation, intra-operative imaging systems, modular approaches, etc. [10]

It was in the year 2011, that *Johan Martell et al* advocated the limitations of using the robotic systems such as the lack of the tactile sensation. A binocular with high resolution was incorporated. Sensory feedback was provided with the help of the visual clues. Deflection of membrane that was being manipulated was visualized to calculate the suture strain. This lacuna of sensory feedback in robot assisted surgeries was expected to be compensated by this real time feedback of suture tension. [10]

Another major obstacle was commented by *Prem N Kakar et al* in 2011. According to him, this obstacle was termed as the *'latent time'*, which meant the time that was required to send an electric signal from the hand while in motion to the actual visualization of the moving hand on a distant screen. There was another robot that was able to act like an anaesthesiologist and this was termed as *"Mc Sleepy"*. It was able to perform

functions like analyzing the biological information, adapting its own behavior and recognizing monitoring malfunction.[2]

Since, the chances of morbidity are high in conventional open surgical techniques, are technically sensitive and can prove to be uncomfortable to the patients, chemoradiation has become a common option for the primary management of the oropharyngeal cancers. However, this chemoradiation has adverse effects of its own which include xerostomia, dysphagia and can also result in late complications such as trismus and osteoradionecrosis. In order to overcome these adverse effects of the chemoradiation, *Transoral robotic surgery (TORS)* can be preferred. This is a minimally invasive technique that provides more precise results with less morbidity. This is possible because of the fact that this technique makes use of the oral cavity for the surgeries and no extraoral incisions are required.[18]

Robotic surgery is now beginning to see adoption in minds of many. With the phenomenon of no contact of surgeon with the patient during the surgeries, a new era of *'no infection, no antibiotic'* will emerge extensively.

The *daVinci* surgical system has been given approval by the FDA. These can be used for performing *TORS* procedures for the treatment of tumors of oropharyngeal region in adults. In future, surgeries on mobile structures, such as beating heart will be improved by creating an image in virtual stillness using the further advances in *'motion gating technology'.* [2]

SURGICAL ROBOTIC SYSTEMS FOR ORAL AND MAXILLOFACIAL SURGERY:

I. *RobaCKa system*
II. *daVinci System*

I. <u>*RobaCKa System-*</u> [6]

It was developed in by University of Karlsruhe (Institute for Process Control and Robotics) and the Ruprecht- Karls-University Heidelberg (Department of Oral- and Craniomaxillofacial Surgery). It was designed for performing craniotomies at the bony skull. It was the 1st ever system that was used to perform milling trajectories along with instruments which show permanent changes in their positions and orientations.

It was designed on the basis of *Caspar robot system.* This was further improved by improving safety using a redundant control system. This system was based on the robotic control, the infrared-navigation-system termed as *Polaris*, a sensor for force torque and an overload protection. Sensor-PC was used to control the supervision and sensor-fusion. The main role of this Sensor-PC was to run a real-time operating system. The infrared navigation system was used to monitor the position and the orientation of the instruments being used in order to ensure the safety. The robots were able to perform the functions using slow movements and that too only after conformation by the surgeons by pressing certain buttons.

These buttons were in direct connection with robot's emergency circuit. The power supply of the robot would completely cut within milliseconds if both the buttons are released simultaneously. Another button that was connected to the robot control, allowed the robot to move to a safer position before the surgeon stops intentionally. Graphical user interface (GUI) was used to support the control of the robotic system during the surgeries.

In the *RobaCKa-system,* this GUI was structured according the ''workflow concept''. This concept helped the surgeon by guiding the whole surgical procedure using a well-structured and clearly defined sequence and a clear graphical presentation. All this was done using only a few buttons. As described in Fig.4, diagnostic images and 3D models of the patient were generated for starting the complete surgical procedure. After that, *KasOp* software was used to simulate and plan the procedure. The last step of executing the trajectory accurately was performed by the robot intra-operatively.

This system was used for the first trial on a patient in the University Hospital Heidelberg. Another field of application of *''RobaCKa''* was its use in milling the beds for titanium

implants. This was tested earlier on cadavers of sheep. It was necessary to build robots that are more dedicated in the field of craniofacial surgery.

II. *daVinci System*- [2]

It is a product of Intuitive Surgical System. It falls under the category of telesurgical devices. *daVinci Surgical System* was approved by FDA on July 11, 2000 for performing the laparoscopic procedures.

The 3 generations of *daVinci surgical systems* that have been developed so far are:

A. *daVinci surgical system* (1999)-

It consists of three components:

- The console for viewing and controlling
- Surgical arm unit
- Optical 3D vision tower

B. *daVinci S HD surgical system* (2006)-

This is the second generation of the *daVinci surgical robot.* It is equipped with the features such as wide range of motions of robotic arms and instruments with extended lengths, interactive video displays and touch screen monitor.

C. *daVinci Si HD surgical system* (2009)-

It has dual console capability. This helps in supporting the training and collaboration, advanced 3D HD visualization with up to 10× magnification. It also supports the 'EndoWrist'® instrumentation which has dexterity and range of motion which is more than the human hand. Further, it consists of the 'Intuitive® motion technology', which is responsible for replicating the experience of open surgery while preserving the alignment in a natural eye-hand position.

Innovations incorporated in the *daVinci* system-

These innovations were made to incorporate the substantial improvements which were lacking in the conventional endoscopic surgery. These were as follows:

a. It consisted of true three-dimensional imaging using the twin-mounted 5-ram endoscopes. These helped in projecting separately to the left and right eye.
b. Improvement in versatility and flexibility of operative instruments was seen in the distal articulation of EndoWrist instrumentation.

Operating with the help of a *daVinci* surgical system- [2]

Once the patient is positioned, 3 - 4 small incisions are made on the patient's body depending on the arms present on the model. There are 2 endoscopic cameras present on a single port that helps in providing the stereoscopic image. Rest of the ports are equipped with the arms that are dedicated to perform the surgical procedures of dissecting and suturing.

The surgeon sitting at the surgeon console, looks at 2 separate monitors. Independent camera channel produces the virtual 3D stereoscopic image that is visualized by the surgeon using both the eyes. There is a joystick-like instrument that is present below the screen which helps the surgeon to manipulate the surgical instruments. As soon as the surgeon makes any movement, an electrical signal is sent to one of the instruments. This is how the instrument moves in synchronization with the movement of the surgeon's hand. A 'frequency filter' device eliminates the hand tremors that are greater than 6 Hz allowing the surgeon to work on a miniature scale. Another device termed as the 'motion scaling device' scales the movement of the surgeon's hand up to a ratio of 5:1.

daVinci system is the only FDA-approved robotic surgical system that is being currently used in the field of head and neck surgeries**.** [19]

***TRANSORAL ROBOTIC SURGERY (TORS)* IN ORAL AND MAXILLOFACIAL SURGERY:**

In the year 2005, McLeod and *Melder* reported the 1st use of the *daVinci* surgical robotic system for performing the laryngeal surgery. This system was used to excise a vallecular cyst. There were no complications reported in any of the patients an all were discharged on the same day of the surgery.

Later, in 2005, technical feasibility of using *daVinci* robotic system for performing airway surgery on a mannequin and cadavers were reported by *Hockstein* and colleagues. The success of the cadaveric surgeries further led to the use of robotic systems in performing procedures such as *Transoral Robotic (TORS)* supraglottic partial laryngectomy and resection of neoplasms present on the base of tongue. The studies on robotic systems in various head and neck regions along with their outcomes have been shown in table 1 [20] whereas table 2 [21] depicts the long term and short-term gastrostomy tube dependency rates following *TORS.*

Authors	Subjects (numbers)	Anatomic regions/sites approached/resected (numbers)	Airway	Swallowing/feeding	Average blood loss	Average hospital stay	Follow up	Remarks
Weinstein et al.	Patients (29)	Oral cavity, Oropharynx and Laryngopharynx	74% extubated successfully and rest did not require permanent tracheotomy	96% were without gastrotomy tube on last follow-up	189 ml	NR	6 months	One patient developed distant metastasis on the follow up, 50% resection of base of tongue associated with dysphagia.
Genden et al.	Patients (20) of these 18 patients only operated due to lack of exposure	Base of tongue (3) Tonsil (7) Posterior pharyngeal wall (3) Supraglottic Larynx (3) Parapharyngeal space (2)	None of patients required tracheotomy	Oral diet started between 1 and 3 days	80 ml	1.7 days	4 months	–
Moore et al.	Patients (45)	Base of tongue (26) Tonsillar fossa (19)	The mean duration of tracheotomy tube in situ was 7 days	Average duration of NG tube placement was 12.5 days, 8 PEG placed eventually removed, 88.9% swallowing orally at 4 weeks	12.6 ml	3.8 days	12.3 months	No major complication and no procedure aborted
Boudreau et al.	Patients (36) of these 29 patients had successful resection	Oral cavity (3) Oropharynx (22) Hypopharynx (1) Larynx (10)	72% were extubated post-op. Rest of the patients were extubated safely in one week.	89% started oral intake by 2 weeks	51 ml	2.9 days	NR	Guidelines proposed: (1) lower T classification, edentulous patients with successful resection, (2) gastrotomy tube dependence predicted by advanced age, tumour location in larynx, higher T classification, lower MDADI score
Iseli et al.	Patients (62) of these, 54 patients had successful resection	Oral cavity (6) Oropharynx (33) Larynx (12) Hypopharynx (3)	Tracheotomy done in 9%, all were decannulated by 14 days	Within 2 weeks 83% were on oral intake	NR	63% were discharged in 1–2 days; few 6% stayed back longer than one week	13 months	Retained postoperative feeding tube was associated with preoperative tube requirement, higher T stage, oropharyngeal/laryngeal tumour site), and the tumour being recurrent or a second primary tumour
O'Malley et al.	Patient (1)	Parapharyngeal space and Infratemporal fossa	No tracheostomy required	Clear fluids in the immediate postoperative period	50 ml	2 days (average duration of surgery: 2 h 32 min)	NR	Suitable for well circumscribed benign lesions
O'Malley et al.	Cadaver (1) and live mongrel dog (1)	Anterior and middle cranial fossa, Midline skull base, Sella, parasellar, and suprasellar regions	NA	NA	NA	NA	NA	Still in experimental stage
Hanna et al.	Cadavers (4)	Anterior and middle cranial fossa Cribriform plate, Fovea ethmoidalis, Medial orbits, Planum sphenoidale, Sella turcica, Suprasellar and parasellar regions, Nasopharynx, Pterygopalatine fossa and clivus	NA	NA	NA	NA	NA	Still in experimental stage. Advantages offered: 3 D visualization, four arms of the robot which permit tremor free closure of dural defects
Rahbar et al.	Patients (5) Paediatric airway Successful closure of type I and type II laryngeal cleft in two	Paediatric airway	NR	NR	NR	NR	NR	Obtaining proper exposure and smaller instruments is required

	patients, procedure abandoned in three patients because of lack of exposure							
Lewis et al.	Cadavers (5) Patient (1)	Thyroid Transaxillary hermithyroidectomy was performed without gas	NR	NR	NR	NR	NR	Used for follicular neoplasm
Miyano et al.	Patients (2)	Thyroid Bilateral transaxillary total thyroidectomy performed using gas insufflation	NR	NR	NR	NR	NR	Used for benign thyroid disease
Haus et al.	Procine model	Thymectomy Submandibular gland excision Parotidectomy and Neck dissection	NA	NA	NA	NA	NA	In experimental stage

Table 1: Outcomes of studies on robotics in various head and neck surgeries

Table Courtesy: 27. Garg A, Dwivedi R C, Sayed S, Katna R, Komorowski A, Pathak K A. Robotic surgery in head and neck cancer: a review. Oral Oncology 2010;46:571-76.

S.No.	Study	Short Term	1 year	2 years
1.	Weinstein et al. (2010)	18%	2.40%	0%
2.	Moore et al. (2009)		0%	0%
3.	Iseli et al. (2009)		9.50%	
4.	Genden et al. (2011)		0%	0%

Table 2: Long term and short-term gastrostomy tube dependency rates following TORS

Table Courtesy: Dowthwaite S A, Franklin J A, Palma D A, Fung D, Yoo J, Nichola A C. The role of transoral robotic surgery in the management of oropharyngeal cancer: a review of the literature. Int J Cancer 2011:1-2.

Conclusion:

Robotic systems for performing surgeries have proved to be a new and exciting tool that is seeking adoption in the minds. Recently, the *daVinci Surgical System* has been approved by the FDA. This system is being used for *TORS* procedures such as oropharyngeal tumors in adults. Surgeries on mobile structures such as the beating heart can be improved with the advances in 'motion gating technology'. [2]

In India, only few centres have the availability of the surgical robots. The main lacunae of these systems are the high costs of the systems and the increased operative charges. The 1st Centre in India to acquire a surgical robot (*daVinci surgical system*) was the Escorts Heart Institute and Research Centre.

The first robotic urology surgery in India was performed in April, 2005. Further, in India, in 2008, the 1st robotic thoracic surgery (thoracoscopic thymectomy) was performed. Indigenous robotic surgical systems are now being worked upon by the collaboration between the CARE foundation and the Indian Institute of Information Technology (IIT) Hyderabad. [2]

These systems have the features that allow the robot controller to directly access the planning data. The robotic arms provide the high accuracy and precision independent of the progress of the operative time. This in turn provides the benefit of achieving high quality in the operation theater. The use of surgical robots in performing the procedures in craniofacial surgery is considered to be reasonable because of the presence of vital structures in the vicinity and great impact of bone repositioning at human skull. [22]

Despite of the advantages, these systems have to be more mature in order to be incorporated in the daily routine. This leads to the requirement of smaller systems which are more suitable for the operating room. Former industrial robots are not required to be used in routine procedures because of their clumsiness. Moreover, there is requirement of high efforts in order to make them safe, sterile and clinically practicable. The intra-operative planning lays the basis of the new concepts of the computer assisted surgeries. This will lead to the incorporation of the features of intra-operative CT or MR compatible systems. Some research programmers have also devised robots for such environments; however, these are still far from their use in the clinical applications. [6]

TORS for treating the lesions present on the base of the tongue has shown significant advantages over both conventional open tongue base surgeries and laser microsurgeries. Both the functional as well as cosmetic outcomes have negative effects after the conventional open surgeries. Procedures such as mandibulotomy with a lip split or visor flap or transpharyngeal approaches have shown adverse effects on mastication, swallowing, speech and cosmesis. These adverse effects can be eliminated using the *TORS*. The open surgical procedures have an added risk of infection because of the formation of a communication between the oral cavity and the neck. Moreover, open surgeries may require tracheostomy which is not the case with the *TORS* tongue resection. All these advantages of *TORS* has proved it to have a promising application in human trials and this might further prove to be a valuable minimally invasive and low morbidity therapy for the management of the tongue neoplasms. [23]

The use of *daVinci® Surgical Systems* in the field of OMFS has been found to be promising on the basis of the results reported in the literature. In management of oropharyngeal tumors, *TORS* may provide an organ preserving approach. This also leads to no requirement of conventional lip-split mandibulotomy. It can be used in managing the benign and malignant lesions and also for the surgical management of sleep hypopnea syndrome which might be caused due to the hypertrophy of the base of tongue. It also leads to improved precision of vascular anastomoses in the field of oromaxillofacial reconstructive surgery. Further prospective clinical studies are required to prove the feasibility of its use in *OMFS*. [3]

Given below is the list of *Transoral Robotic Surgery (TORS)* procedures: [12]

- Radical tonsillectomy
- Tongue base resection
- Supraglottic laryngectomy
- Partial laryngectomy
- Hypopharyngectomy
- Total laryngectomy
- Robot assisted transoral laser excision within the oropharynx, larynx, and hypopharynx
- Robot assisted surgeries in setting of flaps
- Microvascular anastomosis for free flaps

- Robot assisted lingual tonsillectomy for sleep apnea
- Robot assisted resection of tumors of parapharyngeal region
- Nasopharyngectomy

The major limitation of robotic surgery that is being worked on now is the lack of tactile feedback. While performing the conventional surgeries, the surgeons are well versed with the hepatic feedback, and the sense of temperature, pressure, tension and vibrations, which is lacking in the surgeries performed by the robotic systems. The new transformations are being tried in order to address these limitations of the robotic surgeries by providing the surgeons with the real time sensory feedback.[5]

Patients who undergo conventional open surgical procedures such as mandibulotomy or pharyngotomy have to encounter severe cosmetic deformity, occlusal disharmony and dysphagia. These approaches further lead to negative impact on quality of life of the patients and may give rise to a condition where there is a requirement of gastrostomy tube or tracheotomy for long term. These results in speech and swallowing dysfunctions. All these shortcomings of the conventional open surgeries can be overcome by using the robot assisted surgeries. These robotic surgeries have many advantages over the conventional one which includes better visualization, minimal invasive nature, improved hemostasis, improved instrument movement.

These advantages are responsible for a clear visualization of the lesion, reduces the duration of the hospital stay, improved function, freedom of movement, preservation and maintenance of the post-operative quality of life of the patient. Several reports have demonstrated that *TORS* may have great potential in order to access the oropharynx and the supraglottic larynx with less morbidity. [24]

The introduction of robotic surgery, will lead to separation of patient from human contact during surgery, which may bring the era of *'no infection, no antibiotic'.*

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Review Article

LATHAM'S APPLIANCE: A COMPREHENSIVE REVIEW

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Abstract:

The Surgeon as well as the orthodontist still faces several challenges on dislocation of the maxillary segments in CLCP. Pre-surgical orthodontic device known as latham appliance. The motive of this appliance is to decrease the cleft width before the surgical procedure. In first three months it is inserted on the patient. Segments gets relocated in a few weeks, it is situated their till lip surgery. Custom made appliance have the acrylic pads which are over maxilla hinged posteriorly with the help of a mechanism of expansion. Latham appliance main motive is to increase repair of lip and nose surgery by applying the appropriate force to skeletal base and also inhibits the patient tongue from pressing to the cleft.

Latham appliances is also modified to make it more ease and efficient than the traditional one. Modified latham device (MLD) may reduce the burden of treatment on parents and also decreases the quantity of time required for estimation of cleft segment.

Keywords: Pre-surgical orthodontic device, Cleft lip and palate, MLD, Acrylic pads, Expansion mechanism.

INTRODUCTION

One of the most common birth defect is cleft lip and palate which may causes appropriate expense relative to the emotional difficulties, rehabilitation as well as economics to a person. In a recent study, it had been projected that the total of 0.033% of all Indian population suffers from cleft lip and palate. The average prevalence rate among 100,000 was found 32.18 for both genders.[1] During the 6th & 12th weeks of gestation if any fusion failure occur in the left and right maxillary prominences can causes the CLCP. [2] The Surgeon as well as the orthodontist still faces several challenges on dislocation of the maxillary segments in CLCP.[3]

There are two common strategies which are commonly used to correct the nasal asymmetry and to close the lip. First strategy includes the repair of nose and lip about 3 months of age regardless of size of alveolar gap and sometime during childhood for any residual deformity may followed by secondary correction. The Second strategy includes pre-surgical orthopaedic molding early after birth prior to primary repair surgery.[2]

Braumann et al clearly mentioned in their paper, "the aims of pre-surgical infant orthopeadics are to reduce the width of the cleft gap to achieve an optimal alignment of the cleft segments within the first few months of infancy prior to cheiloplasty and to allow surgical repair with minimal tension".[5]

As the cleft width decreases the soft tissues subjected to low tension gives preferable outcome of surgical repair [6,7] . Moreover, there are so many other advantages of pre surgical infant orthopaedics which are normalizing the feeding as well as the function of tongue, development in speech, reduces the chances of aspiration, mainly it reduces the severity of original dental cleft deformity and skeletal deviations.[7,8]

Initially in 1686 the use of pre surgical infant orthopaedics was described by Hoffman in which he used an extraoral anchor headcap in order to place retraction force on premaxilla.[9] Then Desault performed CLCP patients in 1791 by using a cap on the premaxilla under extraoral force.[10] In 1950's McNeil along with Burston treated CLCP patients by utilizing intra oral plates through which they presented an arch (dentoalveolar) grade control.After then the other appliances

were developed to pin the bar made up of stainless steel which is expandable and can retained by Hagerty in the year of 1957 after that others like Mladick and Georgiade showed up at 1968, in the year of 1970 -71 Georgiade gave his observations. And at 1975 Georgiade collaborated with Latham for further analysis and at last Latham at 1980.[11,12]

LATHAM APPLIANCE

In 1950's Burston and McNeil introduces the pre-surgical orthopeadic correction and latham technique is a variant of that approach. Pre-surgical orthodontic device known as latham applaince. The motive of this appliance is to decrease the cleft width before the surgical procedure. In first three month it is inserted on the patient. Segments gets relocated in a few weeks, it is situated their till lip surgery. Custom made appliance have the acrylic pads which are over maxilla hinged posteriorly with the help of a mechanism of expansion.[3]

"ECPRA (Intraoral Elastic Chain Premaxillary Repositioning Appliance)" is another name for Latham appliance. Latham appliance is also known by the name as dentomaxillary advancement (DMA) appliance which was developed in the year of 1980. It is an active pin-retained appliance which require a surgical fixation to the bone. With the rapid orthopeadic correction latham appliance align the alveolar arch. From the age of 2 to 5 months the appliance is to be placed surgically. Latham appliance operated by concurrently applying the pressure to cleft segments, for proper positioning move the alveolar segments over a period of 4 to 6 weeks. Nevertheless, an anterior and posterior cross-bite is an unnecessary consequences may occur more often with the usage of Latham appliance.[13] All though prolong term observations had shown that more anterior and posterior cross-bites was occurred in children who were treated with the Latham appliance, Chan et al summarized in their study that the dental arch relationships did not get affected by in Latham appliance the preadolescent children.[14]

TREATMENT PROCEDURE

The initial step of the treatment of an infant having cleft disorder is to take the maxillary impression (Figure 1), here the newborn should be of 2 weeks or older. [15] On the basis of the complexity of the cleft team, Surgeon, dentist (paediatrician) or orthodontist would perform this part of treatment. Doctor or a dental specialty laboratory produces the master cast to fabricate the pre-surgical orthopaedic device.

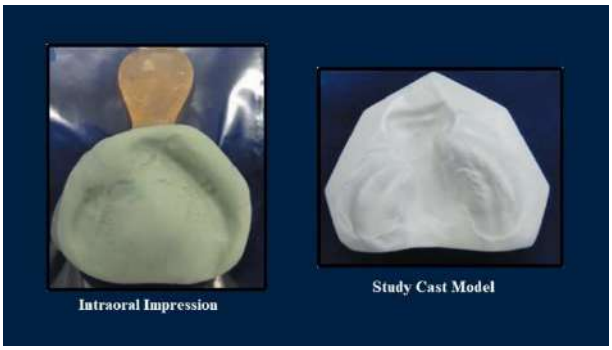

Figure 1: Impression and cast of the cleft patient

POC delivery is a rapid procedure should be done under general anaesthesia within age of 5 weeks.[15] The two channel locking pins affixes the two maxillary base which passes through acrylic material to palate for the intraosseous retention. When the POC device is inserted in the patient, the patient will send under keen observation of the doctor overnight and get discharged by following morning. Here, the outpatient surgery can be performed in the further procedure.[16]

UNILATERAL CLEFT LIP AND PALATE

Among all the UCLP cases, pre-maxillary part of larger segment mediopalatally brought by the mechanical forces and in many of the cases lesser segment is brought forward about 2 – 3 mm to come in contact with larger segment.[13]

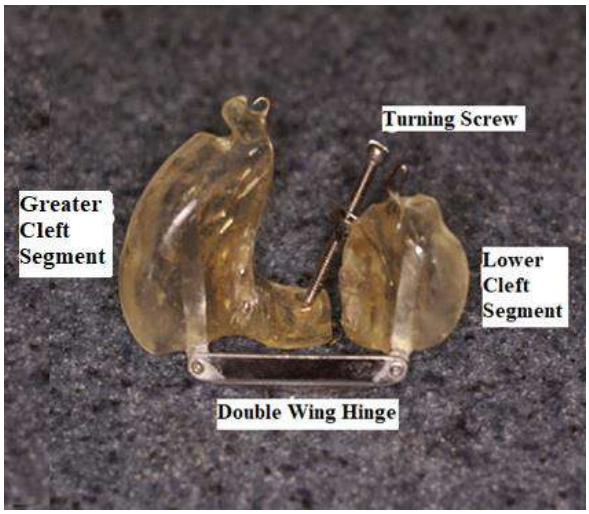

Figure 2: Dento maxillary advancement (DMA) appliance

Once the patient is sent back to the home after placing the DMA appliance (figure 2) it is instructed to their parents to activate screw by driving it to onehalf turn (i.e., 0.25mm distance) two times in a regular day in UCLP treatment. Alveolar alignment can be related to the activation rate, dimension of cleft as well as the measure of correction done (upto 14 mm).[16] Basically around 3 to 6 week time is taken for

cleft side to move forward w.r.t. alter side. [12] In the complete alignment time the patient is evaluated by the surgeon weekly until there is no possibility of screw turning. Elastomeric chain will be used in front of appliance if the remaining gap exceeds 2 – 3 mm between the segments. After insertion of the device 2 – 3 weeks resting period is recommended to achieve the ideal movement, the resting period helps to resolve the load residue that is strain which is generated because of applied active force that is stress.[16] The POC device is removed after three months under general anaesthesia and further reconstructive surgery can be performed by the surgeon.

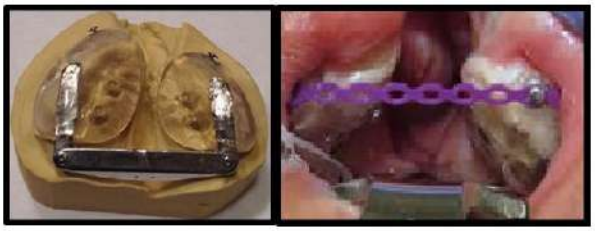

Figure 3: Modified Latham Appliance

Randy Feldman and Ernesto Ruas developed the Modified Latham Appliance (figure 3)in which they replaces the screw to an "orthodontic elastic power chain" in order to approx. cleft segments. Within 2 weeks lesser and greater alveolar (palatal) segments can be approximated. Furthermore the appliance is being updated in terms to spare the gingival tissue as well as to increase the performability of surgeon to execute a gingivoperiosteoplasty at removal of appliance. Modified latham appliance reduces the burden of treatment on parents and also decreases the quantity of time required for estimation of cleft segment.[17]

BILATERAL CLEFT LIP AND PALATE

In these cases, lateral palatal segments get expands mechanically by the use of the appliance. This permitted the following retraction of protrude premaxilla in the suitable position.[13]

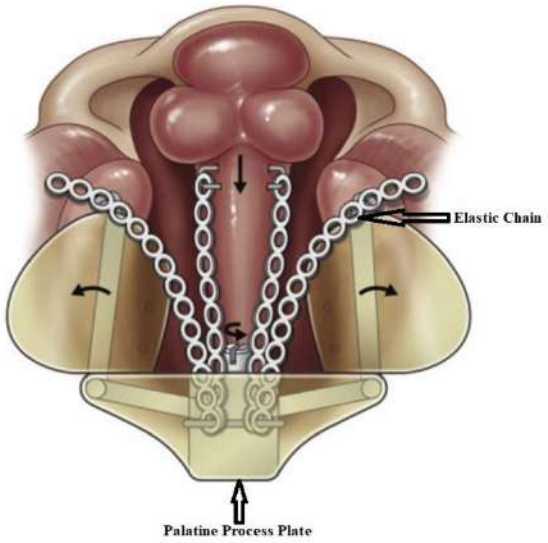

Figure 4: "ECPR (elastic chain premaxillary repositioning) appliance". Elastic chain generates activation force for retruding the pre maxilla in order to expanding lateral segment. Pre maxillary pins which are located ahead to the vomerine suture are pulled by the elastic chains.[24]

Staple is placed through septal premaxilla by the surgeon and connects that with chains that may proceed posteriorly undercross over the roller beneath the expansion drive box (figure 4). If there is a need of maxillary segment, instruct the parents to turn one-quarter twice a day or numerous onequarter turns in weekly done by surgeon. Forces produced by chains is about 57g (2oz) in 4 to 6 weeks, the required pre-maxillary allignment is to be achieved with this.

To correct the deviated septum, the wire islet is added to palatal margin which is opposite as well as adjacent to deviated vomer. The removal of the appliance is done under general anaesthesia, around 3 months of age to perform reconstructive surgery by the surgeons.[12]

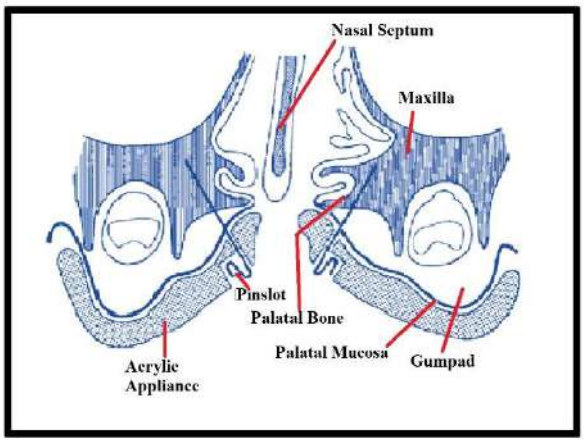

Figure 5: Latham appliance stabilization in maxilla by stainless steel pins

Two slots can positioned within the palatal planes, in both the acrylic plates. Into the palatal shelves, pins are inserted through these slots.[3] (figure 5).

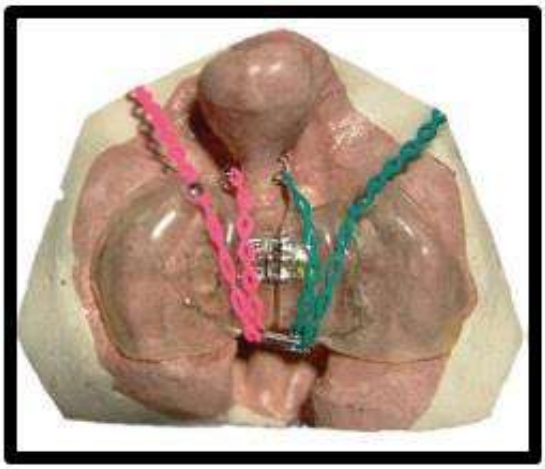

Figure 6: Modified latham device for bilateral cleft lip and palate patient

Modified latham's device, (figure 6) in which latham screw, replaced by an 8 mm expansion screw and in the anterior portion there are two buttons in the device. For orthopaedic treatment the modified device provides a low cost alternative.[18]

CONCLUSIONS

In a series of cleft patients, latham appliance was generally come up with favourable long term results, without harming facial skeletal growth. Effective in reducing a protruded premaxilla, alveolar ridges gets aligned, expands the maxillary segments, decreased fistula formation, minimal tension of soft tissues on the surgical closure. It is a valuable pre-surgical orthopaedic device for treating cleft cases. As there is always a scope for improvement, further study is needed to analyse the merits and demerits of this appliances.

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PROSTHETIC REHABILITATION OF A CHILD WITH SEVERE EARLY CHILDHOOD CARIES ASSOCIATED WITH LOSS OF VERTICAL DIMENSION

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Abstract
Early childhood caries (ECC) is a rapid type of dental caries, contributing to low self-esteem and the production of childhood mistrust due to teeth loss, gradually leading to malocclusion and psychological issues. It is always difficult to regenerate badly decayed primary teeth and due to the aggressive growth process of child, prosthetic appliance must not impede orofacial structural development. The esthetic and functional requirements needed should also be met. The present case study documents the therapeutic management of reversible partial prosthesis of patients suffering from extreme early childhood caries, in order to improve the social and physiological growth of the infant in order to improve the functionality of the stomatognathic system.
Key Words: Child, Denture, Oral Rehabilitation, S-ECC, Vertical Dimension.

INTRODUCTION

Early childhood caries (ECC) is recognized globally utmost common persistent condition in infants, which is exemplified as an issue of public health.[1] The sequence of ECC is functional, physical and esthetic degradation, which also leads to an effect on the overall welfare of children at an early age.[2] S-ECC at age 3-5 years represented as: 1≥carious, missing (due to caries) or restored surfaces in primary maxillary anterior teeth, or decayed, missing, and filled surfaces (DMFS) scores of ≥4 (3yr), ≥5 (4yr), or ≥6 (5yr).[3] S-ECC care requires premature extraction of teeth and comprehensive reconstruction of tooth structure, which is a complicated and costly procedure and also affects the well-being and standards of life, person, family and community influence of oral health. Child's dentition restoration with a complete or partial removable prosthetic denture is more complicated and time consuming than in adults.[4]

This article highlights the therapy preparation of a pediatric patient with S-ECC as well as the stabilization of the prosthesis, re-estabilizing the vertical dimension.

Case

A 5-year-old male patient has visited with the chief concern of multiple decayed teeth for 3 years, to the Department of Paediatric and Preventive Dentistry. In order to relieve the spontaneous nature of pain, medication was prescribed by the local dentist.

Clinical and radiographic examination revealed multiple decayed teeth with pulp exposure i.r.t 55, 73, 83 and 84. Proximal caries i.r.t 71, 72, 81, 82.

The coronal portion was grossly decayed i.r.t 52, 53, 54, 63, 64, 65, 74 and 75. Thus, a diagnosis of severe early childhood caries was made. (Figure 1 and 2)

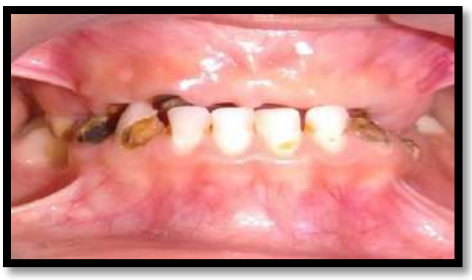

Figure 1: Pre-operative intraoral view

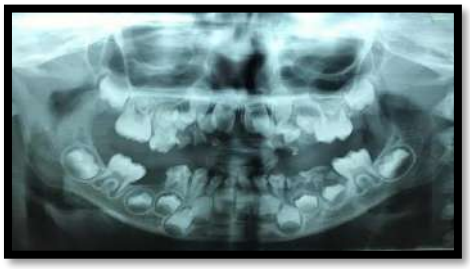

Figure 2: Pre-operative orthopantogram

Patient parent's was explained about the type, time and cost of entire treatment and consent was obtained. Emergency phase was not required.

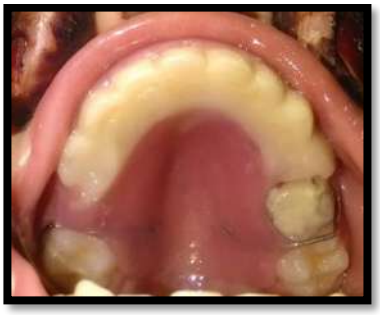

Figure 3: Removable partial denture i.r.t maxilla

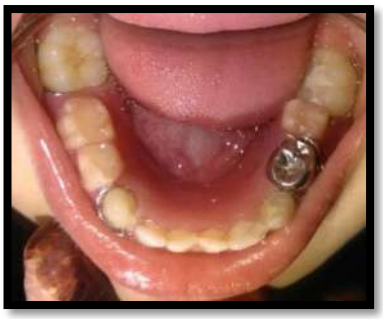

Figure 4: Removable partial denture i.r.t mandible

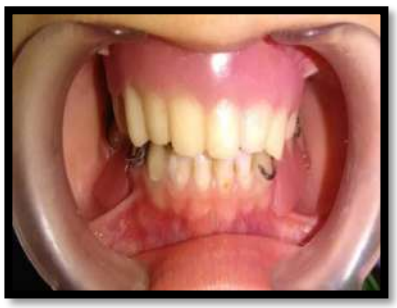

Figure 5: Post-operative view

Corrective procedures performed are as follows:

- Extraction of 52, 53, 54, 63, 64, 65, 74 and 75 was done after administrating local anesthesia.
- Proximal carious lesion of 71, 72, 81, 82 was restored with restorative glass ionomer cement.
- Lesion sterilization and tissue repair was performed i.r.t 55 followed by cementation of stainless steel crown using luting glass ionomer cement.
- Pulpectomy i.r.t 73 and 83 was carried out followed by metapex obturation.
- Formocresol pulpotomy was done i.r.t 84 followed by cementation of stainless steel crown using luting glass ionomer cement.
- Fabrication of removable partial denture i.r.t maxilla and mandible. First impression was recorded and cast was poured, then base plate is fabricated using self-cure acrylic resin. Ideal wax rim constructed. After inserting in mouth, lost vertical dimension was restored by adjusting height of rim. Then primary teeth were constructed using tooth color acrylic resin and also C-clasps were incorporated in dentures to provide extra retention. The removable partial denture was then finished and polished, tried and delivered to the patient. (Figure 3,4 and 5). Post-operative instructions were given to maintain oral hygiene and follow up was scheduled after every one month.

DISCUSSION

Other indication for removable partial denture in pediatric patient include loss of deciduous or permanent teeth either due to some genetic disease like ectodermal dysplasia, Papillon-Lefevre syndrome, amelogenesis imperfecta, dentinogenesis imperfecta etc or traumas.

Usually, three medical-biological indicators affected by these defects i.e., prophylaxis, function (speech and chewing) and esthetics. Generally, the diet of affected child is limited to soft foods, that influence the whole child's development. Missing teeth also lead to migration of adjacent teeth, loss of alveolar bone and inadequate occlusion.

Fabrication of removable partial denture in child must be design such that it allows alteration during further growth of maxilla or mandible bone or eruption of tooth. Therefore, child's prosthetic fabrication is multi-disciplinary approach.

CONCLUSION

Due to the continuous growth processes, usage of removable prosthesis in oral rehabilitation of young patients requires especial attention apparently.

As oral therapy, the quality of life for this child and his parent upgrade provides the children with improved aesthetic, diet, phonation, and functional condition.

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Nonsurgical Management of Gingival Enlargement in an Elderly patient with Cardiac disease: Case Report

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Abstract
In older individuals, antihypertensive drugs in the calcium channel blocker group are widely used. Amlodipine is a calcium channel blocker used in the treatment of hypertension and angina. Although amlodipine is considered as a safe drug, very rarely it may induce gingival overgrowth also. Here we present a case of amlodipine-induced gingival overgrowth in a 64-year-old male patient who had undergone cardiac surgery and was on medication. Complete resolution of the enlarged gingival mass was achieved without any invasive procedure.The treatment included Phase-1 therapy followed by supportive periodontal therapy resulting in good and acceptable clinical outcome.

Keywords: Cardiovascular ailment, anti-hypertensive treatment, drug induced gingival enlargement, nonsurgical therapy.

INTRODUCTION

A common trait of gingival disease is gingival enlargement or gingival overgrowth which characterized by an increased gingival size. Gingival overgrowth is predominantly an inflammatory reaction to the presence of plaque, which is modified by the presence of systemic disease or use of medicines. Sometimes genetic conditions though rare can cause overgrowth of gingiva without the presence of plaque. Use of immunosuppresing drugs, calcium channel blockers and some anti-convulsants can cause gingival enlargement and create problems in esthetics, mastication, eruption of teeth and speech in susceptible patients.[1]

In medical practice, use of calcium channel blockers is widespread in the management of CVS disorders. Gingival overgrowth is a recognized adverse effect associated with many these drugs. Dihydropyridines belonging to this large group of drugs are frequently implicated in the cause of enlargement.[2] of which amlodipine, used mainly for treatment of hypertension and angina, was the first of this class reported in 1994 by Seymour et al to be causative for enlargement.[3] This is a case report of a patient presenting with amlodipine-induced gingival overgrowth who had undergone cardiac surgery and was on medication. The treatment was carried out in the outpatient department with Phase-1 therapy followed by supportive periodontal therapy.

Case report:

A 64-year-old male patient reported to a Department of Periodontology in Uttar Pradesh with a chief complaint of swelling and redness with bleeding from the upper and lower front teeth regions since 3 months. No significant findings extra orally were noted. On thorough clinical intraoral examination, generalized gingival enlargement of marginal and interdental gingiva extending up to attached gingiva with diffuse erythematous bead like nodular growth was observed in the maxillary and right mandibular anterior teeth with poor oral hygiene maintenance (Figure 1). Gingiva in the affected area was fiery red and also bled on probing. Ortho-pantomogram revealed no significant changes except for a moderate generalized bone loss. The medical history revealed that the patient was hypertensive and had a cardiovascular disease for which he had undergone surgery 5 years back and was medicated with 5mg amlodipine since. The patient did not report any deleterious habits or drug allergies and his vital signs were normal.

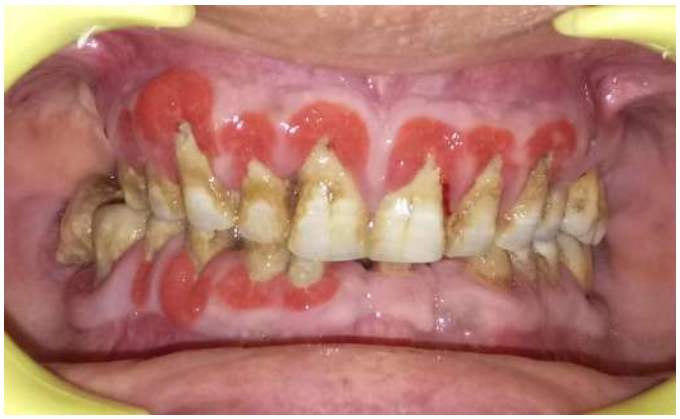

Figure 1: Pre-operative view showing gingival enlargement

Correlating medical history, the clinical presentation of gingival enlargement and a history of prolonged usage of

amlodipine, the case was diagnosed as combined gingival enlargement. In the preliminary phase, oral prophylaxis under local anesthesia was performed, followed by reinforced oral hygiene instructions and was prescribed with a twice daily mouthwash of 0.2% chlorohexidine. Follow up recall was after 21 days, 1 and 3 months. After 1 month, there was definite resolution of the gingival enlargement and marked improvement in the color and texture of the gingiva (Figure 2). Further scaling and root planing was done with reinforcement of oral hygiene instructions. After 3 months, complete resolution of enlargement was noted with an appreciable reduction of inflammation (Figure 3). Patient was satisfied and comfortable with the final outcome.

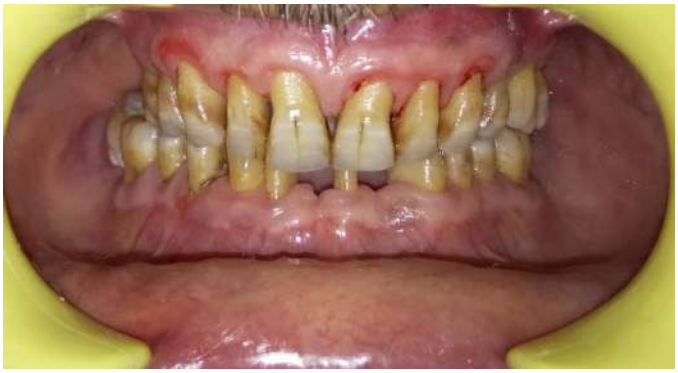

Figure 2: Post-operative view showing response to non-surgical periodontal therapy after 1 month.

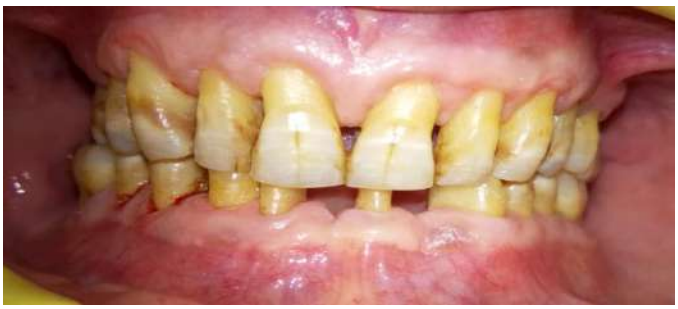

Figure 3: Post-operative view showing improved response to therapy after 3 months

Discussion:

Lederman in 1984 first described gingival overgrowth associated with calcium channel blockers in patients treated with nifedipine. The prevalence of gingival overgrowth due to the use of calcium channel blockers such as diltiazem, verapamil, amlodipine is reported as 74%, 21%, 3.3%, respectively.[4] Amlodipine is a 3rd generation dihydropyridine calcium channel blocker which is structurally similar to nifedipine and is of frequent use in the conservative management of hypertension and angina. The first reported gingival overgrowth due amlodipine was by Ellis et al. in 1993,[5]. Since then, very few reports regarding the prevalence of AAGE have appeared in studies as compared to other calcium channel blockers including nifedipine.[6] Clinical manifestations of AAGE usually happen within 1 to 3 months after start of treatment with a therapeutic dose of 10 mg/day and normally starts as interdental papilla enlargement mainly in the anterior segment of labial surface. Seymour et al[2] reviewed the pathophysiology of drug-induced gingival overgrowth and considered it to follow a multi-factorial model, with involvement of several factors, including the interaction between the drug and its metabolites with gingival fibroblasts.

The pathogenesis of the enlargement is undetermined, and the treatment for the same is limited to oral prophylaxis, reinforcement and maintenance of an adequate level of oral hygiene and surgical removal of the overgrown tissue.[7]Although, both inflammatory and non-inflammatory pathways are considered as the underlying mechanism behind drug-induced gingival enlargement, the non-inflammatory mechanisms are proposed to include defects in the collagenase activity due to reduced uptake of folic acid; increase in adrenocorticotropic feedback due to blockage of aldosterone synthesis in the adrenal cortex and enhancement of keratinocyte growth factor. An alternate hypothesis suggests that the inflammation may a direct result of the toxicity of the concentrated drug in GCF with or without the presence of bacteria. This inflammation could enhance several cytokines and signalling molecules i.e. transforming growth factor-β1.[8]

Various studies done on amlodipine suggest that effect of amlodipine on gingival hyperplasia is not appreciable at 5 mg/ day dose even when taken for more than 6 months but studies do indicate a dose of 10mg/day can be a cause of appreciable hyperplasia.[9] The present case was a unique presentation as hyperplasia occurred at a low dose of amlodipine i.e.5 mg/day and appeared after prolonged usage of 5 years. The mechanism by which these drugs act on the gingiva to induce enlargement is poorly understood but it has been suggested that phenytoin and calcium channel blockers may interfere with the intracellular Ca^{2+} uptake hence stimulating the gingival fibroblasts and causing increased collagen production. The percentage of patients developing enlargement is low even though receiving the same drug and dosage indicating that patient susceptibility to the drug may also be a probable reason.[8]

Conclusion:

In present case, no invasive surgery was performed considering the age and medical condition of the patient and was subjected to phase 1 and supportive periodontal therapy. Patient followed up after 1 month showed marked resolution of the gingival enlargement along with the inflammatory component of gingiva. Three months follow up showed a clinically appreciable healthy gingiva indicating a successful treatment outcome. Overall the patient was very happy and satisfied with the final outcome.

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CASE REPORT

UNCONVENTIONAL DENTURES FOR IMPROVED ESTHETICS AND RETENTION: A CASE REPORT

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Abstract: While determining the treatment plan of any dental procedure, the three factors that should be considered are phonation, mastication, esthetics. The prosthetic rehabilitation of any edentulous patient has been a major challenge in dentistry. The most frequent complaint of any denture wearer patient is poor retention of mandibular denture and esthetics. The aim of this case report is to define the need of esthetics, retention, and stability in edentulous patient. This case report focuses on benefits of tooth supported over denture and immediate denture rather than conventional denture. The hopeless teeth were extracted and immediately replaced by artificial teeth to replicate the vertical dimension, phonetic and esthetics of the existing natural teeth as part of an immediate denture.

Key word: esthetics, immediate denture, retention, tooth supported over denture

Introduction

In complete denture fabrication, esthetics and retention are the primary objectives. Immediate denture is a prosthesis that is fabricated to replace the lost dentition and associated immediately following the extraction of natural teeth.[1] In general, there are two types of immediate dentures- conventional immediate denture and interim immediate denture.

In conventional type, the prosthesis can be used as the definitive or long-term prosthesis. The interim type is used for a short time after tooth extraction. After the completion of healing period, the immediate denture may be relined or replaced with the newly fabricated final denture. It was reported that the immediate denture shows numerous advantages as preservation of facial appearance and vertical dimension, phonetics and reduction of post-extraction pain[2].

Tooth supported overdenture is a simple and cost effective treatment than implant supported over denture. It maintains the integrity of residual ridge because bone resorption starts after tooth extraction. Retaining natural teeth as abutments for dentures can considerably reduce the progress of residual ridge resorption. Multiple teeth/roots that are present in compromised dentition can be used as abutments for overdenture fabrication. Thus the stress concentration can be shared between the denture bearing areas and the abutments. These overdentures can reduce the impact of residual ridge resorption, loss of esthetics and compromised mastication. Overdenture also improves the retention and stability of denture[3].

Clinical report:

A 61-year-old male patient reported to the Department of Prosthodontics with chief complaint of difficulty in mastication and poor esthetics. On examination, it was revealed that the teeth 13,14,23,24,34,43 were present in the oral cavity. Patient presented with no significant medical history and no occlusal and temporomandibular disorders. Overall, clinical examination and radiographic assessment revealed an unrestored partially edentulous maxillary arch with generalized periodontitis and poor prognosis of the remaining dentition. Therefore, conventional immediate denture was planned for the maxillary arch.

In the mandibular arch patient had undergone extraction 5 years back with respect to the posterior teeth. Teeth present in the mandibular arch were 34 and 43. After thorough clinical and radiographic assessment it was decided to retain the canine and premolar for tooth supported overdenture. The patient accepted the treatment plan for an immediate maxillary denture and tooth supported mandibular

overdenture and signed the informed consent for the same.

Diagnostic impressions were made with irreversible hydrocolloid (Algitex, DPI) for both maxillary and mandibular arches. Intentional root canal treatment was done in relation to 34 and 43 (fig 1,2) followed by fabrication of metal copings for both the teeth (fig.3). The metal copings were cemented using glass ionomer cement (GC gold label)

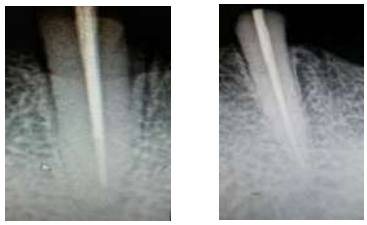

Fig.1,2 Radiographic picture of Root canal treatment irt 34.43

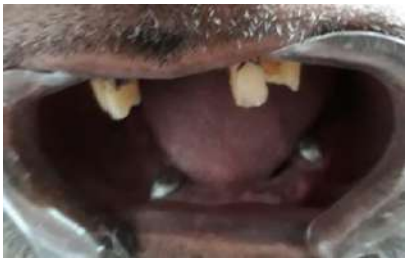

Fig 3 Pattern resin coping irt 34,43 & metal cast post & Placement of copings

Subsequently, primary impressions of both the arches were made with irreversible hydrocolloid (algitex, DPI). Border molding was done using low fusing impression compound in both the arches. For the maxillary arch final impressions were made with zinc oxide eugenol impression paste (DPI Impression Paste) using dual impression technique, while in mandibular arch it was made using light body polyvinylsiloxane impression material (fig 4).

Fig. 4 Final impression irt maxillary & mandibular

The impressions were poured with type 3 dental stone plaster (Denstone) to obtain the master cast. Impressions and master cast both were disinfected with 2% glutaraldehyde for 10 min. After that temporary denture base was made with auto polymerizing resin and occlusion rims were fabricated(fig.5).

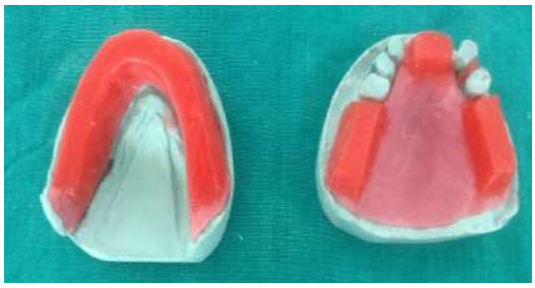

Fig. 5 Fabrication of Occlusal rim

Jaw relation was recorded and mounting of maxillary and mandibular cast was done on mean value articulator. Teeth arrangement was done followed by posterior try in. Then remaining natural teeth on the maxillary cast were scraped off and the denture base was extended over the anterior region followed by anterior teeth setting. The waxed up dentures were acrylised using heat cure polymerizing resin.

On the day of insertion remaining natural teeth in the maxillary arch were extracted and denture insertion was done with respect to maxillary and mandibular arches (fig.6). Both the dentures were evaluated for proper extension, retention, stability and occlusion. Necessary corrections were made

accordingly, and post-operative instructions were given to the patient and was recalled for follow up after 24 hrs.

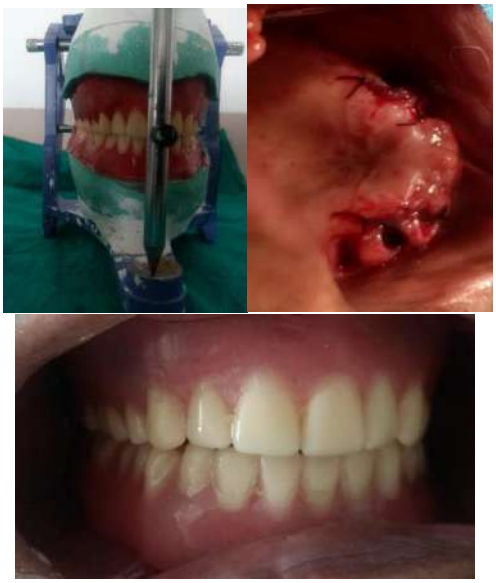

Fig.6 Teeth setting, extraction irt 12,13,22,23,24, immediate denture irt maxillary arch and tooth supported overdenture irt mandibular arch

Discussion:

There are three treatment modalities which are followed for fabrication of denture in patients with the loss of remaining natural teeth with poor prognosis. In First treatment modality patient has to undergo extraction of all the remaining teeth and after extraction has to wait for 7-8 weeks of healing period followed by fabrication of conventional denture. With this treatment modality patient is left not only during healing phase but also time required for the fabrication of complete denture. This may not be acceptable for socially active people. Second modality is to convert existing RPD to an interim complete denture which is not definite treatment for the patient. Third modality is to make an immediate complete denture.

The interim immediate denture is designed to enhance the esthetics, and function for a limited period of time after which it is replaced by definitive prosthesis. During the phase of teeth replacement, preservation of appearance is also important.[4]According to Todd and Lader, level of anxiety is increased when people face loss of their natural teeth and they have to rely on complete dentures.[1] Thus immediate denture is a better treatment option for patients who are socially active and face loss of remaining natural teeth. In the present case periodontically compromised teeth requiring extraction are present in the maxillary arch. As the patient was anxious about appearance an immediate interim denture was given, however it was planned to be replaced by definitive prosthesis after proper healing.

Tooth supported over denture is a more predictable treatment modality than a conventional prosthesis that can provide a better retention, stability, esthetics, and comfort. Basically it maintains the integrity of the residual ridge by retaining some of the natural teeth thereby maintaining proprioception. The remaining natural teeth further improves the retention and stability of the denture also. It can be used universally and provide psychological benefit for the patient because extraction can be avoided.

In the present case, patient was having a periodontically healthy canine on right and premolar on the left side in the mandibular arch. Hence it was planned to fabricate tooth supported overdenture for mandibular arch by using canine and premolar as abutments. However, patient should be motivated to maintain adequate oral hygiene because poor oral hygiene can lead to loss of abutment teeth. Regular follow up should be done to evaluate oral hygiene status[5].

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CASE REPORT

MANAGEMENT OF ANTERIOR DEEP BITE- A CASE REPORT

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Abstract:

Deep overbite is perhaps one of the most common malocclusion and the most difficult to treat successfully. Aetiology must be considered in detail to formulate a comprehensive diagnosis and treatment plan for each patient so that optimal skeletal, dental, and aesthetic results can be attained. The choice of treatment is based in part on the etiology of deep bite, the amount of growth anticipated, the vertical dimension, relationship of the teeth with the adjoining soft tissue structures, and the desired position of the occlusal plane. An adult who has more than 6 mm overbite or 8 mm of overjet could be considered a candidate for surgery solely on the basis of dental relationships, without even considering facial esthetics but in following case report we could deal very efficiently a similar kind of discrepancy solely by orthodontic treatment.

Introduction:

Deep overbite is perhaps one of the most common malocclusion and the most difficult to treat successfully. The amount of incisor overlap varies greatly and is primarily a manifestation of dental malocclusion. Understanding the concept of overbite is imperative to any discussion of deep-bite malocclusion. In 1950, Strang defined overbite as "the overlapping of the upper anterior teeth over the lowers in the vertical plane." However, the crown length of the upper and lower incisors varies significantly in individuals, therefore redefined overbite as "the amount *and percentage* of overlap of the lower incisors by the upper incisors."

The ideal overbite in a normal occlusion may range from 2 to 4 mm, or more appropriately, 5% to 25% (overlap of mandibular incisors by maxillary incisors) (Fig. 1). According to Nanda, a range of 25% to 40% without associated functional problems during various movements of the Temporomandibular joint (TMJ) may be considered "normal." However, overlap greater than 40% should be considered "excessive" (deep bite) because of the potential for deleterious effects on the overall health of the surrounding periodontal structures and the TMJ.[1-4]

A case report of management of severe deep bite, and decreased overjet for a Class I malocclusion patient using reverse curve of spee arch wire is discussed in this article

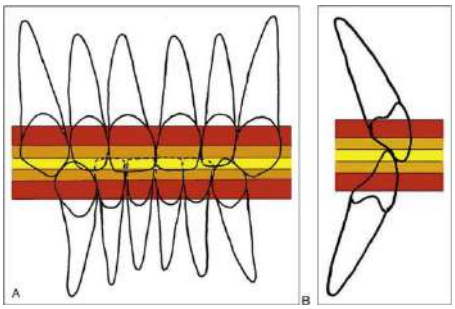


Figure 1. Zones of overbite. From 5% to 25% is normal *(yellow)*, 25% to 40% is increased overbite *(orange)*, and greater than 40% is excessive (deep) overbite *(red)*. **A**- Frontal view, **B**- Lateral view.

Etiology:

A skeletal or dental overbite is caused by genetic or environmental factors, or a combination of both. *Skeletal* deep bites usually have a horizontal growth pattern and are characterized by;

(1) Growth discrepancy of the maxillary and mandibular jawbones,

(2) Convergent rotation of the jaw bases,

(3) Deficient mandibular ramus height,

(4) Intrinsic and extrinsic growth rotation of the mandible.

In these patients the anterior facial height is often short, particularly the lower facial third. On the other hand, *dental* deep bites show supraocclusion (over eruption) of the incisors, infraocclusion (under eruption) of the molars, or a combination. Other factors that can affect deep bite are alterations in tooth morphology, premature loss of permanent teeth resulting in lingual collapse of the maxillary or mandibular anterior teeth, mesio-distal width of anterior teeth, and natural, age-related deepening of the bite.[3,5]

Deep bites that are primarily caused by environmental factors can also be classified as *acquired* deep bites. It is well known that a dynamic equilibrium exists between the structures around the teeth (tongue; buccinators, mentalis, and orbicularis oris muscles) and the occlusal forces, which assist in the balanced development and maintenance of the occlusion.[6] Any environmental condition that disrupts this dynamic harmony can lead to a malocclusion, such as the following:

- A lateral tongue thrust or abnormal tongue posture causing infra occlusion of the posterior teeth
- Wearing away of the occlusal surface or tooth abrasion
- Anterior tipping of the posterior teeth into extraction sites

Deep-bite aetiology must be considered in detail to formulate a comprehensive diagnosis and treatment plan for each patient so that optimal skeletal, dental, and aesthetic results can be attained.

Diagnosis:

A 26 years old male patient sought treatment for deep bite. He had no significant medical history. He had undergone root canal treatment in relation to 46 four years back. He had a slight convex profile and competent lip with 1 mm overjet and 6 mm overbite. Maxillary incisors were severely retroclined and rotation in relation to 11 and 12. He had two peg laterals in relation to upper arch. Mandibular left central incisor was periodontally compromised.Occlusal features revealed U shaped maxillary and mandibular arch. The lower midline was coinciding with respect to the upper midline. He had pit and fissure caries in relation to 36, 37 and 47 along with mandibular anterior crowding. (Fig.2).Temporomandibular joint (TMJ) assessment revealed no history of pain or clicking on maximum opening and closure. The right and left excursive movements were normal, oral hygiene status average with maximum mouth opening of 39 mm.

OPG and cephalometric analysis

The panoramic radiograph showed that all teeth were present and 46 was root canal treated along with prosthesis (crown). It also revealed optimum bone support for orthodontic mechanotherapy (Fig2). TMJ space revealed normal size, shape and position of the condylar heads.

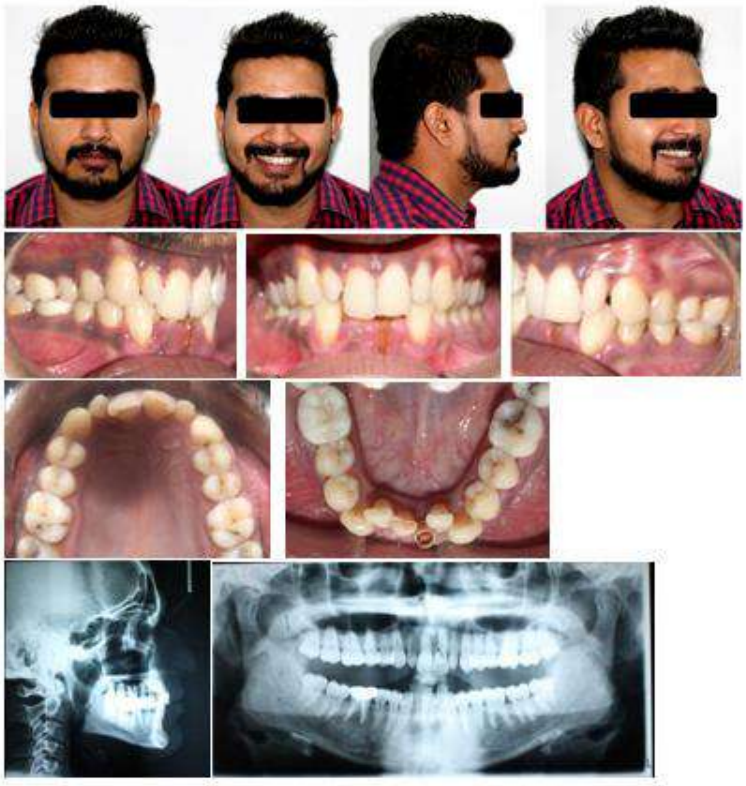


Figure 2.Pretreatment Records

Cephalometric analysis showed a Class I skeletal pattern with low mandibular plane angle. The maxillary incisors and NA were 1 mm and 16° and mandibular incisors and NB were 2 mm and 14°(Table 1). Based on these findings, the patient was diagnosed with Angle's Class I malocclusion with Deep bite.

Treatment objectives and treatment plan:

The treatment objectives were to create a satisfactory occlusion with correction of deep bite, and alignment of maxillary and mandibular teeth. Correction of axial inclination of maxillary and mandibular anteriors with intrusion of the maxillary and mandibular anterior teeth to reduce deep bite.In this case reverse curve of spee arch-wirewas used in mandibular arch and excessive spee in maxillary arch for correction of deep bite. Using arch wires to level the curve of Spee (excessive in the maxillary arch and reverse in the mandibular arch), regardless of the type of alloy, will promote extrusion of posterior teeth, especially of premolars, followed by pseudo-intrusion of incisors (more buccal tipping than pure intrusion) (Fig. 3).[7]

Mandibular left central incisor was extracted for aligning the mandibular anteriors. Extraction of mandibular central incisor decided because it was periodontally compromised.

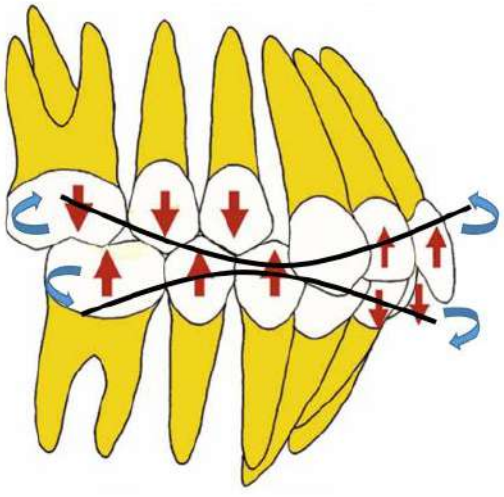


Figure 3.Mechanical effects of arches used to manipulate the curve of Spee.

	NORM	PRE TREATMENT	POST TREATMENT
SNA	**82°**	**82°**	**82°**
SNB	**80°**	**81°**	**80°**
ANB	**2°**	**1°**	**2°**
MPA	**32°**	**25°**	**26°**
1/NA	**22°**	**16°**	**21°**
1-NA	**4.0mm**	**1 mm**	**4.0mm**
1/NB	**25°**	**14°**	**15°**
1-NB	**4.0mm**	**2 mm**	**2.0mm**
IMPA	**90°**	**80°**	**95°**
1/1	**131°**	**144°**	**128°**

Table 1: Cephalometric Readings of Patient's Lateral Cephalograms tracing.

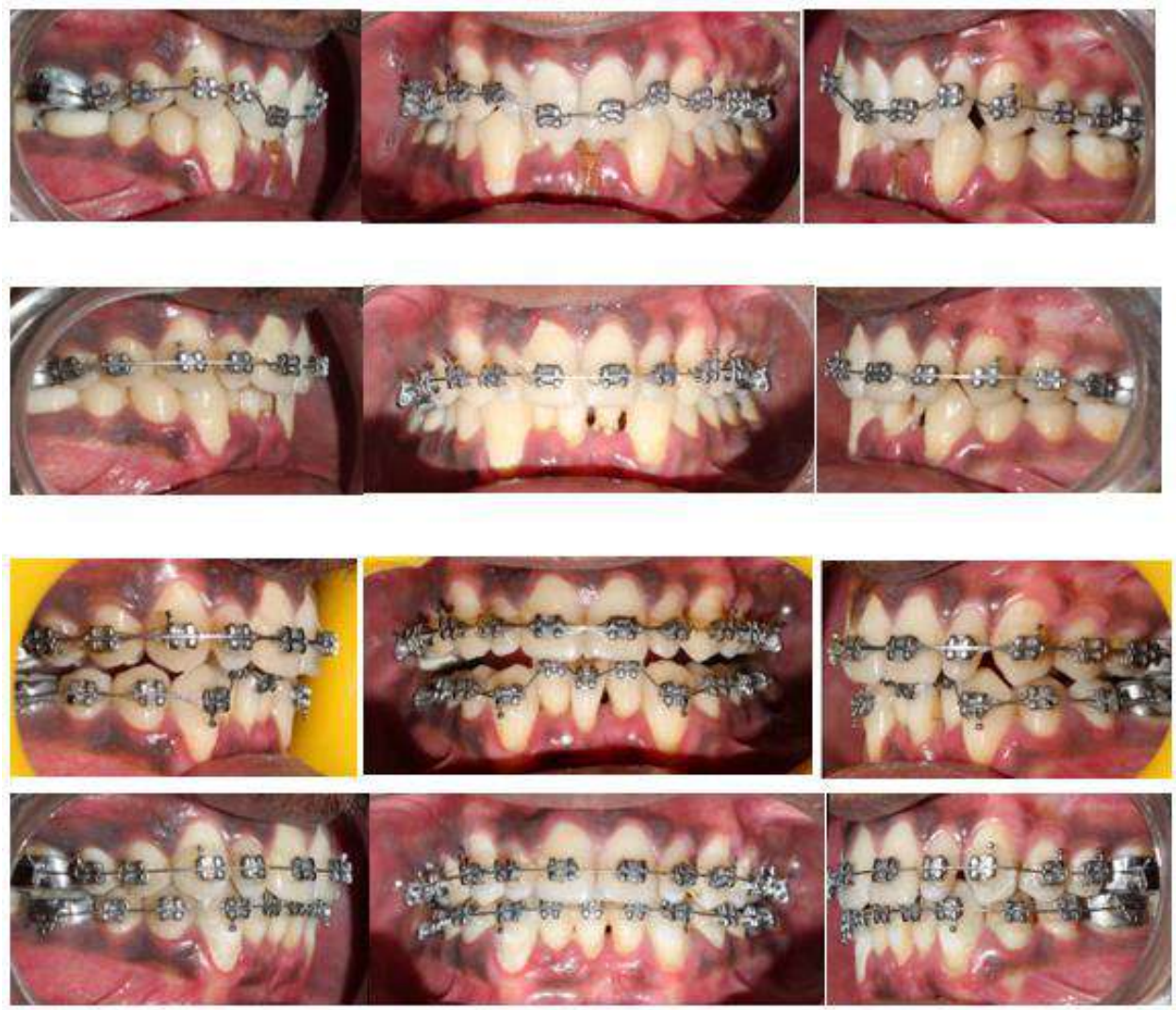
Treatment progress: (Fig. 4)

Orthodontic treatment began in March 2017 and lasted for 13 months. Preadjusted 0.022" MBT brackets (3M Unitek) were bonded to all teeth. As the treatment progressed, the left mandibular central incisor was removed as its prognosis was poor. With sequential nickel-titanium arch-wires, alignment and levelling in upper arch were achieved in 2 months. Excessive spee incorporated in 0.016 X 0.022" rectangular stainless steel wire to correct the overbite. Lower arch was bonded subsequently after five months when bite was opened.Initially 0.012" and 0.014" Ni-Ti wire placed followed by 0.016" reverse curve of spee wire used for correction of spee in lower arch with an intention to cause intrusion of anterior and extrusion of premolars. Class I molar relation wasmaintained on both sides and class I canine relation achieved bilaterally. Upper dental midline coincided with the long axis of right mandibular central incisor.

After 13 months of active treatment, class I molar relationship, ideal overjet and overbite with pleasing soft tissue profile was achieved (Figure 5). Following this, debonding was done and post treatment records were taken. Fixed bonded lingual retainer given in upper and lower arch for retention.

Result:

The post treatment extraoral photographs showed marked improvement of the facial profile, and the patient's smile improved. Maxillary anterior teeth retrusion were corrected, and a Class I molar relationship was maintained. The overjet and overbite were corrected. Mandibular plane angle had increased from 25° to 26°. The upper incisors to NA had increased from 16° to 21°. IMPA had increased from 80° to 95° (Table 1). The movement of the



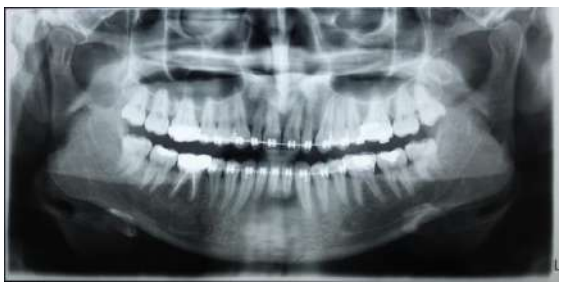


Figure 4. Mid Treatment Records

Maxillary incisors contributed to correction of the soft tissue profile. He was not willing for composite build-up of peg laterals (Fig. 5). The gap present between the canine and premolar area was due to deficient interdental col.

Discussion:

Deep overbite can be corrected by many ways like intrusion of anteriors, extrusion of posteriors and/or combination. However, it should be decided which method will be more beneficial or which will improve the patients facial appearance and functional efficacy.[6]

The choice of treatment is based in part on the etiology of deep bite, the amount of growth anticipated, the vertical dimension, relationship of the teeth with the adjoining soft tissue structures, and the desired position of the occlusal plane.

Intrusion of incisors is difficult. Deep overbite correction by intrusion of anterior teeth offers a number of advantages including simplifying control of the vertical dimension, and prevents downwards rotation of mandible to aid in Class II correction.[10]

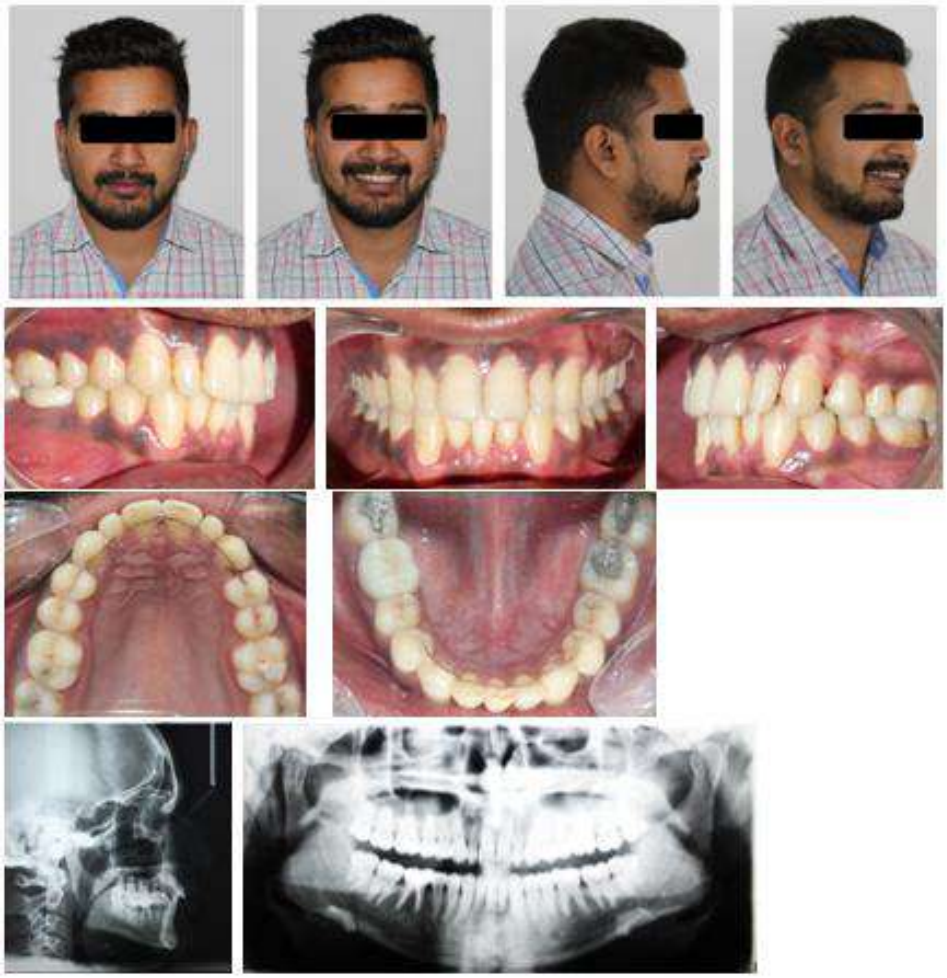


Figure 5. Post Treatment Records

In this case intrusion of upper and lower anteriors were more in comparison to extrusion of premolars which helped in correction of deep bite. Lower left central incisor (periodontally compromised) was extracted to align the lower arch and upper peglaterals compensate the tooth material discrepancy in Bolton analysis.

An adult who has more than 6 mm overbite or 8 mm of overjet could be considered a candidate for surgery solely on the basis of dental relationships, without even considering facial esthetics[8, 9] but in our case we could deal very efficiently a similar kind of discrepancy solely by orthodontic treatment .

Kokich and Shapiro (1984), the deliberate extraction of a lower incisor in certain cases allows the orthodontist to improve occlusion and dental aesthetics with a minimum of orthodontic action.[11]

Declaration of patient consent

The author certifies that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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