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ORIGINAL RESEARCH ARTICLE

THE INFLUENCE OF LOCAL FACTORS ON EARLY DENTAL IMPLANT FAILURE - FIVE YEAR RETROSPECTIVE STUDY

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ABSTRACT

Background: In the last decade, dental implant treatment is becoming more popular in middle East countries. The reasonable cost of dental implants, a wide range of dental implant products, and the competitiveness of private dental centers have played a role in this positive attitude toward dental implant treatment. This resulted in a relatively high turnover of dental implant patients in the private dental sector. More data are now becoming available to study different aspects of dental implant treatment in both governmental and private sectors. One of the important areas of dental implant research is the study of dental implant failure (DIF).

Objective: To identify local factors, which might contribute to early dental implant failure

Materials and methods: Information from 196 Iraqi patients who attended Basamat Private Dental Center in Baghdad from 7.1.2016 to 30.4.2020 were recorded. Biographic and clinical data were reviewed. The judgment on early failure is based on implant mobility at the second-step surgery or the prosthetic part delivery visit.

Results: The highest level of failure is noticed in immediate implant cases. Out of 67 cases in the upper anterior region. It was not statistically significant, though (p= 0.052). Chi-Square Test, also, did not show a statistically significant relationship between early dental implant failure and the dental implant zone (p=0.369 respectively).

Conclusion: It appears that there is no stand-alone local factor that causes early implant failure. Human error could be considered a contributing factor. More technically challenging cases increase the likelihood of early dental implant failure.

Keywords: dental implant, dental implant failure, early dental implant failure, local factors.

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INTRODUCTION

As dental implant treatment gained popularity, several studies were published regarding the possible contributing factors for dental implant failures. Dental implant failure can be early or late. Generally, failure of osseointegration, which is discovered at the second stage surgery is considered an early failure. The reported causes are It Implant placement in an infected socket, pathological lesion, or immature bone previously augmented contaminated implant, or infection [1].

In the last decade, dental implant treatment is becoming more popular in middle East countries [2-4]. The reasonable cost of dental implants, a wide range of dental implant products, and the competitiveness of private dental centers have played a role in this positive attitude toward dental implant treatment. This resulted in a relatively high turnover of dental implant patients in the private dental sector.

This means that more data are now becoming available to study different aspects of dental implant treatment in both governmental and private sectors. One of the important areas of dental implant research is the study of dental implant failure (DIF). This study aims to identify the local factors more likely to contribute to early dental implant failure.

MATERIALS AND METHODS

The study was approved by the Scientific Committee, Ibn Sina University of Medical and Pharmaceutical Sciences 2021. Information from 196 Iraqi patients who attended Basamat Private Dental Center in Baghdad from 7.1.2016 to 30.4.2020 was recorded. During this period 348 dental implant procedures were completed.

The dental implant procedures were performed by the same surgeon (FA). The following protocol was adopted for the treatment; following history taking a thorough extra and intraoral examination was carried out. Digital OPG and/or intraoral digital periapical views were examined and analyzed for the implant site. The dental implants were inserted under local anesthesia (LA). All implants were placed using flapless surgery. Preoperative Chlorhexidine mouth wash was given after LA administration and before the actual surgery. The patients were asked to keep the chlorhexidine inside their mouth for 2 minutes. No antibiotics were prescribed for all the dental implant procedures. Postoperative Ibuprofen 200 mg tablets were prescribed for pain relief. Patients were advised to continue Chlorhexidine mouth wash for at least one week to ensure uneventful wound closure of the dental implant site.

Biographic and clinical data were reviewed. The relevant information was recorded in an Excel sheet. The recorded data included: patient age, gender, implant site (missing tooth), the timing of implant insertion (immediate or delayed implant); implant side, dental implant system, implant length, and implant diameter, and whether sinus lift and/or bone augmentation was performed. The judgment on early failure is based on implant mobility at the second step surgery or the prosthetic part delivery visit.

Inclusion criteria: patients whose data are available and finished their treatment.

Exclusion criteria: diabetic patients, smokers, patients with uncontrolled hypertensive or TMD (which might influence the treatment outcome), patients with incomplete data, and patients who did not finish their treatment.

Six dental implant systems were used for the included patients. These were: IBS® (no=274, 73%), Dentaurum® (no=36, 10.3%), ImplantKa® (no=33, 9.5%), DeTech® (no=19, 5.5%), Easy Implant® (no=5, 1.4%), and NeoBiotech® (no=1, 0.3%).

For the aim of statistical analysis patients' age has been stratified into the following age categories; age group 1:17-30, age group 2:31-40, age group 3: 41-50, age group 4: 51-60, age group 5: 61-70, age group 6: 71 and above.

Both descriptive and inferential statistics were applied in this study. Pearson Correlation, Chi-Square, and One-way ANOVA tests were used to identify the correlations between continuous, categorical, and interval variables. The level of significance was considered at $P<0.05$. SPSS Ver. 25 was used to perform the statistical analysis.

RESULTS

Out of 347 dental implant cases included in this study, 324 (93.1%) cases were completed success-

fully. Twenty-four (6.9%) dental implant cases failed early and they were removed at the second visit or the delivery visit.

The male to female ratio was about 1:2. Sixty-six males were treated with 127 dental implants (mean age 48.80±12.70), whereas 127 females (mean age 45.54±12.10) were treated with 221 dental implants. The Chi-Square test did not show a statistically significant (p=0.276) relationship between a patient's gender and dental implant failure (Table 1).

As shown in Figure 1, the highest percentage of dental implants were reported in the upper posterior zone, followed by the lower posterior zone. The lest percentage was reported in the anterior zone. Table 1 provides the percentage of failure in each zone. The highest percentage of failure was reported in the upper anterior zone, followed by the lower posterior zone. No cases of failure were reported in the lower anterior zone. However, Chi-Square Test did not show a statistically significant relationship between early dental implant failure and the dental implant zone (p=0.369). Out of 67 cases in the upper anterior region, 14 cases (20.9%) were treated with immediate implant and bone augmentation.

Seventy-eight patients (39.7%) (31 males, and 43 females) were treated with more than one dental implant. The total number was 237 implants. 139 (58.6%), dental implants were used for female patients, whereas 98 (41.4%) dental implants were used for male patients. Chi-Square Test did not show a significant relationship between single vs multiple implant treatment and early dental implant failures.

The mean dental implant length for failed cases was 9.7 mm, whereas the mean dental implant diameter was 4.1 mm. Out of 56 cases of short implants (≤8 mm), 4 cases had an early failure. However, neither dental implant length nor dental implant diameter was found statistically related to early dental implant failure (p=0.388 and 0.976 respectively).

Immediate dental implants were performed for 62 cases (Table 1), 15 (24.2%) were performed for males, and 47 (75.8%) for female patients. The mean age range for immediate implants was 43.37 ±12.44). immediate implants were used mainly to replace upper posterior teeth (no=24, 38.7%) followed by lower posterior teeth (no=21, 33.9%). Chi-Square Test did not show a statistically significant relationship between early dental implant failure and the timing of dental implant, (p= 0.052).

Bone augmentations were used for 41 cases (mean age=45.15±11.936), whereas sinus lift procedures were performed for 17 cases (mean age=45.9± 10.395). The percentage of failures for bone aug-

Variable	Frequency of early failure cases	P-value
males	4.7	0.276
females	8.1	
upper anterior	10.4	0.369
upper posterior	5.6	
lower anterior	0	
lower posterior	7.6	
right side	8.3	0.399
left side	5.6	
17-30 age category	7	0.442
31-40 age category	4.4	
41-50 age category	10.4	
51-60 age category	7	
61-70 age category	0	
71- age category	0	
immediate implant	12.9	0.052
sinus lift	0	0.25
bone augmentation	7.3	1

Table 1: the study variables and their percentages of early implant failure

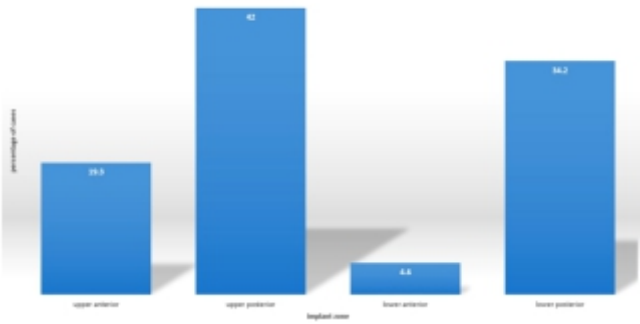

Figure 1:
Percentage of cases for each dental arch zone

mentation and sinus lift is shown in Table 1. Chi-Square Test did not show a statistically significant relationship (p=1) between bone augmentation and implant failure. No cases of sinus lift were reported with early dental implant failure.

Table 1 summarizes the percentages of early failure cases for each of the study variables. The highest percentage of failure is noticed in immediate implant cases, followed by the upper anterior region and female patients. The male patient showed the lowest percentage.

DISCUSSION

The main focus of this study is to determine the most likely local factor, which could contribute to early DIF. Patients with systemic diseases, especially diabetic patients were excluded in this study.

As far as dental implant zones are concerned, there is a consensus that posterior teeth loss in both upper and lower arches is more common than anterior teeth loss[5, 6]. This could influence the distribution of dental implants. The difference between upper and lower dental implant cases in this study is comparable to Negri et al study[7]. The highest number of the upper posterior implant in this study (almost a third of the cases), can be justified by the number of implants performed for the upper premolar region. Most of which have been requested by female patients 67 cases (67%) for aesthetic purposes.

Dental implant length was not found to contribute to early dental implant failure. There is no general consensus about the influence of dental implant length, nor diameter on the early DIM. [8-12]

Early dental implant failure, as reported in this study, was not found to be influenced by the dental arch factor. There is a controversy in the literature regarding the dental arch influence on dental implant outcome[13-15]. It has been acknowledged that the dental arches by themselves do not seem to represent a risk factor[5, 6,] unless related to other variables.

Many patients seek dental implant treatment for the posterior mandibular region after a long period of extraction, which significantly jeopardizes the regional bone height and width[7]. The presence of the inferior alveolar dental canal and the lingual concavity increase the surgical challenge during implant insertion. Such limitations necessitate the use of shorter and, subsequently, wider implants. This adds to the surgical challenges of these cases due to the need for bone augmentation.

Despite it was not statistically significant, the highest percentage of DIF was recorded in immediate dental implant cases. This might explain why females, compared to males, reported a higher number of failures (Table 1). Females had more cases of immediate implants. Besides, many cases of the immediate implant in the upper anterior zone required bone augmentation. This could add to the surgical challenge in these cases. There are published studies that acknowledged the fact that bone augmentation could be a risk factor for implant failure[11,15].

As mentioned earlier, inferential statistics in this study did not identify a single factor with an obvious influence on early dental implant failure. It seems that stand-alone local factors do not significantly contribute to the outcome of the dental implant. This has been acknowledged by other studies [7,16].

It has been suggested that disagreement between different studies on DIF could be related to differences in the selected samples, samples' size, different surgical protocols[13, 17-19], different follow-up periods [20, 21], or unidentified immune-inflammatory host factors[7].

The present study, however, could suggest that absence of a single most likely contributing factor is one of the reasons for this disagreement. There is a possibility that more than one factor at the time might act as the cause of failure. Failure of these studies to consider the human error alone or in conjunction with other factor could be another reason. It seems that early dental implant factor is a multifactorial. It also implements that human error should be considered.

This study, unlike other studies, analyzed cases performed by a single surgeon in a single private center. Other studies either involved multiple centers or more than one implantologist. This might neutralize the influence of the human factor. The authors believe that anatomical and surgical challenges in cases of immediate implants (in both aesthetic and posterior mandibular zones) could increase the chance of human error. The more challenging the

implant procedure, the more possibility of error in decision making and/or procedure execution.

Not many studies acknowledged the human factor as one of the reasons for dental implant treatment outcome[22]. It has been stated, however, that surgical skills, and/or judgment[16,23,24] could influence implant success. Both surgical skill and experience might help the surgeon to take into account individual case characteristics. Each surgical case has its technical and surgical challenges. This needs to be considered in future studies on dental implant failures.

The main limitation of this study it is a retrospective study. Retrospective studies do not allow the researcher to have the full required information for each case. This could cost the study a significant number of valuable data.

CONCLUSION

It appears that there is no stand-alone local factor that causes early implant failure. Human error could be considered a contributing factor. More technically challenging cases increase the likelihood of early dental implant failure.

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REVIEW ARTICLE

STRATEGIES FOR OPTIMIZING INTERIM INFECTION PREVENTION IN PEDIATRIC DENTAL PRACTICE DURING THE COVID-19 RESPONSE

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ABSTRACT

COVID-19 viral transmission via dental procedures warrant the need to execute certain specific protocols to be strictly followed to reduce the risk and spread of the infection. This narrative compte rendu scrutinizes and suggests the modification in patient management, clinical practice, introduction of devices during the COVID-19 pandemic and the road ahead with reference to pediatric dentistry.

Keywords : COVID-19 , children , infection control, pediatric dentists.

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INTRODUCTION

Coronaviruses (CoVs) are members of the large family of Coronaviridae. These single chain RNA viruses range from 60-140 nanometres with projections resembling spikes on its surface.[1] These spike (S) protein attaches to angiotensin converting enzyme 2 (ACE2) receptors that is found on the surface of many human cells, including those in the lungs allowing virus entry[2] and causes respiratory illness in humans. Some of the lethal Coronaviridae are - Severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV).[1]

In December 2019, a new variant of coronavirus that causes pneumonia was first detected in Wuhan, China. Initially, it was called as 2019 novel coronavirus (2019-nCoV). It was referred by the International committee on taxonomy of viruses as SARS-CoV-2. And the official name of the disease spread by this virus as COVID-19 as declared by WHO.[3] This rapidly spreading viral disease, designated as a pandemic was declared as a Public Health Emergency of International Concern (PPHEIC) has globally affected more than 194 countries (WHO, 2020).[2-5] With incredibly high morbidities and mortalities worldwide.[6] Despite worldwide efforts to contain viral spread, the outbreak has not been stopped yet.[3] The COVID-19 pandemic has had a noteworthy impact on dentistry.

Routes of transmission

The controversy on the modes of transmission of the SARS-CoV-2 virus seems to be speculating and perplexed among many researchers, including the WHO.[6]

This virus has been detected in respiratory, GI and other bodily secretions and also in air samples suggestive of chances of airborne transmission.[7]

The common route of transmission of this novel corona virus via close person-to-person contact (about 2 m) include direct transmission through coughing, sneezing, talking and droplet inhalation/exhalation and contact transmission via oral, nasal and conjunctival mucous membranes to people who do not have adequate barriers.[4,6] Airborne transfer through aerosols produced in dental procedures is another probable route of transmission of this virus.[4]

Another route of transmission occurs indirectly when saliva droplets fall on other surfaces, such as the ground and objects made of different materials, and people come into contact with them.[8] There are three pathways for COVID-19 spread via saliva - from COVID-19 in the lower and upper respiratory tract that enters the oral cavity together with the liquid droplets frequently exchanged by these organs, COVID-19 present in blood can access the mouth via the gcf, and lastly, via the major or minor salivary gland infection with subsequent release of particles in saliva through the salivary ducts.[3]

Direct physical touch between an infected individual and susceptible host and indirect contact with infectious secretions on fomites can cause the contact transmission.[6]

There is also a concern of faecal-oral route of transmission of COVID-19. Xu et al [9] found that majority of children with SARS-CoV-2 had persistently positive rectal swabs even after their nasopharyngeal tests were negative.

Prevention of COVID-19 among children

It is the responsibility of parents or caretakers to take the necessary precautions to prevent the disease in children. The CDC has put forth certain recommendations for prevention, which include:

1. Monitoring activities of children at home, school and outside.
2. Limit large group activities
3. Keep distance during play and interaction
4. At home and school, keep the surfaces and objects sanitized
5. Discourage group travels and outings
6. Hand hygiene must be taught to children and monitored periodically[1.]

Clinical features of children with COVID 19

SARS-CoV-2 has a long incubation period of 2-14

days.[5] The average incubation period in children is 8 days which is longer than that of adults.[4] The explanation why COVID- 19 is less severe in children as compared to adults is still confusing. Proposed elucidations include:

1. Children have a more active innate immune response
2. Healthier respiratory tracts as they have not been exposed to as much cigarette smoke or air pollution as adults
3. Fewer underlying diseases
4. Weaker ability to trigger an acute inflammatory response to SARS-CoV-2.[3] Markers of pro inflammatory response like C- reactive protein is uncommon in children which is suggestive of reduced inflammatory response to infections in children.
5. Reduced expression of Angiotensin Converting Enzyme-2 (ACE-2) receptor which is necessary for the virus to secure.[1]

The most prevalent symptoms are fever, dry cough, nasal symptoms, fatigue upper respiratory tract infection GI symptoms like anorexia, diarrhoea, nausea/vomiting. The nasal symptoms are runny nose and nasal congestion. However, symptoms of loss of smell are usually not present. It rarely progresses to lower respiratory tract infections. Other symptoms like hyposmia and dysgeusia have also been reported. With emerging cases of COVID-19 in children, a recent trend of Kawasaki like disease also called as Multisystem Inflammatory Syndrome (MIS-C) has been noted. It usually manifests itself 3-4 weeks after the child recovers from SARS-CoV-2 infection and develops antibodies against the virus1.

Overall, the prognosis of COVID-19 is good in children and mortality rate is lower than in adults; of 0.01%.[1,7]

Risk of Infection in apediatric dental setting

Dental procedures are focal points for cross infection[5] - because of aerosol production, handling of sharp instruments and close proximity of the patient while carrying out dental treatments. A DHCP is categorised in very high exposure risk category as reported by OSHA as in a dental setting, there is risk of contamination via numerous sources - bioaerosols, splatter, droplets, salivary secretions, debris and blood. These could be sources of dissemination of acute respiratory infections. A salivary gland could be a major source of the community based viral transmission of COVID-19 by asymptomatic infections originating from infected saliva. Splatter comprises of a mixture of air, water, solids coupled with bacteria, virus, fungi posing as a biological risk to the dental health personnel.[11] Bioaerosols are suspension of biological fragments in gaseous media which possibly is produced by powered dental instruments.[7]

Since children can be asymptomatic or present with mild/ moderate non-specific symptoms, all child patients and their guardians should be considered as potentially infected and thus carriers of COVID-19 unless contrary is proved.[3,5] Additionally, dental offices have a greater number of potentially infected/ contaminated surfaces - dental chairs, spittoon, handles, dental instruments etc. SARS-CoV-2 can survive on these surfaces for up to 72 hours.[5]

The mild expression of infection amongst children, aerosol transmission, incubation period without symptoms prompt the dentists to take obligatory precautions to curtail the risk of transmission in the dental office.[4]

Teledentistry

Across many countries, several primary and secondary dental services have been banned, with many countries providing telephone based triage systems to diagnose those patients requiring immediate or emergency intervention.[5] Triage by telemedicine (telephones, video calls, video monitoring) and management of patients suspected of COVID-19 without a face to face visit is highly recommended.[11] The dentist talks over the phone with the parents to obtain all the possible information both on child health status and the oral symptoms in order to understand if the dental procedure represents an urgent need and cannot be postponed.[3]

Currently, several smartphone applications, such as DOCTOR Oral® diagnosis, are available for medi-

cal practitioners, clinicians and dentists, in order to perform tentative quick diagnosis just by viewing a picture taken on the patient's smartphone.[12] In the USA, the US Telephone Health (Telehealth) systems have been introduced which is free and transparent to patients during the COVID-19 public health emergency. In Brazil, Telehealth services have been regulated by the Ministry of Health to scale down the disease transmission.[5]

Infection Control

Interestingly, the nosocomial transmission by airborne SARS-CoV-2 virus-laden aerosols in healthcare facilities may be plausible.[6] Effective infection control is mandatory to prevent or minimize the risk of infection transmission via organized dental procedures which cannot be delayed or postponed. Dental triage of usual dental conditions categorizes patients into 3 types. 1-mild/ moderate symptoms and can be managed remotely by antimicrobials and requires advise and self-help, 2-urgent care needed. These patients have severe or uncontrolled symptoms unmanageable by patient and requires to see a dentist, 3- emergency care for emergency condition which require immediate attention.[11] The dental treatments can be done by means of the following methods:

1. Limiting the points of entry- monitor and limit the points of entry to the dental facility[11].

2. Waiting room- animated videos showing the technique of hand hygiene.[1]

3. Social distancing -Patient appointments should be properly arranged so that no more than one child patient with one accompanying guardian are present in the dental office.[11,13] In the event of overlapping patient appointments, in the reception area, ensure that all individuals maintain a safe distance from each other.[4] Though social distancing would be promising in combatting the COVID-19, the minimum distances that have been maintained between an infected person and a host are arguable and are a long way from being established based on any scientific proof.[6]

4. Body temperature estimation - the paediatric dentist, auxiliarie9i, patient and accompanying person should be investigated for their body temperature using a contact free forehead infra-red thermometer.[3]

5. SpO2- fingertip pulse oximeter before entering the dental office.[4]

6. Protective equipment for the patient and accompanying person - hand hygiene by handwashing or by means of 60-95% alcohol rub[1,11] or sanitizing gels immediately before entering the dental office and use of disposable coveralls / barriers should be provided to minimize the contact of possibly virus contaminated clothes with different surfaces of the office.[3,4] Children are encouraged to pretend that they are putting on special power suits. And moreover, making children dress similar to the dental clinic staff could decrease the fear of children seeing everyone in coveralls and gowns.[4] For children able to spit, the use of a pre-procedural antimicrobial mouth rinse (PPMR) like 1% hydrogen peroxide or 0.2% povidone iodine are recommended owing to the fact that it has nonspecific virucidal activity against corona viruses. However, Chlorhexidine may not be potent in destroying SARS-CoV-2.[1,3,4]

7. Controlling gag/ cough reflexes - Avoid posterior intra oral and bitewing radiograph. Rather, OPG/ CBCT maybe advised.[1,7] Impressions maybe avoided or sedation maybe performed to avoid gag reflex.[7]

8. Control of cross infections - Children's toys, magazines, seats, faucets, restraining devices such as Velcro fasteners etc. maybe sources of cross infection as they are difficult to be disinfected. The use of these maybe avoided.[7,11] The clinical setting should be disinfected after dismissal of every patient using standard hospital grade disinfecting solutions (US Environment Protection Agency).[4,11] After working on a patient without suspected or confirmed COVID, wait for 15 mins after the dental treatment is completed and the patient has exited to begin the disinfection process of the dental operatory and surroundings. This allows the droplets to fall from air after the procedure and ensure sufficient surface disinfection.[11] The frequently touched surfaces like handles, chairs, screens, keyboards, phones, lamps etc. should be disinfected and is critically important as the virus could survive on these surfaces for several

hours to days depending on the temperature and humidity.[3] The reception area including door handles, seats etc. should be thoroughly disinfected to prepare the area for the next patient.[4]

9. Reducing splatter / bioaerosol generation- Extra oral evacuation devices and specialized devices for aerosol reduction which removes infectious droplets at the source as they are emitted; thereby minimizing or preventing their dispersion in air maybe promoted.[7] Anti-retraction dental handpieces with specially designed anti-retractive valves help curtail cross contamination.[4] Use of minimally invasive dentistry should be prioritized, such as pit and fissure sealants, SDF, selective caries removal, Halls technique, CMCR and ART including SMART[1] (Silver modified atraumatic restorative technique) technique should be taken into consideration and promoted.[3,5,7,11] Also, use of four handed technique along with use of clean and sterile hand instruments is recommended to contrast viral spread.[3]

10. Management of contaminated air - the exhaust air must be vented outside to prevent the recirculation of the contaminated air.[7] Ventilation system that maintains the negative pressure in the operating room is recommended. Considering air disinfection using ozone gas or ultraviolet germicidal irradiation is ideal. Use of a portable HEPA (High Efficiency Particulate Air) air filtration unit maybe also considered during and following aerosol generating procedure.[11] In the absence of these systems, it is advised to keep the windows of the office open to let the air circulate.[4]

11. Improving personal protection - Hand hygiene to remove any possible pathogen transfer to bare hands, using disposable barriers, dispensing clean and sterile dental instruments and materials just before treatment, personal protective equipment including gowns, hair covers, clean non sterile gloves, respirators, shielded face masks, shoe covers should be used as appropriate (CDC and prevention 2020).[4] Hand hygiene may be performed with 60-95% alcohol or washing hands with soap and water for at least 20s.[11] Hand hygiene recommended by WHO is "two before, three after" - i.e., washing hands.

a. Before touching a patient

b. Before clean/ aseptic procedures

c. After body fluid exposure/ risk

d. After touching a patient

e. After touching patient surroundings[1]

Eye protection - Remove eye protection prior to leaving the operatory. Reusable eyewear must be thoroughly cleaned and disinfected. Personal eye glasses and contact lenses are inadequate.[11]

Mask- Instead of the use of the regular surgical masks, the use of particulate respirators like the surgical N95 respirators authenticated by the NIOSH or the FFP2-standard masks set by the European Union are advised as it offers a certain level of protection against the airborne transmission of SARS-CoV-2.[1,7] Alternatives to N95 masks include filtering face piece respirators N99, N100, P95, P99, P100, R95, R99, R100, full facepiece air purifying respirators and elastomeric half masks.[11]

PPE suits and face shields can also be modified with cartoon designs to modify the child's behavior.[1] Use of a clean isolation gown is done and removed to be discarded in a waste or linen container before leaving.[11]

Before entering a patient care area, perform hand hygiene and don a clean protective clothing or gown that covers skin and personal clothing likely to be soiled by potentially infectious material like blood, saliva, or other materials. If a protective clothing become soiled, they should be changed. A respirator is worn and the mask ties are secured on the crown of the head (top tie) and base of the neck (bottom tie). If loops are present, hook the mask around ears. Respirator straps should be placed on the crown of the head and base of the neck and checked for a user seal check each time. Eye protection should not include personal eyeglasses and contact lenses. Perform hand hygiene and non-sterile gloves are worn. They should be changed when torn or heavily contaminated prior to entering the room. After completion of dental care, gloves are removed and the gown or protective clothes are discarded in container for waste or linen. Disposable gowns are discarded after each use and protective clothes are laundered after each use. Exit the patient care area and

perform hand hygiene, remove eye protection by grabbing the strap and pulling upwards and away from head without touching the front of the eye protection. Clean and disinfect reusable eye protection prior to reuse by the manufacturer's reprocessing instructions but discard disposable eye protection after use. Remove and discard surgical mask or respirator without touching the front. For a surgical mask untie (or unhook from the ears) and pull it away from the face carefully without touching the front. For a respirator remove the bottom strap by touching the strap only and bring it over the head carefully. For the top strap; grasp it and bring it over the head to pull the respirator away from the face without touching the front. Finally perform hand hygiene to follow standard precautions.[11,13]

Limit DHCP during a procedure to those essential for the procedural support and patient care. This avoids multiple room entry and bundling. Entry of a known or suspected COVID-19 patient must be restricted or allowed to enter with PPE. DHCP at higher risk for severe illness from COVID-19 (old age, pregnancy, comorbidities) should be excluded from caring for a confirmed or suspected COVID-19 infection. DHCP recovered from COVID-19 can care for COVID-19 infected patients.[11]

12. Rubber dam isolation - Could significantly limit airborne particles in a 3-foot diameter of operational field by 70%.[4]

13. Infectious waste management - Extracted teeth are potentially infectious and thus disposed in medical waste bins. Extracted teeth sent to a dental laboratory for shade or size comparisons should be cleaned, surface-disinfected with a hospital grade disinfectant. Dental prostheses, appliances, impressions and bite registrations need to be managed by coordination between the laboratory and dental practice with appropriate cleaning and disinfection with a hospital grade disinfectant.[11]

14. Monitoring DHCP- DHCP should monitor themselves regularly for fever and symptoms of COVID-19.[11]

CONCLUSION

There isn't enough scientific literature available on the model to be followed in the management of paediatric dental patients during the outbreak of such a pandemic. The role of the dental fraternity is critically important since it has the highest risk of spreading the virus in relation to COVID-19. This pandemic would change the outlook of the routine dental practice all over the world and the focus might change to preventive dentistry rather than invasive procedures which would put the DHCP unwittingly at risk. Since this pandemic continues to evolve and change day by day, paediatric dentists and other health care professionals should keep up with a high level of awareness of evidence-based guidance to help and treat patients, preventing risk and nullifying viral spread. Strict universal precautions for control of cross infection to safe guard the health of the DHCP and patients is mandatory. This should be continued ideally throughout the pandemic, and in future as and when practice restrictions ease.

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REVIEW ARTICLE

VOICE AS A DIAGNOSTIC TOOL

ABSTRACT

Detection of diseases using voice analysis is a current research topic in medical engineering. It is a reliable, efficient, economic, and easy to use method. It also helps to detect the disease at its earlier stage. Voice analysis is done with the help of tools such as electroglottography, acoustic analysis, and spectral analysis. Voice analysis has been used in diagnosing conditions such as Parkinson's disease, Alzheimer's disease, mild cognitive impairment, and attention deficit hyperactivity disorder. This review provides an overview of voice analysis, tools used for the analysis of voice, applications of voice analysis in diagnosing medical conditions and potential prospects in the field of dentistry,

Keywords: Voice analysis, acoustic analysis, Parkinson's disease, Alzheimer's disease, cognitive impairment, Oral cancer.

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INTRODUCTION

Voice or vocalization refers to the sound that humans and other vertebrates produce using the lungs and vocal folds. Everyone has a unique voice as their fingerprint. It helps in defining personality, mood, and health. The disorders of voice mainly involve troubles with pitch, loudness, and quality.[1]

Speech recognition software has been used to detect spoken words and turn them into text or respond to commands. In today's world, as researchers are been developing, they are been looking at the voice acoustic qualities to find out about the medical or even the emotional state of the speaker. Interest has been put into the emerging software which detects persons with neurological disorders.[2]

Voice analysis software

Detection of diseases using voice analysis is a current research topic in medical engineering. It is a reliable, efficient, economic, and easy to use method. It also helps to detect the disease at its earlier stage.

Various features are extracted using Digital Signal Processing (DSP) techniques. These features contain information on the health of the voice tract and of organs responsible for speech. These features represent the voice and may be used to discriminate the voice of healthy and unhealthy persons. The spectrum analysis, glottal waveform analysis are some forms used to extract the voice features. These features are then classified using various classification techniques like vector quantization, dynamic time wrapping, support vector machine, Gaussian mixture model, and artificial neural network.[3]

Mechanism

The act of speaking is a complex phenomenon as it involves the movement of the tongue, lips and jaws. There is coordination and movement of many structures at the same time. So thoughts have been given into adapting already existing advanced speech recognition technologies and put them to work for this task.

Using databases of human speakers featuring voices from around the world, Moro Velazquez, a research scientist at the Center for Language and Speech Processing (CLSP), created algorithms that search for irregularities in how they speak. This approach gives a precise diagnosis in the range of 90-95 percent. The main obstacle is consistency. When using certain databases, his diagnosis rate has been closer to 65-70 percent.[3]

Tools used for voice analysis

a. Electroglottography (E.G.G.)

Electroglottography (EGG) is a non-invasive technique that registers laryngeal behavior indirectly by measuring the change in electrical impedance across the throat during the act of speaking.[4] The method was first developed by Fabre (1957) and influential contributions are credited to Fourcin (1971 with Abberton)[5] and Frokjaer-Jensen (1968 with Thorvaldsen).[4,6]

Limitations of EGG

• Difficulties in obtaining signals from women and children than men because of the smaller size of the vocal fold, wider angle of the thyroid cartilage.

• Signal of rapid movement of vocal fold tends to superimpose on the signals produced by slower movements of other structures.

• High chances of signal distortion.

Despite these problems, EEG has established itself as a valuable tool for evaluating laryngeal behavior. The EGG is superior to all other methods in that it is completely non-invasive (it exerts no influence at all on the articulation and production of sounds).[6]

b. Acoustic analysis

The acoustic speech signal is the system's output and is rich in information about pitch, loudness, and quality. The signal is complex and is therefore broken down for analysis into the dimensions of frequency, amplitude, and time. Acoustic measurements are made from signals recorded on high-intensity equipment in a quiet environment and with the use of standard instructions.[7]

Three parameters, namely Peak Slope, Normalized Amplitude Quotient, and Cepstral Peak

Prominence, are used to assess voice quality changes in patients with vocal fold nodules. Peak Slope (PS) allows differentiation of breathy, modal and tense voice, Normalized Amplitude Quotient (NAQ) is used to separate the types of phonation effectively and Cepstral Peak Prominence (CPP) enables the early detection of dysphonia.[4]

Data should be interpreted in light of subject age and gender, interactions between parameters, speech sample selected for analysis, and several tokens. It is also important to know whether the samples were consistent with typical voice use or maximum or best performance.[7,8]

c. Spectral analysis [9]

Spectral analysis is used to find out how acoustic energy is distributed across frequency. It is typically used in phonetics to discover the spectral properties of the vowels and consonants of a language, comparing the productions of different speakers, or finding characteristics that point forward to speech perception or back to articulation. Earlier, the calculations were time-consuming.From 1950 onwards, this was done by the spectrograph, that burnt a spectrogram onto paper as a permanent record. Nowadays, a suitable computer program will calculate speech spectra in seconds. There are two methods for spectral analysis: the fast Fourier transform (FFT) and Linear Prediction (LP).[10,11] FFT finds the energy distribution in the actual speech sound, whereas LP estimates the vocal tract filter that shaped that speech. The advantage of FFT is easier setup, the disadvantage is difficulty identifying formants by speakers with higher-pitched voices. LP has better success with high-pitched voices, but the settings need to be carefully tuned for each speaker.[9–11]

Application in medical diagnosis

In medical diagnosis, voice analysis has made concrete progress. Voice analysis software is developed which can detect neurological diseases such as Parkinson's disease, attention deficit disorder. Researches are in progress for apps that can tell whether you are tied or in fact in depression.The technique that analyzes vocal patterns in Parkinson's disease helps for early diagnosis than is currently possible.[2]

A cross-sectional, cohort study conducted in Brazil reported the use of laryngeal electromyography in a large number of patients with Parkinson's Disease and vocal complaints grouped according to Parkinson's Disease severity. The patterns observed suggested that laryngeal electromyography is a valuable diagnostic tool for Parkinson's Disease even at early phases of the disease.[12]

Max Little, a mathematician and MIT research fellow who works in voice analysis developed vice analysis technology for Parkinson's disease. A healthy person's voice is strong and stable and for someone with Parkinson's, a tremor emerges. Using machine learning algorithm for detection of tremor and weakness in voice, using machine learning algorithm to detect tremor and weakness, Little developed a model to identify the vocal quality of Parkinson patient with an accuracy of around 99%.[2]

According to the present research analysis, sound vibrations, which were earlier employed as therapeutic healing for mental health related conditions, are now being applied into various disease diagnostics including cardiovascular and psychiatric ailments. After successful execution of clinical trials, Health Insurance Portability and Accountability Act (HIPAA)- compliant vocal biomarkers are being tried as effective non-invasive and safe alternatives to currently available disease diagnostic systems such as CT scan, MRI, and X-ray. Prominent voice-based companies such as IBM Corporation, Cogito Corporation, Audio Profiling, Sonde Health, and Beyond Verbal are focusing on sampling data for providing accurate results.[13]

Now, machine learning-based voice recognition technology, such as that developed for Amazon's voice home assistant, Alexa, are being utilized to identify voice patterns that are specific to different neurological diseases. And, as with Alexa, people can give voice samples from the comfort of their home. The biotech companies are working to bring to market technology to monitor a patient's health in the clinic or remotely, using smartphone apps or other wearables, with samples of voice. The hope of

the future is to use voice data to create non-invasive, inexpensive ways to track changes in symptoms and response to medication, tools called voice biomarkers.[14]

Little describes the usage of the telephone for voice analysis as "technologically convenient'' as around 75% of people around the world have access to phones. But the major disadvantage of this software is that it cuts out human subjectivity. Over this, the advantage of any kind of algorithm is that the entire process is repeatable and entirely objective. The stress anyhow this technology has to be used in a clinical context because you needed to have access to care.[2]

A growing body of work is focussing on the ongoing clinical validation of speech-based measures in a variety of clinical contexts. Speech has been demonstrated to have diagnostic validity for Alzheimer's disease (AD) and mild cognitive impairment (MCI) in studies using machine-learning classification models to differentiate individuals with AD/MCI from healthy individuals based on speech samples[15-18]. Additionally, speech analysis can detect individuals with depression[18-21], schizophrenia[18,22,23] autism spectrum disorder[18], and Parkinson's disease, and can differentiate the subtypes of primary progressive aphasia and frontotemporal dementia[18,24]. Classification models provide diagnostic validity for speech measures and could be used to develop tools for disease screening and diagnosis.

Langner a mathematician at Charite Hospital, Berlin developed an analytical model deep speech pattern analysis, which defines six different features of voice: loudness, tempo, rhythm, timbre, articulation, and melody. His current research focuses on diagnosing attention deficit hyperactivity disorder. Based on voice analysis he found differences in utterances of children with and without Attention Deficit Hyperactivity Disorder (ADHD), including fluctuation in speech loudness and melody. But he also says speech analysis should not be used as a standalone diagnostic tool, rather should be a tool to support a doctor.[2] Few other studies have indicated potential use of voice analysis for diagnosis of ADHD.[25,26]

DENTAL PROSPECTS

As the voice analysis software program is gaining great momentum in the field of medical science, the same can also be applied to dental science. It could be of significance for diseases or disorders of tongue and carcinoma involving the oropharynx region. Speech-language pathologists routinely assess oro-motor structure and function to identify contributing factors underlying a client's speech or swallowing disorders. A new examination involves 1hour speech-like tongue exercises (rapid syllable repetitions) that affect dysarthric speech.[27]

Oral squamous cell carcinoma and its treatment impair speech intelligibility by alteration of the vocal tract. It can be done by the means of an automatic, standardized speech recognition system.[28] Studies show the significance of voice analysis software to be an important tool in the diagnosis of laryngeal carcinoma. Laryngeal carcinoma that forms on the vocal cord often causes hoarseness or change in voice. This might lead to them being found at very early stages.[28]

Acoustic analysis can also be employed in making necessary modifications of dental prostheses, especially complete and partial removable dental prostheses to enhance speech clarity.[29,30]

CONCLUSION

Voice as a diagnostic tool is a current research trend in non-invasive diagnostic methods. The focus is on the early diagnosis of diseases enabling prevention. Voice signal analysis can be to help track the changes in medical conditions over time. Several related software is under research. Recognizing the importance of voice analysis, it will become more pervasive. This sort of technology paves way for future research.

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REVIEW ARTICLE

THE IMPORTANCE OF GENERAL EXAMINATION IN TEMPOROMANDIBULAR DISORDER PATIENTS

ABSTRACT

The Temporomandibular disorders or TMD is a less discussed topic in dentistry, as the diagnostic and treatment protocols are still controversial. The diagnosis is usually made when the patient reports with clicking or pain around the joint. But mandible, as part of the postural chain, also has some effect on the general health that needs to be addressed. The systemic symptoms like headaches, neck aches, spasm of the floor of the mouth, various otalgic symptoms etc has to be taken care of. But correlating these, facts for the diagnosis of TMD is very important. This helps to approach the TMD treatment in the perspective of multi disciplinary fashion.

Key words: Temporomandibular joint disorder, headaches, neck aches, posture imbalance

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INTRODUCTION

Temporo Mandibular Disorders or TMDs are defined as a subgroup of craniofacial pain problems that involve TMJ, masticatory muscles and associated head and neck musculoskeletal structures.[1] TMDs are classified as one subtype secondary headache by International Headache Society in International Classification of Headache disorders II.[2] In 2008, The American Academy of Orofacial Pain has expanded on this classification.[3] TMD itself is thought to by many as a psychological condition.[4] But in reality it is a physical, structural and mechanical problem affecting muscular, skeletal and endocrine systems. Hence TMD may exist as a distinct entity or associated with Orofacial pain conditions.

Dentist usually makes a diagnosis of TMD in patients present with pain around joint, limited mouth opening, asymmetric mandibular movement and clicking or crepitus sounds around joints. Except pain, all other symptoms gores unnoticed by the patient which makes the treatment delay. But the general health of the patient needs to be addressed also as TMDs has an impact on general health too. This article mainly emphases the importance of general examination in the diagnosis of TMD and how doctors can helps to improve the quality of life in these patients.

Headaches

Headaches are the most common symptoms of TMD several studies in adults have shown a strong association between TMD and headaches and a reduction in headaches has been reported after the treatment of TMD. Headaches attributed to TMD are usually prominent in preauricular areas of face, masseter muscles and/or temporal regions. These headaches tend to be unilateral when TM complex is the generator of pain but may be bilateral in case of myogenic involvement.[5] In adult, an association is usually considered to exit between TMD and Tension type headaches. Both TMD and headaches are more common in women especially around 35-40yrs of age than men even though a recent study showed a positive correlation between these two irrespective of age and gender.[6] Mandibular deviation from midline is also shown to be greater in TMD patients with headaches with 0-14% in normal individuals and 5-43% in TMD patients.[7,8,9,10] The most important theory proposed for TMD involvement in headaches pain is that it can occur as a result of dysfunctional masticator system. It has been hypothesized that any stage of TMD internal derangement can cause secondary muscle disorder due to altered disc/condyle relationship. This may result in tension type headaches with pericranial tenderness because of the involvement of temporalis muscles.[11]

Neckaches

The neck is considered in the condict to and from the body. The TMJ makes muscular and ligamentary connections to cervical regions forming a functional complex called cranio cervical mandibular systems. Hence the dysfunction within the neck structures commonly leads to problems in the jaw and vice versa. The most common cause of neck pain results from the weakened muscle and poor posture. Cervical disarrangement leads to non- alignment or disarticulation of TMJ. In such cases, the joint did not work properly during the function and therefore the neck muscles which are associated with the muscles of mastication undergo spasm. The spasm of scalene and trapezius muscles will cause the compression of nerves and vessels which lay near brachial plexuses of nerves at the back of neck that causes tingling or numbness of hand or fingers. Several studies shows that TMD patients presents with excessive forward head position, usually associated with shortening of posterior extensor muscles [suboccipital, semispinalis, splenii and upper trapezius muscle], as well as shortening of sternocleidomatoid (SCM). Anterior displacement of head lowers the field of vision and inorder to improve, cervical lordosis increases. Many muscles of anterior neck controls jaw and tongue. Pain in these muscles will be referred to face and teeth and can causes difficulty in swallowing. Additionally the nerves that innervates jaw muscles and TMJ co - mingles with the nerves of neck. Hence the any dysfunction within the neck structures commonly leads to jaw problems and vice versa.[12] Anyone experiencing numbness, tingling, dizziness, nausea associated with neck pain should be evaluated by chiropractors to rule out cervical impingement of nerves and vessels in neck.

Postural imbalance

Posture represents the spatial relationship of skeletal

structures to one another. Teeth are considered to represent the terminal endpoint of postural chain. Thus the way teeth articulates affects the relationship of TMJ within the glenoid fossa, which inturn affects the occiput and cervical spine. The mandibular postural muscles are the part of muscle chain that allows the individual to remain standing with head erect. So the stress or muscle spasm in either of these components is reflected in the corresponding regions via their interconnecting fascial sheath system.[13] the atlando-occipiatl joint where the skull meets the neck via C1, has an integral role of jaw mechanics in the development of posture. According to the Casey Guzay's Quadrant theorem, the muscles controlled the pivotal axis of mandible occurs at the dens between atlas and axis vertebrae. As a result, mandi/jaw misalignment and dysfunction creates a disturbing posturing of C1 & C2. These vertebrae are intimately related to spinal and head posture and neurological well being. A part of dura matter of brain is attached to foramen magnum and to the frontal dorasal aspects of C1, C2 and C3. The malposition of C1 &C2 torques the dyra matter and causes scoliosis, excessive lumbar lordosis, head tilt, cervical hypolordosis, thorasichyperkyphosis.[14,15,16,17,18]

Deveated nasal septum

DNS is a condition in which the nasal septum, the bone and the cartilage that divide the nasal cavity into half is off the center making the difficulty in breathing. In response of nasal obstruction, the tongue drops and the inward pressure of buccal mucosa are left unstopped. This effect is further enhanced by a pressure differential across the hard palate in the absence of nasal airflow leads to narrow high arched palate. Long term airway dysfunction are many including lateral tongue thrust development which causes depressed eruption of lower posterior quadrants leading to deep bite and distalisation of condyles resulting in TMJ compression.[19]

Sleep & TMD

Many studies have shown a prevalence of TMD among patients with obstructive sleep apnoea {OSA} [sleep related breathing disorder] and sleep Bruxism [sleep related movement disorder].[20] OSA occurs when muscles around patient airway relax during sleep causing airway to collapse and block the intake of oxygen. Masticatory and tongue muscle activity during sleep is thought to play an important role during sleep disordered breathing (SBB). In OSA, the influence of gravity on mandible, especially in supine position combined with masticatory and tongue muscle hypotonia results in posterior shift of mandible and tongue creating oropharyngeal narrowing and increase in upper airway reisistance.[22] The immediate effects are oxy hemoglobin desaturation, blood pressure, heart rate fluctuations and long term effects include systemic hypertension, cardiovascular diseases, and metabolic syndrome.[21] In the process of inspiratory effort, activation of submentalis muscle occurs leading to mouth breathing.

Sleep bruxism (SB) is defined as a stereotyped movement disorder characterized by rhythmic masticatory muscle activity associated with tooth grinding and occasional tooth clenching.[22] The gold standard for the diagnosis of sleep bruxism is polysomnogram. The consequences of sleep bruxism are attrition, abrasion, and masticatory muscle hypertrophy, hypersensitivity of teeth to air, cold or hot food and beverages. Miyawaki reported that among SB adult patients 74% swallowing and RMMA occurs in supine position compared to 23% in lateral decubitus position suggesting sleep position may be a factor in the frequency of oromotor events.[23] Sustained and repeated adverse loading of masticatory system that occurs with SB can cause TMD.[25,26,27,28] The use of oral appliance [OA} in patients with mild to moderate OSA had shown a success rate of 60-80%. OA protrude mandible and induce changes in the anterior portion of tongue, soft palate, lateral pharyngeal walls and mandible resulting in improved airway patency.[30]

Otalgic symptoms

Embriologically, the TMJ and the regions except anterior process of Malleus originates from the Merkels cartilage. Anatomically, the posterior wall of glenoid fossa is formed by the tympanic part of temporal bone. The tympanic plate separates TMJ from external audiatotary meatus. Physiologically, the muscles tensor tympani and tensor palatine are innervated by the trigeminal nerve which innervates the muscles of mastication.

The dysfunction of the tensor tympani muscle in conjunction with tensor veli palatini muscle also plays

an important role in the relationship of TMD and otic symptoms. TMD produces contraction and tension in the tensor veli palatini and tensor tympani muscles that can generate different abnormal muscular behaviors. In TMD the sustained contraction of tensor tympani muscle can alter the ossicular spatial position and the endolymphatic pressure through the transmitted changes from the oval window to the labyrinth walls. This can unchain and unbalance the vestibular impulses expressed in vertigo. Additionally, the same middle ear pathogenic muscle mechanism can diminish the sonic transmitting vibration from the tympanic membrane toward the oval window through the ossicular chain which is expressed as a hearing impairment.[31]

CONCLUSION

Understanding the influence of occlusal priprioception on the human body requires the intimate knowledge of histology, anatomy and physiology of neuromuscular complex. Thus dental occlusion may not only related to the position of mandible and skull, but also with the cervical spine, supra and infra hyoid structures, the shoulders and thoracic and lumbar spine with function as one biochemical unit. These structures also provide orthostatic stability of skull on the cervical spine with if compromised influences on etiology of craniomandibular dysfunction and Orofacial pain. The doctors should not only be the care taker of the dentition but also the health of all structures innervated by and/ or connected to them. Hence the general examination is an important aspect in the TMD diagnosis which shouldn't be neglected as the management of TMD should be done by a multi disciplinary approach.

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REVIEW ARTICLE

LASERS IN PROSTHODONTICS- A REVIEW

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ABSTRACT

The introduction of lasers in the field of prosthodontics has replaced many conventional surgical and technical procedures with more efficient and predictable outcomes. Although lasers were introduced in dentistry as early as the 1960s it gained widespread popularity mainly in the developed countries only from the early 90s. Laser technology has advanced much to equip the present day dentists with a wide range of therapeutic applications. The aim of this review is to describe the current and emerging applications for lasers in prosthetic dentistry.

Key words: Lasers, prosthodontics.

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INTRODUCTION

Laser is the acronym for "Light Amplification by stimulated emission of radiation" named by Gordon Gould in 1957[1,2]. In clinical dentistry, there is a growing awareness of the usefulness of lasers in the armamentarium of the modern dental practice, where they can be used as an adjunct or alternative to traditional approaches.[3] The purpose of this review is to provide an overview of various laser applications in Prosthodontics, and to discuss in more detail several key clinical applications which are attracting a high level of interest.

History of lasers[4]

Theodore Harold Maiman is generally given credit for building the first working ruby laser and operating it for the first time on May 16, 1960 at the Hughes Research Laboratory in Malibu, California. MASER a microwave amplifier by Charles H. Townes, P. Gordon et al became the basic principle for laser pumping. This set the stage for a "snowball effect" which would lead to the development of many laser systems, which we utilize in healthcare today. The application of a laser to dental tissue was reported by Stern and Sognnaes and Goldman et al. in 1964, describing the effects of ruby laser on enamel and dentine. From then on lasers gradually found application in the oral cavity with further advances in technology and research.

Different types of Lasers used in Dental Treatment[1] (Table 1)

Several types of lasers are available based on the wavelengths.

1. The Er: YAG laser possesses the potential of replacing the drill.
2. CO2 laser can be used to perform gingivecotomy and to remove small tumors.
3. Argon laser is used in minor surgery.
4. Nd: YAG is used in tissue retraction, endodontics and oral surgery.
5. The diode laser is effective for oral surgery and endodontic treatment. This laser helps to correct aesthetics flaws. It is used for soft tissue procedures.

Classification of Lasers

According to ANSI and OSHA standards Lasers are classified as:

Class I - These are low powered lasers that are safe to use. E.g. Laser beam pointer

Class II - Low powered visible lasers that are hazardous only when viewed directly for longer than 1000 seconds, e.g. He-Ne lasers

Class II b - Low powered visible lasers that are hazardous when viewed for more than 0.25 seconds.

Class III a - Medium powered lasers that are nor-

Table 1. Common laser types used in dentistry

Laser type	Construction	Wavelength (s)	Delivery system
Argon	Gas laser	488, 515nm	Optical fiber
KTP	Solid state	532nm	Optical fiber
Helium - Neon	Gas laser	633nm	Optical fiber
Diode	Semiconductor	635, 670,810,980nm	Optical fiber
Nd:YAG	Solid state	1064nm	Optical fiber
Er,Cr:YSGG	Solid state	2780nm	Semiflexible hollow wave guide

mally hazardous if viewed for less than 0.25 seconds without magnifying optics.

Class III b - Medium powered lasers that can be hazardous if viewed directly.

Class IV - These are high powered lasers (> 0.5 W) that produce ocular skin and fire hazards.

Advantages of Laser over other techniques[2]

1. It is painless, bloodless that results in clean surgical field, and fine incision with precision is possible.
2. There is no or minimal need for anesthesia.
3. The risk of infection is reduced as a more sterilized environment is created as the laser kills bacteria.
4. No postoperative discomfort, minimal pain and swelling, generally doesn't require medication.
5. Superior and faster healing, offers better patient compliance.

Disadvantages of Lasers[2]

1. Lasers cannot be used to remove defective crowns or silver fillings, or to prepare teeth for bridges.
2. Lasers can't be used on teeth with filling already in place.
3. Lasers don't completely eliminate the need for anesthesia.
4. Lasers treatment is more expensive as the cost of the laser equipment itself is much higher.

Use of Lasers in Prosthetic Dentistry:

Lasers are now being used in a variety of procedures in prosthetic dentistry.

Fixed prosthesis and esthetics

A. Crown lengthening

Clinical scenarios where crown lengthening procedures are indicated within aesthetic zone require special consideration to achieve predictable aesthetic results. Crown lengthening procedures with the help of lasers are indicated in following conditions:

a. Caries at gingival margin

b. Cuspal fracture extending apical to the gingival margin

c. Endodontic perforations near alveolar crest.

d. Insufficient clinical crown length.

e. Difficulty in placement of finish line coronal to the biological width.

f. Need to develop a ferrule.

g. Unaesthetic gingival architecture.

h. Cosmetic enhancements.

Lasers offer unparallel precision and operator control and may be beneficial for finely tracing incision lines and sculpting the desired gingival margin outline[3].

B. Soft tissue management around abutments[4]

Argon laser energy has peak absorption in hemoglobin, thus lending itself to providing excellent haemostasis and efficient coagulation and vaporization of oral tissues. These characteristics are beneficial for retraction and haemostasis of the gingival tissue in preparation for an impression during a crown and bridge procedure.

C. Modification of soft tissue around laminates[4]

The removal and re-contouring of gingival tissues around laminates can be easily accomplished with the argon laser. The laser will remove tissue and provide haemostasis and tissues heal well.

D. Osseous crown lengthening

Like teeth mineralized matrix of bone consists mainly of hydroxyapatite. The water content and hydroxyapatite are responsible for the high absorption of the Er: YAG laser light in the bone. Er: YAG laser has very promising potential for bone ablation[4].

E. Formation of ovate pontic sites

For favorablepontic design re-contouring of soft and bony tissue may be needed. Soft tissue surgery may be performed with any of the soft tissue lasers and osseous surgery may be performed with erbium family of lasers.

F. Altered passive eruption management

Lasers can be used very efficaciously to manage passive eruption problems. When the patients have clinical crowns that appear too short or when they have an uneven gingival line producing an uneven smile, excessive tissue can be easily and quickly removed without the need for blade incisions, flap reflection, or suturing[4].

G. Laser troughing

Lasers can be used to create a trough around a tooth before impression taking. This can entirely replace the need for retraction cord, electrocautery, and the use of haemostatic agents. The results are predictable, efficient, minimize impingement of epithelial attachment, cause less bleeding during the subsequent impression, reduce postoperative problems, and reduce chair time[4]. It alters the biological width of gingiva. Nd:YAG laser is used.

Lasers in implantology

Dental lasers are used for a variety of procedures in implantology like implant recovery, implant site preparation and removal of diseased tissue around the implant.

Implant recovery

One advantage of use of lasers in implantology is that impressions can be taken immediately after second stage surgery because there is little blood contamination in the field due to the haemostatic effects of the lasers. There also is minimal tissue shrinkage after laser surgery, which assures that the tissue margins will remain at the same level after healing as they are immediately after surgery[10,11].

Implant site preparation

Lasers can be used for the placement of mini implants especially in patients with potential bleeding problems, to provide essentially bloodless surgery in the bone[11].

Removal of diseased tissue around the implant: The diode lasers alone or with toludine O dye, CO2 lasers and Er:YAG lasers have been used for implant maintenance, because of their bactericidal effect and technical simplicity[12,13].

Lasers in removable prosthetics[5]

Treatment of unsuitable alveolar ridges[5]: Flabby tissues, undercuts may be rectified with laser application for enhanced retention, stability and support

Treatment of soft tissue lesions: Epulis fissurata, denture stomatitis cases may be treated with soft tissue lasers.

Treatment of enlarged tuberosity: The soft tissue reduction may be performed with any of the soft tissue lasers. Erbium laser is the laser of choice for the osseus reduction.

Surgical treatment of tori and exostoses[5]: Soft tissue lasers may be use to expose the exostoses and erbium lasers may be use for the osseous reduction.

Lasers in maxillofacial rehabilation[4]

The use of lasers in the maxillofacial prosthetics is mainly for the initial work up of three dimensional acquisition of optical data of the extraoral defects. This procedure is called Laser Holography Imaging . Laser technology has proved to be particularly useful for planning the shape and position of the prostheses. It has the potential to eliminate the need for conventional impression techniques .

Laser applications in the dental laboratory[4]

Lasers have been used for deposition of hydroxyapatite (HA) thin films on titanium implants. Pulsed laser deposition (PLD) has proven to be a promising method to produce pure, crystalline and adherent HA coatings which show no disso-

lution in a simulated body fluid .

Use of lasers for surface treatment of titanium castings for ceramic bonding have shown improved bond strength when compared to acid etching techniques which are commonly used. Lasers can also be used for welding[14].

Laser scanning of casts with CAD-CAM systems has been used in the fabrication of porcelain and other restorative materials.

CONCLUSION

Lasers have become a ray of hope in dentistry. When used effectively and ethically, lasers are an exceptional modality of treatment for many clinical conditions that dentists treat on a daily basis. But lasers has never been the “magic wand” that many dentists may hope for. It has got its own limitations. If a clinician decides to use a laser for a dental procedure, he or she needs to fully understand the character of the wavelength being used, and the thermal implications & limitations of the optical energy. However, the future of the dental laser shows incredible promise with some of the newest ongoing research.

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CASE REPORT

KEEN'S APPROACH FOR REDUCTION OF ZYGOMATIC ARCH FRACTURE - A CASE REPORT

ABSTRACT

The jutted out position of zygomatic bone increases it's frequency of fracture in maxillofacial trauma. Zygomatic arch is formed by the zygomatic process of temporal bone and the temporal process of zygomatic bone. Isolated zygomatic arch fractures accounts for approximately 10 percent from literature of all zygomatic bone fractures. The detrimental effect of depressed zygomatic arch fracture includes trismus due to the impingement of the fractured fragments on the coronoid process. Literature provides many techniques like Gillie's temporal approach, Keen's approach, anterior cheek skin incision and direct open approach.

Here we present a case report of isolated zygomatic arch fracture following trauma from wooden piece which accidentally struck on the face in a middle-aged man which was surgically managed by open reduction through Keen's intraoral approach. Successful reduction of fractured segments and normalcy of function was regained with zero extra oral scarring, minimum post-operative pain, satisfactory aesthetics and normal satisfactory mouth opening.

Keywords: zygomatic arch, Keen's approach, fracture

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INTRODUCTION

Various surgical procedures are available to reduce zygomatic arch fractures. Of these, Gillie's temporal and keen's vestibular approaches are most used.[1] We aim to outline the merits of Keen's vestibular approach over Gillie's temporal approach with the help of a case report.

CASE REPORT

A 40 years old male patient was referred by an orthopedic surgeon to Out Patient Department of Department of Oral and Maxillofacial Surgery, Sanjoe Hospital, Perumbavoor, Ernakulam, Kerala, with a chief complaint of restriction in mouth opening and mild tenderness over the left cheek bone region.

He gave a history of wooden log piece accidently hitting his face while unloading wooden log pieces from a lorry few days back. The patient first consulted an orthopedic surgeon who referred him to our department. He also had a lacerated wound over the cheek region, which was sutured elsewhere.

Clinical evaluation revealed flattening of the face in bird's eye view, which was a classical sign of zygomatic arch fracture (figure1).

Figure 1

Figure 2

Depression over the left malar arch region, tenderness and crepitus on palpation and a restriction in mouth opening (approximately 20 mm) was also noted. A Computerized tomography (CT) scan of head with facial cuts revealed an M shaped fracture, with two independent segments which were medially displaced (figure 2). Literature classified this fracture as Group 2(arch fracture) according to Knight and North, 1961.[2]

Open reduction of the zygomatic arch was performed under local anaesthesia, using a Keen's intraoral approach. According to literature "less force is required by our intraoral keen's approach than the extra oral Gillies approach, because the force is exerted where it should be, at the center of the fractured fragments.[2]

Surgical access was gained by an incision approximately 1cm in length at the reflection of the upper buccal sulcus, immediately behind the zygomatic buttress. Supra periosteal dissection was done, and initially a Howarth elevator was used to contact the deep or infratemporal surface of the zygomatic bone. Room was created for the entry of a Rowes modification of Bristows zygoma elevator and an upward, forward, and outward pressure was exerted. A clicking sound confirmed the snapping back of bone to original position. The reduction was con-

Figure 3

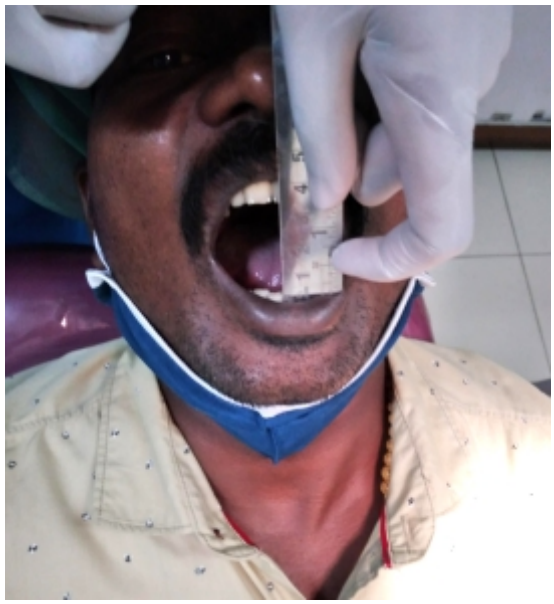

Figure 4

firmed by digital palpation over the zygomatic arch region. Bilateral symmetry was obtained (figure 3).

The intraoral incision was sutured with 3-0 vicryl. (absorbable suture material).The patient was put on a standard antibiotic and analgesic regime for one week. Regular periodic follow up showed progressive increase in mouth opening (figure 4) and reduction in tenderness over the malar region.

DISCUSSION

Due to the most prominent position of zygomatic bone, it is often encountered in maxillofacial trauma cases. Some of the zygomatic arch fractures occur as a component of complex mid facial fractures, while others still may be isolated fractures. When not properly treated, cosmetics is hindered along with function due to impingement of coronoid process.[3]

The Keen's or maxillary vestibular approach which provides a reasonable access to the entire facial surface from zygomatic arch to infraorbital rim to frontal process of maxilla, is considered as a safe and reliable approach for open treatment of zygomatic fractures.[4]

The extra oral Gillies temporal approach needs an extra oral incision within the hair line which results in scar and can compromise aesthetics. Also middle temporal veins are often encountered which may cause considerable hemorrhage during the procedure.[3] The anatomical hazards during Keen's approach are infraorbital neurovascular bundle above and the posterosuperior alveolar vessels along the posterior maxilla, which are rarely encountered.[5]

Though both procedures require only 15-20 minutes, unless fixation is necessary, the main advantage of Keen's approach is that the intraoral scar is well hidden within the maxillary vestibule making this technique to have a high patient acceptance rate.[6] In consolidated fractures, Gillie's temporal approach is preferred as this technique allows application of a great amount of controlled force to dis impact even the most difficult zygomatic fractures.[7]

CONCLUSION

The jutted-out position of zygomatic bone makes it more vulnerable to trauma. Zygomatic bone represents a primary buttress between mid-face and cranium. When the zygomatic arch fractures are medially displaced, it can impinge on the coronoid process leading to trismus for the patient. Though several approaches are available for reducing

zygomatic arch fractures, the extra oral Gillies temporal approach and intraoral keen's approach are preferred. Though both the procedures are reliable, fast and not very technique sensitive along with few complications. Keen's vestibular approach is recommended when scar related cosmetics is monumental.

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CASE REPORT

SUBCUTANEOUS EMPHYSEMA FOLLOWING DENTAL PROCEDURE - CASE REPORT

ABSTRACT

Subcutaneous emphysema is an uncommon but potential complication following dental procedures. Unlike subcutaneous emphysema in medical cases where the escape of air from lung alveoli or gastrointestinal system is the common cause, in dentistry it is iatrogenic. In this article, we present a case of subcutaneous emphysema following a dental procedure that involved buccal space, infraorbital space, and periorbital region. The possible differential diagnoses, complications, and management of cervicofacial subcutaneous emphysema are also discussed.

Keywords: subcutaneous emphysema, dentistry, infraorbital space

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INTRODUCTION

Commonly subcutaneous emphysema occurs from puncture of parts of the respiratory or gastrointestinal system as a result of penetrating trauma or in medical conditions that cause pressure in the lung alveoli. Infections like gas gangrene can also cause air trapped in subcutaneous tissues.[1] Subcutaneous emphysema due to surgical or medical procedures is known as surgical emphysema. Spontaneous emphysema is the term used to describe subcutaneous emphysema due to rupture of lung alveoli or when the cause is not clear.[2]

The development of soft tissue emphysema after dental treatment is not a rare complication. But with few descriptions in the literature, it appears to be under-reported and thus seem as rare as suggested.[3] Soft tissue emphysema following dental procedures, also known as surgical emphysema, subcutaneous emphysema, cervicofacial emphysema, and interstitial emphysema, is usually restricted to only moderate local swelling. However, the spread of larger amounts of air into deeper spaces may sometimes cause serious complications, including airway compromise due to accumulation of air in the retropharyngeal space, pneumomediastinum, and pneumopericardium. Fatal air embolism and soft tissue infections due to dissemination of oral microflora along the emphysematous aero-digestive tracts are expected complications.[4]

Fig. 1

CASE REPORT

A 52-year-old male patient came to the department of oral and maxillofacial surgery with complaints of swelling over the right side of the face for one day. The swelling of the face was noticed while doing tooth preparation for the fabrication of a prosthetic crown on his right upper second molar tooth. The patient gives a history of a wound on the right buccal mucosa which happened during initial crown preparation and when final preparation was done the swelling developed immediately. Other than the swelling the patient had no other symptoms.

The patient was having medications for chronic kidney disease for 2 years. The nephrologist had given medical consent for any non-invasive dental procedures and had instructed to avoid any nephrotoxic drugs like NSAIDs. So the patient was not under any medication that could have caused an allergic reaction. But the patient's apprehension was that the swelling might have developed due to his medical condition or due to some allergy to dental materials.

On examination there was a swelling of the right face involving the right buccal and infraorbital spaces extending up to the right lower eyelid, obliterating the palpebral fissure partially [Figure 1]. The patient had no pain, itching, rashes, or any clinical signs of inflammatory changes. On palpation, the swelling was soft, non-tender, non-fluctuant and with crepitus felt over the soft tissue spaces.Intraoral examination revealed a small puncture wound over the right buccal mucosa opposite maxillary second molar, probably from an air-rotor handpiece bur [Figure 2]. The parotid duct could be appreciated close to

Fig. 2

the wound, but with no involvement. No other significant findings were observed intraorally that could be linked with the swelling.

The puncture wound, crepitus on palpation, fast-developing nature of swelling, all led to a provisional diagnosis of subcutaneous emphysema. The patient was reassured of the condition, antibiotics were prescribed and mouthwash was given for oral rinsing. As there was no dyspnea, dysphagia, or any signs of obstruction in the upper aerodigestive system the patient was sent home and was instructed to review immediately if any other symptoms occur or otherwise after 1 week. The patient did not appear for a follow-up visit but communicated over the phone that the swelling started subsiding in 3 days and completely resolved in 8 days.

DISCUSSION

Subcutaneous emphysema refers to the entrapment of gas or air in the subcutaneous tissue. Subcutaneous emphysema due to medical reasons is not a rare finding. It is usually associated with endotracheal intubation, especially retrograde intubation, tracheostomy, positive pressure ventilation, improper placement of chest drains, endoscopic procedures like laparoscopy, trauma, prolonged surgical procedures like on-surgeries or head and neck surgeries, soft tissue infections like gangrene, rupture of lung alveoli as in spontaneous emphysema, neoplasms involving the aerodigestive tract, cryotherapy procedures, etc.[5-8]

Subcutaneous emphysema associated with dental procedure was first reported by Turnbull, which was emphysema of the face following a premolar extraction. Open soft tissue flaps, extraction sockets, soft tissue wounds, implant sites, periodontal pockets, or open root canals are usual entry points for subcutaneous air in dental procedures. Use of air syringes directly, use of drills involving pressurized jets of air and water, or use of gas liberating agents like hydrogen peroxide in the above mentioned vulnerable areas carry great risk for development of subcutaneous emphysema.[3,4,7-13] In addition to iatrogenic causes, subcutaneous emphysema can also be patient-induced. This typically occurs after extraction in situations in which the patient begins to smoke, cough, exhale forcefully, or vomit before any healing has taken place. In the case of endodontic treatment, sodium hypochlorite accidents, the use of air-driven syringes, and misuse of rubber dams or not using a rubber dam have been documented as causing subcutaneous emphysema.[8]

Subcutaneous emphysema following dental procedures in most cases manifests with mild to moderate local swelling and symptoms when the spread of air is limited to nearby tissue spaces like the buccal, infraorbital, sublingual, or submandibular spaces. However, displacement of air into deeper spaces in the neck like parapharyngeal, retropharyngeal, Infratemporal, and orbital spaces can lead to severe and sometimes fatal complications.[9-12] Some of them include necrosis of subcutaneous tissue, airway compromise, pneumomediastinum, pneumopericardium, pneumoperitoneum, auditory disturbances, retinal artery collapse, optic nerve damage, loss of vision, cerebral air embolism, secondary fascial space infections, etc.[10-14]

Proper diagnosis of the condition is therefore crucial in managing this complication. Differential diagnoses include angioedema, hematoma, soft tissue infections, and contact dermatitis.[10,11] As in any diagnosis, an appropriate case history along with a thorough examination of the swelling is essential in this condition also. A recent history of dental treatment, a clinically appreciable disruption in the mucosal barrier, and a sudden developing swelling with no other symptoms can lead to a diagnosis of surgical emphysema associated with dental treatment.[13] The pathognomonic sign of subcutaneous emphysema is crepitus upon palpation of the affected area.

Subcutaneous emphysema is usually a self-limiting condition and resolves in 3 - 10 days, as the gas is resorbed into the bloodstream for eventual excretion via the lungs. The patient should be observed until the clinician is sure that the air has not involved any dangerous space and is no longer advancing. At this point, the patient can be successfully managed on an outpatient basis with close follow-up. The administration of antibiotics for potential infections and corticosteroids to reduce swelling have been reported in the literature. But the administration of

such agents should be based on clinical evaluation of potential infection, the severity of the swelling, and the general condition of the patient.

Confirmation of the clinical diagnosis is sometimes necessary in severe cases. Investigations like routine radiographs, ultrasound scans, CT scans, MRI, or even histopathological examination of the tissue had been performed by different authors. Radiographs of the involved region, ultrasound imaging, CT, and MRI help identify the air-filled spaces. A multidetector CT is preferred over conventional CT in identifying air spaces. A chest radiograph is needed to rule out mediastinal involvement.[13] Anteroposterior chest radiographs usually show a radiolucent outline parallel to the margin of the heart. Lateral chest radiographs are often more helpful because they show retrosternal radiolucency with outlining of the aorta and mediastinal structures. Histopathologic examination ofspecimens from the region usually showsan extensive separation of attenuated collagen bundles, suggestive of interstitial air. Adipose tissue shows fragmentation of cell membranes. Inflammatory cells, an increase of fibroblasts, or mucin deposits will not be appreciated.[14]

Depending on the extent, patients should be monitored closely before discharge for any respiratory or cardiac distress. If left untreated, there have been instances of subcutaneous emphysema spreading to the mediastinum and thoracic regions, causing pneumomediastinum, pneumothorax, and pleural effusion. There have been reports of arrhythmias and electrocardiogram alterations after the spread of air into the pericardial space, and also emphysema spread to the orbital and periorbital regions, leading to blindness due to nerve compression. Very few reports are there of air embolism developed from subcutaneous emphysema causing seizures and ischemic brain lesions, leading to short-term memory impairment. Thus, early recognition and proper management must be implemented to prevent such progressions.

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