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Chief Editor's Message

Dear Friends

As we sail into one more issue ofJIDAK, i would like to express my feelings to you.

Merely providing a stand will not make wisdom in the mind of walkers... where it leads is a matter of concern and journey.

Similarly, releasing every issue is definitely a matter of immense pleasure for all those who have worked for it.... authors, reviewers editorial board members and publishers...but its just a stand.

How much it is made use of is the real matter of concern. all the articles published in our journal are purely scientific with great applications to academicians as well as practitioners.

Hence I request all of you to make use of it appropriately and give us feedback so that we all can work together to take our branch journal to great heights.

Happy Reading!!!

Dr Vidhya Parameswaran
Chief Editor- JIDAK
IDA Kochi

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REVIEW ARTICLE

DIPLOPIA FOLLOWING MID FACE FRACTURES- A PROSPECTIVE CLINICAL STUDY

ABSTRACT

BACKGROUND AND OBJECTIVE: Mid face trauma needs careful ophthalmological evaluation to assess the presence of vision threatening injuries. Injuries like diplopia mostly occur in midface fractures involving orbit. Inappropriate treatment can be a devastating experience for the patients. It can also lead to medico-legal aligations. Timely detection and correction of injuries reduces morbidity. The prevalence and co-relationship of diplopia in midface fractures and frequency of surgical correction needed is assessed in this study.

METHODS: This study assessed 401 patients with Lefort I, Lefort II, Lefort III, zygomatic complex and naso-ethmoid fracture. Assessment of diplopia in facial fractures was done through clinical examination and specific tests. Ophthalmological evaluation was completed under the guidance of a registered ophthalmologist. Orbital injuries that lead to diplopia was assessed clinically and radiographically. The statistical test used in the study was chi square test and software employed is SPSS

RESULTS: The incidence of diplopia was 15.7% in the present study. Zygomatic complex fractures with involvement of the lateral wall of orbit and the infra orbital rim along with extension to the orbital floor showed highest association with diplopia. Among 401 patients 68 presented with diplopia and among this majority was having zygomatic complex fractures

CONCLUSION: Based on the study it can be concluded that all mid face fracture need a comprehensive ophthalmological evaluation to rule out vision threatening injuries. Early surgical intervention was needed in the correction of hypoglobus, diplopia etc. Zygomatic- complex fracture was the main midface fracture associated with highest incidence of ophthalmic and orbital injuries.

KEY WORDS: Diplopia, supraorbital rim, infraorbital rim, floor fracture , extraocular movements.

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INTRODUCTION

Diplopia is a frequently encountered complications of mid face fractures that involve the orbital walls causing enlargement of orbit leading to displacement of orbital contents. Human orbit is a small cavity having the shape of a pyramid with the apex pointing posteriorly. Within this crowded space are juxtaposed a complex array of tightly packed structures serving the ultimate function of vision[1]. Orbital fat and connective tissue fascia act as a cushion protecting orbital contents and together they serve as a functional unit of vision, whose complexity and precision are unmatched elsewhere in the vertebrate body. Maxillofacial injuries especially those affecting the middle third of the face disrupts the orbital anatomy and cause entrapment and displacement of orbital contents. These injuries causes an alteration in the level of globe leading to diplopia.

Diplopia occuring in mid face fractures is a devastating experience for the patient. Two types are there monocular and binocular diplopia. Alteration in the visual axis with respect to the opposite eye causes diplopia in orbital floor fractures. Displaced orbital floor fracture can causes entrapment of periorbita and inferior rectus muscle leading to diplopia[2]. Usually patients presents with downward displaced eyeball, accentuated superior palpebral groove, extrocular movement restriction. Entrapment and scarring of inferior rectus and inferior oblique muscle between fracture is the cause of limitation of movement of eyeball.

Determination of the prevalence and co-relationship of diplopia in mid face trauma was the objective of this study. This study also assessed the pattern of orbital injuries mostly associated with diplopia. This study emphasis the need for early ophthalmological examination to avoid vision threatening complications.

MATERIALS AND METHODS: The duration of study was from May 2014 to May 2016 in Department of oral and maxillofacial surgery, Government Dental college, Kottayam. Total number of patients assessed was 401, among those who presented with mid face fractures. Stratified sampling method was used grouping the patients into major mid face fracture patterns, Majority of patients were between 20 to 50 years of age in this prospective clinical study. All patients received a comprehensive ophthalmological evaluation. Clinical, Radiographic/ CT evaluation was done to assess various orbital fractures and patterns of injury.

Inclusion criteria : All patients sustaining confirmed midface fractures.

Exclusion criteria: Those with solitary fractures of the dentoalveolar process or pure dental injuries, only soft tissue injuries in facial region, isolated mandibular fractures.

Informed consent and Ethical clearance was obtained from the institutional ethical committee of Government Dental College, Kottayam for the study(IEC/M/07/2014/DCK). Patient evaluation included history, clinical examination, ophthalmological assessment, radiographic evaluation, and treatment given. History included personal details, date of injury, causes of trauma to mid face. Pre-existing ophthalmic injuries, alterations in visual acuity related to conditions like diabetes, and due to other ocular diseases were noted.

Clinical examination: Restriction of extraocular movements assessed by asking patient to sit or stand with head up and looking straight ahead. A pen or finger was held about 14 inches from the patient's eyes; ask the patient to follow the finger as it is moved through the six cardinal fields of gaze. A cover/uncover test was also done. In forced duction test a cotton tip applicator soaked in topical anesthetic was held on the conjunctiva for one minute. A small non-toothed forceps was used to grasp the conjunctiva and extraocular muscle insertion about 8 mm from the cornea and the globe is rotated both towards and away from the muscle. Resistance suggested muscle entrapment[7].Diplopia assessed by red-glass test[7]. A red plane glass is placed in front of one eye and light source was moved in all nine directions of gaze. Red glass helped to dissociate the eyes and makes diplopia more recognizable by perceiving both white light and red light when diplopia is present. A horizontal line is drawn through the center of the pupil of both eyes. Depression of level of pupil below this line suggest hypoglobus. All the four orbital rims were palpated for any tenderness or step defect. Extraocular muscles entrapment lead to restriction of extra ocular movements and diplopia.

Radiological evaluation: waters view was the main plain X–ray view used. CT scan; axial and coronal views were used to assess the involvement of various orbital walls and rims. Mid face fractures were radiographically confirmed using waters view, PA skull, lateral skull views and axial, coronal and sagittal sections of CT Scan'.

Results: The results are summarized in the form of tables and graphs as follows. The statistical test used in the study was chi square test and software employed is SPSS.

Figure 2 : Diplopia test

Figure 1. Superior gaze restriction

Figure 4 : Intraop view

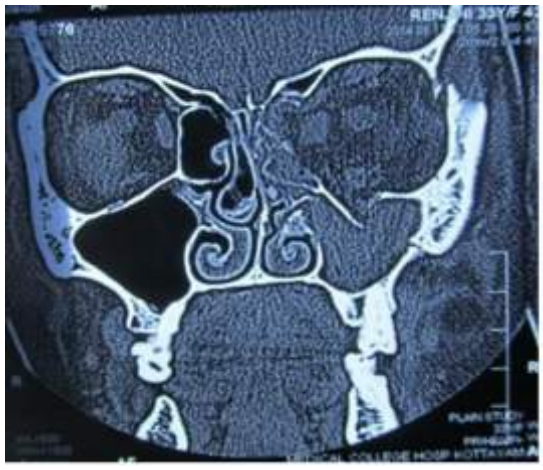


Figure 3: Coronal CT view

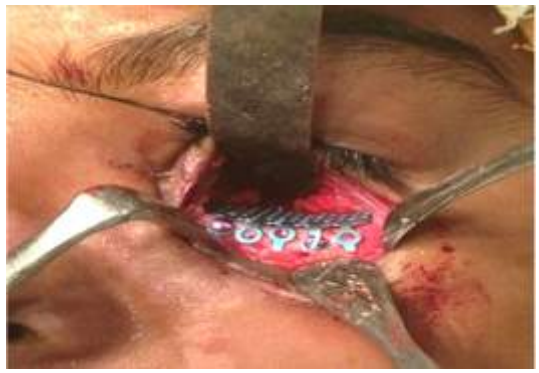
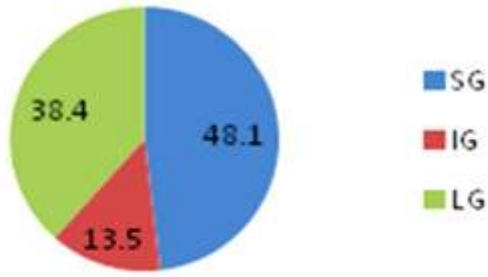


Figure 5: Floor Repair

Restriction	Frequency	Percentage
SG	75	48.1
IG	21	13.5
LG	60	38.4
MG	0	0
Total gaze restrictions	156	0.1

Table 1: Distribution of restriction of extraocular movement in various gazes.



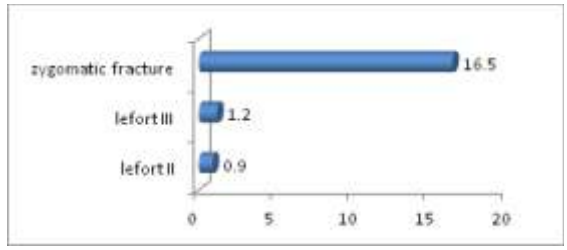
Graph 1: The restriction of extraocular movement in various gazes.

LG-Lateral gaze restriction, SG-Superior gaze restriction, MG-Medial gaze restriction, IG-Inferior gaze restriction.

The major gaze restriction observed in the study was superior gaze restriction followed by lateral gaze restriction

Midface fracture	Frequency	Percent
Lefort I	0	0.0
Lefort II	4	0.9
Lefort III	5	1.2
Zygomatic complex fractures	66	16.5
Naso ethmoid fractures	0	0
No injury	326	81.4
Total	401	100.0

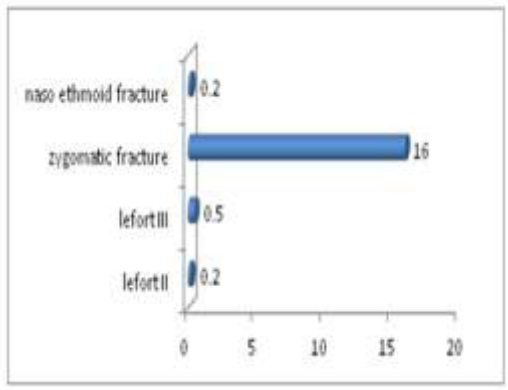
Table 2:
Superior gaze restriction in mid face fractures



Graph 2 :
Superior gaze restriction in mid face fracture

Midface fracture	Frequency	Percent
Lefort II	1	0.2
Lefort III	2	0.5
Zygomatic complex fractures	64	16.0
Naso ethmoid fractures	1	0.2
No injury	333	83.1
Total	401	100.0

Table 3: Distribution of diplopia in mid face fractures.



Graph 3: Distribution of diplopia in midface fractures.

18.6 % of patients in the study presented with superior gaze restriction and of this 16.5 % were having zygomatic complex fractures.

Among 401 patients 68 presented with diplopia and among this majority was having zygomatic complex fractures.

Discussion: Ophthalmic injuries occur frequently during mid facial trauma. There are many studies associating maxillofacial fractures and ophthalmic injuries in literature. Road traffic accidents followed by assault, falls, and sports injury are the major etiological factors[1]. Assaults stand as the main etiology in recent studies[2]. In our study 401 patients with midface trauma were assessed. The main etiology was road traffic accident (80.5%) followed by assaults (16.7%) and accidental falls. (2.8%). 345 males (86%) and 56 females (14%) were assessed for the percentage of occurrence of ophthalmic injuries like diplopia in various mid face fractures.

Restriction of extraocular movements were seen in 38.9% of cases,156 patients had restriction of extraocular movement. Out of the patients 48.1% have superior gaze, 13.5% have inferior gaze, 38.4% have lateral gaze and none have medial gaze. The percentage of occurrence of diplopia was 16.9%.

Diplopia in primary position or downward gaze is an embarrassing experience for the patient. Frequency of diplopia in association with mid face reported in literature is 5 to 37 %3. Incidence of persisting diplopia is 5-7 %4,5. Types of diplopia is monocular or binocular. Lens opacification and displacement are the usual causes of monocular diplopia. Binocular diplopia occurs secondary to trauma. Edema and hematoma due to trauma can lead to diplopia which resolves as it subsides. Persistent diploia can be due to restriction of extraocular movements caused by muscle entrapment and scarring, neurogenic injuries causing atrophy of orbital issues and fat or alteration in the level of orbit and visual axis due to orbital trauma. Orbital floor fracture with muscle entrapment commonly result in diplopia. Diplopia not resolving as edema subsides needs combined maxillofacial and ophthalmological evaluation. Diplopia is a common complaint among the patients with maxillofacial trauma. In study by Jamal et al.(2009) reported 16% incidence of persistent diplopia[6]. In the present study, among 401 cases 16.9% had diplopia. 16.0% of the diplopia was associated with zygomatic complex fractures, 0.2% with Lefort II, 0.5% with Lefort III and 0.2% with naso ethmoid fracture. Occurrence of diplopia in mid face fracture was around 19.8 % in previous studies by Al- Qurainy et al in 1991 and Barry C in 2008 and Marin MI in 1998[7,8,9].

Considerable deformity of bony orbit and globe can lead to esthetic and functional handicap. Evaluation of the extent of comminution of the orbital wall, timing of surgery, and a precise surgical technique is important in the correction of diplopia. Correction of diplopia should not be delayed for more than 1 week as irreversible scarring of orbital soft tissues and necrosis of prolapsed fat can occur in extreme positions of gaze. The result of correction surgery depends on the state of soft tissue and restoration of bony form of zygoma and orbital floor. Proper reduction and fixation of fractured bones along with release of the soft tissue entrapment and three-dimensional reconstruction of the orbital floor using auto graft, allograft or alloplastic material assures correction of diplopia. Surgery must be gentle with meticulous hemostasis and steroid cover. Bone must be placed behind the equator to push the globe forward. Autogenous materials include cranial bone, iliac crest, rib maxillary anterior wall, or auricular cartilage. Resorbable and non-resorbable alloplastic materials include Teflon, Marlex, Prolene, polyethylene and metallic alloys like titanium mesh Resorbable mesh and plate and homografts like lyodura and zenoderm are other options.

Conclusion

Zygomatic complex fracture was the most common middle third fracture that resulted in diplopia. Expansion of orbital volume due to disruption of the orbital walls lead to these ophthalmic injuries. The midface fractures definitely alters the normal sequential pattern of orbital contents, thus producing effects like diplopia altering the normal quality of life. Timely surgical intervention and proper restoration of orbital contour can correct these disabling and aesthetic consequences of mid face trauma.

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REVIEW ARTICLE

VIRTOPSY : FUTURE OF AUTOPSY ?

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ABSTRACT

Virtopsy which literally means virtual autopsy, a scalpel-free procedure of autopsy subsequently developed into a multitool documentation and analysis research project, combining 3D body surface imaging methods with merged CT/magnetic resonance imaging (CT/MRI) data and 3D shape analysis. It is a simple, non-invasive procedure to record the surface and internal features of the deceased. As virtopsy involves preserving the records, it is immensely helpful for future correlations. This technique is a new development in the field of forensic sciences, and its acceptability in the court of law is yet to be proved. Scientific rationale and practical merits of virtopsy salutes and respects the religious and emotional sentiments of various ethnic groups. The present article is an overview of this emerging technique.

Key words: Virtopsy, Imaging methods, Forensic sciences.

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INTRODUCTION

Death is an inevitable part of life and at few occasions scientific examination of bodies after death becomes mandatory[1]. Forensic science is a multidisciplinary science amalgamating criminalistics, engineering science, general jurisprudence, odontology, pathology/biology, psychiatry and behavioural science, questioned documents, toxicology, and physical anthropology. On the other hand, forensic medicine deals with the examination and identification of relevant medical data in both living and dead [2].

The traditional procedures of autopsy included dissection, interpretation and cataloguing and the data gathered from the examination was then put together for arriving at the conclusion. The dead body was then delivered for the last rites to be performed. However, the mutilations involved in the procedure often left the distressed family disturbed. These pitfalls led to the birth of virtopsy[3].

Virtopsy is a minimally invasive, observer-independent new-age approach in postmortem examination[4]. Virtopsy is a virtual substitute to a traditional autopsy, conducted with scanning and imaging technology. The name is a portmanteau of 'virtual' and 'autopsy' and is a trademark inscribed to Prof. Richard Dirnhofer (de), the former head of the Institute of Forensic Medicine of the University of Bern, Switzerland [5].

The non-invasive nature of virtopsy is its salient feature, offering many advantages over conventional gross autopsy. The resultant advent of virtopsy into forensic pathology appraisal, therefore, has been a necessary development[6].

Virtopsy represents not only the first step toward a better obtaining of information regarding death causes, lesions types, etc., through modern technologies but also an alternative that ensures the right to body integrity, to intimacy, and assigning an intrinsic value to the human body. At the same time, virtopsy avoids social stigma, whose huge prejudices would exhibit on the family members and on the deceased person, impacting the image of his life. Although virtopsy is advanced and has many benefits, it in itself is not entirely free from demerits[7].

This article reviews on virtopsy where in various articles were tracked down through web search, relevant data were selected, extracted and summarized here.

History:

A question "The autopsy: Do we still need it?" released by a journal "Chest" in 1970 led to an initiation of new paths and alternative ways for autopsy[8]. Imaging techniques were suggested as the most important pathway and was supported by the establishment of organizations like the Society of Imaginological Autopsy (Japan), the Institute of Forensic Medicine (Denmark), the Headquarters of Medical Examinations of the Armed Forces of the United States of America and the Victorian Institute of Pathology (Australia)[9]. In the nineties, the Institute of Forensic Medicine of the University of Bern, Switzerland, started to document on the properties of the human body in a concrete, objective and non-invasive way. This arose the creation of a new discipline, designated as "Virtopsy", a virtual project of autopsy[2]. In this context, the idea of the objective and non-invasive documentation of the body lies in the observation of the anatomical structures through computed tomography (CT), magnetic resonance (MRI) and micro radiology devices. The computed tomography images of the observed structures were developed into 3D reconstructions by using specific software (e.g. Tera Recon Aquarius NET®, Foster City, California, United States of America). Another part of the documentation deal with the body surface recording, performed by forensic photogrammetry and 3D optical scanning[9].

The keystones of Virtopsy are –Three-dimensional (3D) surface scanning 3D/computer aided design photogrammetry, Multi-slice computed tomography (MSCT), Magnetic resonance imaging (MRI), MRI spectroscopy.

Procedure of Virtopsy

Virtopsy contains the following tools[9]:

- 3D surface scan using 3D photogrammetry based optical surface scanner
- Post-mortem CT (PMCT) with adjuvants such as PMCT-guided biopsy (pm-biopsy and PMCT-guided angiography)
- Post-mortem MRI (pm-MRI)/MRS (magnetic resonance spectroscopy).
- 3D facial reconstruction.

The procedure of virtopsy is based on the

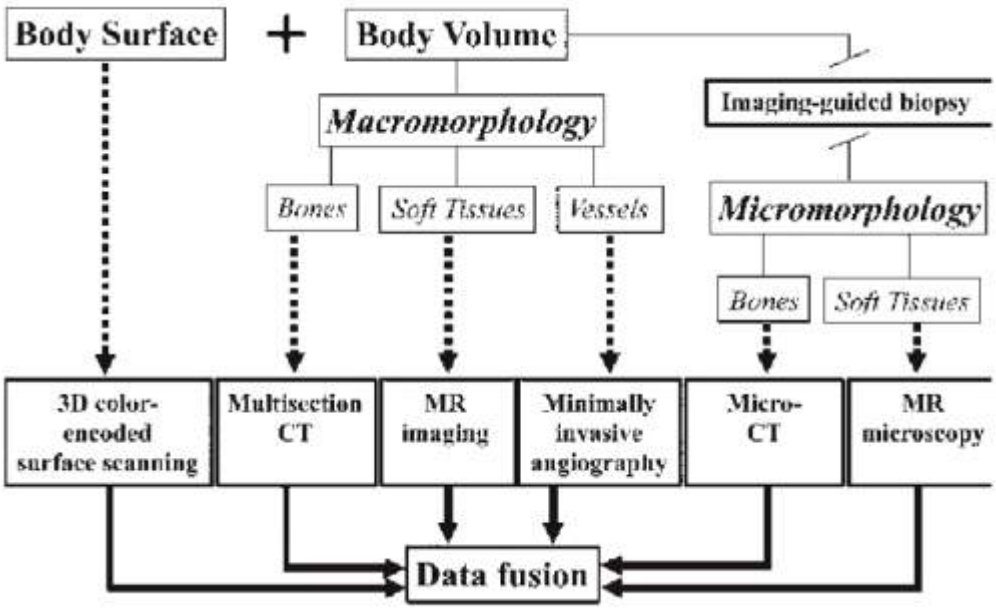

Fig. 1 : Chart illustrates the Virtopsy project, in which forensic information is acquired with various radiologic methods.
Courtesy - Dirnhofer R, Jackowski C, Vock P, Potter K, Thali MJ. Virtopsy – minimally invasive, imaging guided virtual autopsy.

principle of triangulation and an entire procedure requires approximately 30 minutes. The accuracy of virtopsy on detailing anatomical structures depends on the equipment and the settings used.

A. Arrange the corpse for autopsy

- Place small disks along the exterior of the body so that the surface scan and the interior scans could easily be lined up.
- The markers are used by the computer processors to calibrate the exterior scan of the corpse and match with internal imaging processes.
- Virtobot was developed at university of Bern. Using it, interpersonal inaccuracies can be avoided. It scans around the dead tissue with light radiation and takes photos with high quality.

B. 3D color model of the corpse

- The scan uses stereoscopic cameras of 0.02mm resolution to capture the color image, and a projector is used to cast a mesh pattern on the body.
- The robot move over the body creating a 3D image and the process takes as little as 10seconds.

C. After surface scanning - preparing[10] for CT/MRI

- Brought to the CT and MRI workplace usually double-covered inside a blue bag through which X-rays can easily pass, in order to prevent contamination and then the body is placed on the sliding table of the CT, MRI, and MRS equipment.
- While the body is scanned, the bag will remain closed, in order to respect privacy of the dead, maintain hygiene of the surroundings and to remain undisturbed by any non-forensic personnel in the room (Figure 2).

D. CT and MRI/MRS

- A corpse is subjected to CT scan, a procedure that takes upto 20 seconds and obtains up to 25,000 images.
- Each image is a slice or cut through the body. Further, the corpse is also subjected to MRI and MRS scans.

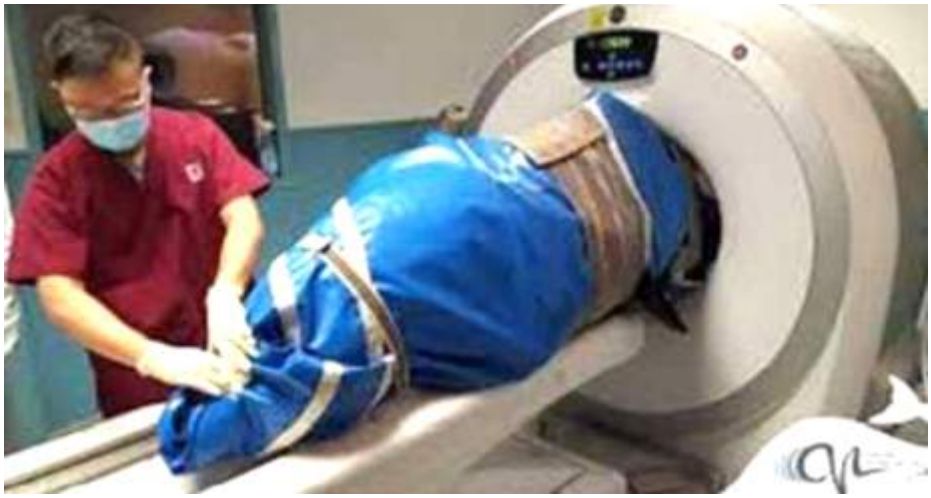

Fig.2 : Blue bag containing the corpse during scanning
Courtesy - Virtopsy: Digital Era of Autopsy, Shreshta Sathish.

E. Combining the data

- Interior and surface scans are fed to powerful desktop computers where in data are combined, further furnished using computer aided drafting-style programs and ultra-powerful graphics processors.
- In a short interval as 10 min, crisp, detailed images of bone and tissue are reconstructed using powerful desktop computers, from the data representing thin X-ray slices of the body.
- Different tissues, foreign objects (such as bullets) and bodily substances absorb the scanner's X-rays in varying amount and the different absorption levels are supplied into a 3D visualization of different colors and opacities.
- The computer can allot the density differences of any color, but this is often standardized as
  - Blue for air pockets,
  - Beige for soft tissues,
  - Red for blood vessels,
  - and White for bones.

F. 3D Forensic Facial Reconstruction

- Computerized 3D FFR: 3D computerized models are constructed using manual clay model techniques.
- Computerized systems
  - 3D animation software: to replicate the face onto the skull
  - Sensable Technologies
  - Phantom Desktop TM Haptic Device
  - Virtual sculpture system with haptic feedback[11].

Virtopsy table

This is a large touch-sensitive liquid-crystal display screen represents the operating table displaying the image of the body. This device was developed by Dr. Anders Persson[11]. (Figure3).

Practice of Virtopsy

Virtobots

virtopsy uses an all-in-one machine called "Virtobot" which integrates the four imaging tools of virtopsy. This machine will allow combined surface and body volume data addition within a single 3D space, making present-day data fusion techniques dispensable. (Figure 4)

Virtomobile

Virtobot is a gigantic machine making its use in the sites of mass disaster ineffective. This led to the requirement of a more compact device for practice of virtopsy. Thus, virtomobile was conceived. It is a variety of Virtobot mounted on a trailer which can be easily transported to the site of disaster[12].

Fig. 3 Virtopsy table - Large touch-sensitive liquid-crystal display screen represents the operating table displaying the image of the body
Courtesy- Virtopsy: The Digital Era of Autopsy ,Shreshta Sathish.

Applications:

For identification of individuals

Dental identification procedures often deal with comparison between post-mortem and ante mortem data, dental deoxyribonucleic acid techniques and development of dental post-mortem victim details. Post-mortem dental data are compulsory for dental identification and these are obtained principally by visual examination. But visual examination is arduous in victims with charred bodies and damaged oral cavities. In such cases, virtopsy becomes a very quick, reliable way for getting post-mortem records[13].

Smith et al. reported a case of positive identification of a deceased individual which was achieved by performing a CT scan on an unidentified cranium and comparing multiple landmarks, images with corresponding features in an ante mortem CT scan of a missing individual. The result revealed that they were exactly the same on both CT scans, confirming the identity of the missing person[14].

For toxicological examination

Virtopsy can be used as a tool to determine the death of an individual in cases of drug abuse[13].

Fig. 4
A representative image of the VIRTOBOT system. Courtesy: Louise Murray, Biomedical Picture of the Day (BPoD). Managed by the MRC London Institute of Medical Sciences

Virtopsy in road traffic accident

Aghayev reported a case series of three cases of fatal blunt head injury using post-mortem MSCT and MRI that revealed substantial hard and soft tissue injuries of the head and signs of high intracranial pressure along with herniation of the cerebellar tonsils. Similar findings were found in clinical autopsy, which was performed after the digital autopsy[15].

Role of virtopsy in cardiorespiratory failure from nontraumatic origin

Sohail et al. described the utility of PMCT examination in determining the cause of death among male prisoners dying in Karachi jails, and it was concluded that PMCT is as effective as dissection autopsy in recognizing pulmonary infections and natural causes of death [16].

In determining the timing of death

Virtopsy can be used to determine the timing of death by the changes seen in both MSCT and MRI in head injury cases[17].

Role of virtopsy in death due to burns

Thali et al. reported a case of a completely charred body resulted from a single motor vehicle/fixed object collision with a post-crash fire. With a help of radiological methods of MSCT and MRI it was possible to document the injuries caused by burns as well as the forensic relevant vital reactions such as air embolism and blood aspiration and they concluded that post-mortem imaging is a good forensic visualization tool with a great capacity for forensic documentation and examination of completely charred bodies[18].

Role of virtopsy in gunshot injuries

Thali MJ et al. reported a case series of eight gunshot victims scanned by MSCT and MRI; the data from these imaging techniques were post processed in a workstation, interpreted with subsequent correlation of findings from classical autopsy. The spiral CT and MRI examinations with the subsequent two-dimensional multi-planar reformation and 3D shaded surface display reconstruction the entire gunshot created complex skull fractures and brain injuries (deeply-driven bone splinters and wound channels) could be documented in complete graphic detail [19].

Virtopsy in drowning deaths

Plattner reported a case of drowning in which the findings of a massive vital decompression with pulmonary barotrauma and lethal gas embolism were identified in the radiological images[20].

Virtopsy in hanging or manual strangulation

Case series of nine persons who died from hanging or manual strangulation was reported by Yen K et al. They described a post-mortem MSCT and MRI reports of the deceased. The neck findings were compared with those discovered during forensic autopsy. In addition, two living patients underwent imaging and clinical examination following severe manual strangulation and near-hanging, respectively. The report concluded that MSCT and MRI revealed strangulation signs concordantly with forensic pathology findings[21].

Virtopsy for age and gender determination

Sexually dimorphic bones that include pelvic bones such as the os sacrum are used to determine the gender in forensic practice. PMCT scan provides an easy and fast method for depicting and measuring bone structures prior to elaborative autopsy preparations[22].

Medico-legal autopsy in Covid-19 deaths is a high-risk procedure and should be avoided where ever possible[23]. 'Virtopsy' has been suggested as an effective alternative to high-risk traditional autopsy procedure in pandemic situation like Covid-19[24].

THE VIRTUAL DENTAL AUTOPSY PROJECT (VIRDENTOPSY)

The identification process of unidentified human remains should always adhere with best practices in human identification, which should always comprise a complete dental

Fig.5 : Virdentopsy™ registered brand (Class 44).
Courtesy - Silver, E.W.; Souviron, R.R. Postmortem records. The dental autopsy. In Dental Autopsy; Silver, E.W., Souviron, R.R., Eds.; CRC Press: Boca Raton, FL, USA

autopsy even when no forensic odontologists are available onsite. Based on this hypothesis, The Human Identification Laboratory and the medico-legal section of the University of Turin started a research project in 2020 Furthermore, teleconsultation in medicine and dentistry, especially during the COVID-19 pandemic[25] and potential risk of infection[26], can also be applied in forensics, and specifically in the human identification process. This allows forensic pathologists to perform the autopsy procedure without compromising on the technical inputs of forensic odontologists. Currently, there are few institutions worldwide that have recognized the feasibility of remote dental autopsy[27,28] but none are currently offering teleconsultations in forensic odontology for the purpose of human identification or considering offering this service on a humanitarian basis. The project comprises research topics such as pathology, anthropology, odontology and archeology under the umbrella of human rights of the dead and humanitarian forensic odontology[27,29,30]. The term VIRDENTOPSY blends the terms "virtual" and "dental autopsy". It is a registered brand (Figure 5) with a dedicated website[30] in order to offer a remote forensic odontological assessment of post-mortem dental data of unidentified human remains. Virdentopsy provides facilities for the systematic collection of post-mortem dental data performed by forensic pathologists, dentists with no forensic background, dental hygienists with a forensic background, or other forensic operators authorized in the mortuary. These operators perform the dental and intraoral collection of postmortem dental data (also in livestreaming), following what is usually performed by forensic odontologists in the preliminary dental examination of human remains, which is one of the stages of a traditional dental autopsy[31]. Data can be passed on to the human identification laboratory, where one or more forensic odontology consultants could evaluate the data received and provide charting and the dental autopsy report[31]. Provisions on the unidentified human remains consist of the following data collection:

I. 2D or 3D video recording of the dental arches and oral cavity, using intraoral camera or smartphones (Figure 6).

ii. Photographic collection of the dental arches.

iii. Photogrammetry of the dental arches using an intraoral scanner (Figure 7).

iv. 3D scanning of jaws and skull.

v. Intraoral radiographic collection using digital sensors.

vi. Any radiographic imaging of the skull (Panoramic images, OPG, TC scans, if available).

vii. Live streaming using smartphone and smart glasses (Figure 8).

By registering on the Virdentopsy website, it will be possible to choose a type of assessment, either a single unidentified human remains, or an assessment within a DVI procedure, and decide if a primary or secondary expert opinion is required. Quality control checks would be carried out on the received data. The service is remunerated or pro-bono depending on the applicant entity. This forensic service will also be available for age estimations of living individuals and for hands-on training sessions of forensic odontology courses[32].

Advantages of virtopsy:

1. It is a non-invasive and a scalpel free imaging technology.
2. It has a digital storage facility over years or decades and even transferrable over the web for second opinion.
3. It is an ethical evolution which serves better acceptance for the relatives of the deceased and also by certain religious customs where incisions are not recommended after death.
4. No hazard of infections from the blood or other tissue fluids as there is no mutilation of the body.

Fig. 6 : Operator using smart glasses to observe and record dental features on the mandible.
Courtesy- Nuzzolese E. VIRDENTOPSY: Virtual Dental Autopsy and Remote Forensic Odontology Evaluation

Fig. 7 Post-mortem photogrammetry collection of upper dental arch using an intraoral scanner.
Courtesy- Nuzzolese E. VIRDENTOPSY: Virtual Dental Autopsy and Remote Forensic Odontology Evaluation

5. It is less time consuming and body can be released immediately after the scanning[1].
6. It is extremely efficient in studying wounds and helps matching of the probable weapon. This can be studied without disturbing the body architecture[33].

Disadvantages of Virtopsy:

1. It is not possible to differentiate all the pathological conditions with this technique.
2. It is associated with insufficient data base when compared to conventional autopsy.
3. It exhibits dilemma in distinguishing ante mortem/postmortem artifacts, color changes and establishment of infection status.
4. Infrequently small tissue injury may be missed[33].
5. The initial investment for the equipment required may not be feasible in developing countries[4].

Emerging Applications of Virtopsy:

I. Volume analysis software used in virtopsy helps in accurate estimation of mass of internal organs[13].

ii. Post-mortem angiography is a virtopsy technique that is helpful in visualization of the cardiovascular system that includes infusion of contrast medium with the aid of peristaltic pump and contrast medium[13].

iii. Robotic virtual autopsy is a multifunctional system that can perform automatic post-mortem and three dimensional surface scanning which qualitatively increase the improvement in the outcome of forensic investigations. The robotic virtual autopsy also helps in detecting the change in color of tissue[13,34].

Conclusion

Virtopsy is a non-invasive and a scalpel free imaging technology. This technique allows for the permanent preservation of the document of proof, regardless whether the victim is dead and undergoing post-mortem or surviving. In comparison to other methods, imaging techniques are able to capture the findings at the moment of investigation without causing any damage and provides better analyses. It can also be used in cultures and situations where autopsy is not supported by different religions or by family members. Virtual autopsy is a new development in the field of investigations of death, and its acceptability in the court of law is yet to be proved. We can hope that in near future, we all will be accustomed to some kind of virtual autopsy or non- invasive autopsy technique which will be beneficial for the courts as well as the autopsy surgeons and the relatives of the deceased.

Fig. 8:
Live streaming images observed remotely from a forensic odontologist
Courtesy- Nuzzolese E. VIRDENTOPSY: Virtual Dental Autopsy and Remote Forensic Odontology Evaluation

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REVIEW ARTICLE

FIXED PARTIAL DENTURE REMOVAL – WHEN, WHY AND HOW?

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ABSTRACT

Permanently cemented restorations may need to be removed for various reasons, such as elimination of secondary caries beneath the crown, endodontic treatment of a tooth with irreversible pulpitis, or removal of a fixed partial prosthesis with a loosened retainer at one end. However, disassembly of a fixed prosthesis is always an unpredictable procedure that may end in complications. The aim of this paper is to explain different methods of removal systems, and when and why they might be considered.

Keyword: Cementation failure, Ultrasonic, Jack-screw, Disassembly, Crown-splitter.

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INTRODUCTION

The use of crowns and bridgework to restore a patient's dentition is a common procedure performed by dentists. Despite advancements in the materials and methods used to manufacture such restorations, as well as the cements used to keep them in place, crowns and bridges deteriorate and must be replaced. The reasons for failure are multiple and can be classified as1,2.

These findings emphasize the importance of inspecting crown and bridgework for indicators of failure on a frequent basis (Table1). In the interproximal regions, bitewing radiographs can reveal information on the marginal fit of restorations and retainers. On occlusal loading, thorough examination may reveal the characteristic appearance of bubbles emerging at the loose retainer's edge.

Biological
- Caries
- Endodontic treatment
- Endodontic re-treatment
- Periodontal
- Occlusion
- Metal allergies

Mechanical
- Cementation failure
- Defective margins
- Post and core failure under crowns or fixed bridges
- Precision attachment breakages
- Fractured porcelain facings

Aesthetics
- Colour
- Contour

Table 1: Reasons for fixed prosthesis failure

Treatment must be carefully planned, designed, and executed. Long-term success requires patient maintenance with good plaque management.[3]

Considerations prior to crown and bridge disassembly[4]

1. Medical contraindications
2. Restorability of retainer(s)
3. Periodontal status
4. Intra oral access
5. Status of underlying core
6. Cement lute used
7. Crown and bridge materials

Crown and bridge disassembly classification

There are number of mechanisms available for disassembling crown and bridge. It would be helpful and easier for the general practitioners if these mechanisms are classified into groups. Liam D Addy has classified different crown removal systems into groups in his article (Table2). These include[3] –

Conservative: prosthesis remain intact

Semiconservative: minor damages to the prosthesis. It could be potentially reused.

Destructive: prosthesis damaged and not reusable.

In general, conservative crown and bridge removers work by giving a percussion or traction force to the prosthesis, breaking the luting cement and allowing it to be removed in one piece. Cutting a small hole in the prosthesis allows a force to be placed between the

Conservative	Semi-conservative	Destructive
1. *Richwill Crown and Bridge Remover* 2. Ultrasonic 3. Pneumatic (KaVo) *CORONAflex®*) 4. Sliding hammer 5. Crown tractors 6. Matrix bands	1. *Higa Bridge Remover* 2. *Wamkey®* 3. *Metalift Crown and Bridge Removal System*	Crown or bridge sectioning: 1. Tungsten Carbide Burs 2. Burs and *Christenson Crown Remover*

Table2: Classification of crown removal system

preparation and the bridge to break the luting cement, which is a semi-conservative approach. Destructive techniques involve sectioning of crown or bridge to enable it to be levered off.

Conservative techniques for prosthesis disassembly

Ultrasonic vibrations, either alone or in combination with other treatments, can be effective in removing restorations.[5] Siqvel and matrix band applied over the crown, burnished into the undercuts, and then drawn vertically can be a good approach for cautious removal[6] (Figure1A).

Richwill crown and bridge remover (Richwill Laboratories, Orange, CA) is a thermoplastic resin recommended for crown and bridge removal.[7,8] The resin is softened in hot water, and the patient is told to occlude until the resin block has shrunk to two-thirds of its original size. This is then chilled until it is firm using water from a triple spray syringe. After that, the patient is told to open his or her mouth quickly and forcibly. In conjunction with the use of ultrasonic energy, this procedure has been reported to be 100% successful for temporary crowns and 60% successful for dislodging cast restorations.[7] Before performing this treatment, it's important to think about what's opposing the restoration that requires removal, as well as the periodontal health of all the teeth involved (Figure1B).

Crown and bridge removers with sliding hammer designs are available in the market. To loosen the restoration, an appropriate point is picked to engage the crown margin, and then a weight is moved along the shaft in a series of short, fast taps. This technique is not recommended for patients with periodontally involved teeth owing to the risk of unintended extraction (Figure1C). They are therefore best recommended for cast metal restorations.[9]

The Pneumatic (CORONAflex) crown and bridge remover is an air-driven device that connects to standard dental airline and works by delivering a controlled low amplitude shock at its tip along the long axis of the abutment tooth (Figure1D). The loop is rib below the connector and the tip of the crown remover is placed on the bar. By removing the index finger from the air valve on the hand piece, the impact is activated. Clamps are also available with this

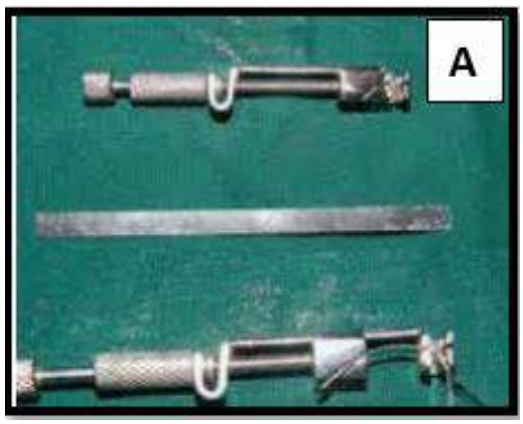

Figure 1A

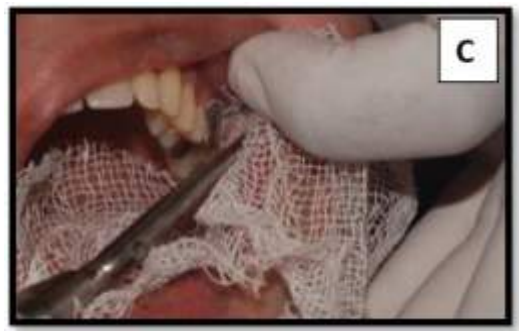

Figure 1C

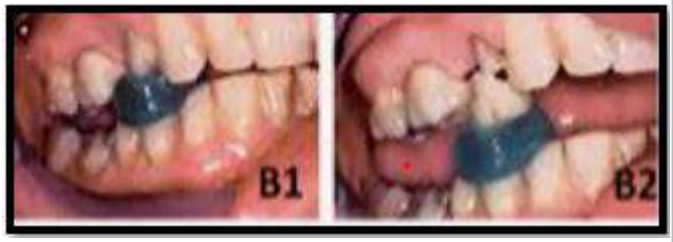

Figure 1B

Figure 1D

kit, in which clamps are fixed to individual crowns using auto- polymerizing resin and the impact is delivered via clamp to the crown.

Crown tractors grip the restoration with the aid of rubber grips and a powder designed to dislodge the restoration without damaging the restoration. This is usually used removing provisional crowns, crowns restored with temporary cement, crowns that are difficult to remove at the try-in stage.

Semi-conservative techniques for prosthesis disassembly

Semi-conservative approach to disassemble the prosthesis, requires a small amount of damage to the prosthesis. The advantage with this is that it allows a more controlled and less traumatic application of force to dislodge the casting.

The Metalift system works on the jack-screw principle: a precise hole is drilled into the occlusal surface of a cast restoration, the area around the hole is undermined, and then a threaded screw is twisted into the space (Figure2A).[10] When the instrument is stopped from advancing by contact with the underlying core, a thread is cut in the metal of the casting, and prolonged spinning of the screw causes a 'jacking force,' which displaces the crown from the preparation. This technique is used to remove metal ceramic crowns with a minimum metal thickness of 0.5mm.

WamkeysTM are small, narrow-shanked cams that come in three sizes. The physician drills a hole parallel to the occlusal surface and at the hypothesised level of the underlying core through the crown or retainer (Figure2B). A Wamkey of appropriate size is inserted, with the cam's widest surface parallel to the occlusal surface, until it is centrally located when rotated 90 degrees around the shank's axis. The force should be applied in the direction of crown or retainer insertion, which is easily dislodged. The restoration can be resurfaced and the hole sealed with plastic filler material.[3]

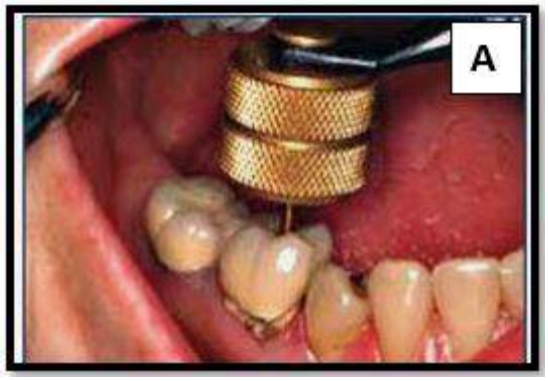

Figure 2A

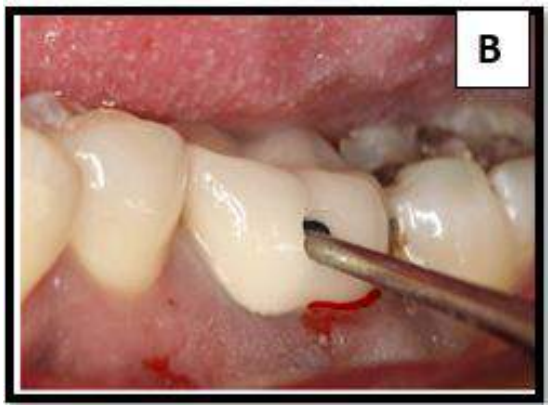

Figure 2B

Destructive techniques for prosthesis disassembly

Commonly practised method by most of the clinicians to remove the crown and bridge is by using a carbide or tungsten bur (Figure4). By confining the slot to the labial surface and disrupting the cement lute with an ultrasonic tool, space can be created to elevate the crown or bridge and keep it intact. When using adhesive cements, it may be required to cut through the lingual surface as well, which will entirely ruin the crown.[3] While attempting to remove the crown, a gauze piece must be reinserted to prevent the patient from aspirating it (Figure 3).

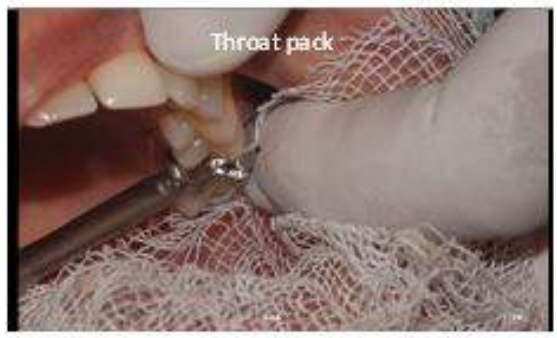

Figure 3

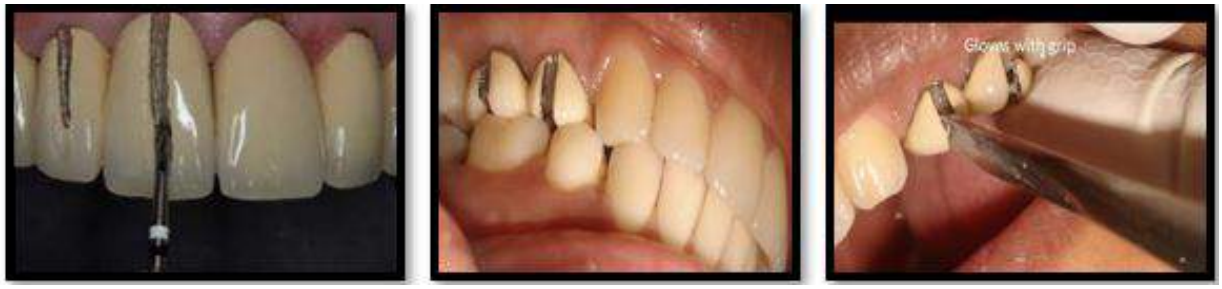

Figure 4

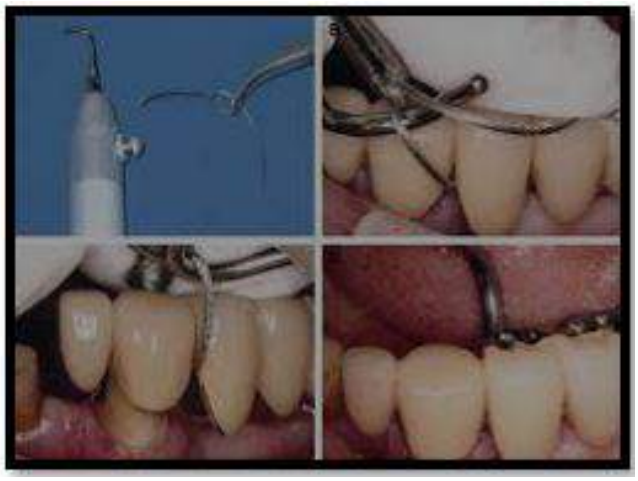

Figure 5

Figure 6

While excavators and Mitchell's trimmers can be employed, a Christenson crown remover is a handy tool for this final stage. The use of such a 'crown splitter' evenly distributes the split, decreasing stress on the tooth/core. The restorations that have been removed in this manner cannot be reused, but they can be relined and used as temporary restorations.[3]

A suture thread or dental floss can be tied to the bridge (Fixed prosthesis) before removing it to prevent its aspiration (Figure5).

Removal of Porcelain Crowns and Veneers

Lasers can be utilised to successfully debond porcelain laminate veneers and crowns as an alternative to standard removal techniques (such as handpieces and diamond burs). A veneer restoration can be adequately debonded in less than 2 minutes using an erbium laser at 2780-2940 nm (Figure6). The wavelength of the laser goes through the porcelain and is absorbed by the water in the luting agent, causing the resin to soften thermally. After the laser is applied, a mechanical remover (curette or crown remover) is used to remove the entire veneer.[11,12]

Retrieval of Implant Crowns

If an abutment screw loosens, the head of the abutment screw must be accurately found and accessed. This can be accomplished using a variety of techniques, including intraoral periapical radiography or cone beam computed tomography, staining the occlusal surface of the crown at the location of the abutment screw as a means of locating screw access, and creating a small access opening or slot within the crown to reach the abutment screw and tighten it without damaging the cemented crown.[13,14,15]

During wax-up, Prestipino et al[16] created a flat retrieval slot in the lingual marginal area of the crown-abutment interface. They inserted a flat-headed driver into the slot and rotated it clockwise, causing a torquing force that drove the abutment below while pushing the prosthesis higher, finally breaking the cement seal.

A process for fabricating a retrievable cemented restoration was described by Rajan and Gunaseelan. During the wax-up, casting, and ceramic application of the implant crown, a screwdriver is used to keep a screw access channel open. Excess cement extruded via the channel is removed once the crown is cemented, and the channel is sealed with composite resin. Uludag and Celik later used this technique to create a multiunit prosthesis.[17,18]

A technique for reaching an abutment screw in a cement-retained restoration was described in two clinical reports. Using a vacuum-formed transparent stent or guide, the approach tries to precisely establish the 3-dimensional position of the abutment screw. The guide is built above the cemented restoration's cast, with access holes inserted to aid in screw site visibility. The guide is put in the mouth for crown retrieval, and the crown is drilled through the access holes to locate the abutment screws.[19,20]

CONCLUSION

The discussion above has focussed on some specific devices and systems applicable to the area of interest. No universal system exists for the safe, intact removal of permanently cemented prostheses. Each clinical situation differs, and some circumstances may dictate the use of a combination of techniques. Success lies in careful treatment planning, none of the instruments are universally applicable. Some situations may require conservative approach while some destructive. Patient should be made aware, at the outset of the treatment, of the unpredictability of attempts at conservative and semi-conservative crown and bridge disassembly, and also the risks associated with it.

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REVIEW ARTICLE

FAILURE IN ENDOSSEOUS IMPLANTS: AN OVERVIEW

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ABSTRACT

In present world endosseous dental implants have been a successful treatment alternative for restoring missing teeth. Dental implants have almost replaced old school fixed and removable prosthesis and with the introduction of the concept of osseointegration, the success of dental implants has increased dramatically because of better understanding of bone response and the improvement in bone loading concepts. As every treatment has its own pros and cons ,implants are also not successful in every case, as evidenced by reports reviewing the reasons for implant failures. The focus of implant research is shifting from descriptions of clinical success to the identification of factors associated with failure.

Keywords: Endosseous, Failure, Implant,Peri-implantitis,Tooth.

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INTRODUCTION

Implants helps a lot in replacing missing tooth. Although it is most successful procedure for replacing missing teeth but every good thing is associated with failures.[1] Some authors have related failures to biological or microbiological reasons, and others have attributed dental implant failures to biomechanical or biomaterial factors or implants surface treatment and characteristics.[2] Improper patient selection, accumulation of bacterial plaque because of poor oral hygiene, traumatic occlusion, debris retention resulting from improper prosthetic restoration and bone preparation without the use of coolants, high torque, slow speed hand pieces, have been the factors contributing to the breakdown of otherwise successful implants.[3]

Definition of Implant Failure

The total failure of the implant to fulfill its purpose (functional, aesthetic or phonetic) because of mechanical or biological reasons.[4] Dental implants may fail for different reasons, with a range that differentiates between a failure and a complication. Esposito et al stated that this definition includes biological failures related to biological processes and mechanical failure of the component including fractures of implants, coatings, connecting screws and prosthesis.[5]

Tonetti and Schmidt classified dental implant failures chronologically as early and late failures. They presented the different elements in the understanding of the biomechanical equilibrium, where osseo-integrated implants and the surrounding bone represent a single functional unit that withstands repeated loading cycles.[2]

The concept of failure beyond the loss of integration has included esthetic, functional and phonetic reasons. Successful implant integration does not necessarily result in satisfaction in patient with high expectations.[6] Furthermore to avoid or decrease the percentage of failure caused by loading, a loading concept has been introduced by Misch so as to permit the physiology of bone to respond to the additional load; this concept is called progressive bone loading.[7]

Warning signs of implant failure[8]

- Connecting screw loosening
- Gingival bleeding and enlargement
- Connecting screw fracture
- Angular bone loss noted radiographically
- Fracture prosthetic component
- If there is long-standing infection and soft tissue sloughing during the healing period of first-stage surgery.

Classification[2]

According to condition

- Ailing Implant
- Failing Implant
- Failed Implant

According to Etiology

- Host factor
- Surgical factor
- Implant selection factor
- Restorative factor

According to timing of failure

- Before stage II
- After stage II
- After restoration

According to failure mode

- Lack of osseointegration
- Unacceptable aesthetics
- Functional problems
- Psychological problems

According to supporting tissue type

- Soft tissue loss
- Bone loss
- Combination

Host factor

- Medical status
- Habits
- Oral status

Medical Status

• Osteoporosis and other bone diseases[9,10]

Postmenopausal osteoporosis is a skeletal disorder in which there is a decrease in bone density and bone mass. It is considered to be a relative contraindication for osseointegrated implants, caused by decreased bone density, which negatively and substantially affects the

'implant-bone contact. Longer healing period, hyperbaric oxygen therapy, and therapeutic treatment for osteoporosis. The use of hydroxy apatite (HA) coated implants would help increase the implant-bone contact surface area with a biochemical bonding to the bone instead of mechanical bonding. The increased number of implants to support the prosthesis also is considered contributing factor for better load distribution.

• Uncontrolled diabetes[11]

Diabetes mellitus does not affect directly the failure of implants. Diabetes experience more infection in clean wounds than patients without diabetes. The liability of infection is probably caused by thinning and fragility of the blood vessels so as to alter blood supply.

Habits[12]

• **Smoking:** Studies have shown that 'One of the primary factors that leads to implant failure is smoking.

• Para functional habits

Habits such as bruxing and Clenching create mechanical and biologic complications related to prosthetic components, materials and Bone-anchored hardware or the state of osseointegration.

This is the most common cause of implant bone loss or lack of rigid fixation during first year after implant insertion

Oral Status[13,14]

Dental plaque is one of the main factors that leads to implant failure. Because the suprabony connective tissue fibres are oriented parallel to to the implant surface, it is susceptible to plaque accumulation and bacterial ingress.

Management

- Recall patient frequently, preferably at a minimum of 3-month intervals.
- Periodontal indices, bleeding on probing and radiographic evaluation should performed, using plastic tipped probes for checking pocket depths.
- Soft tissue debndement should be performed by means of plastic curettes and plastic tips.

Juvenile and rapidly progressive periodontitis

It seems that there is a strong link between periodontally involved patient and dental implant failure. Gram-negative anaerobic flora with high level of spirochetes associated with failing implants.

Irradiation Therapy

The relationship between dental implant failure and the irradiated patient is not clear. The main problem with irradiated patients is decreased salivary flow xerostomia, the liability for infection because of the decrease in blood supply and the possibility of osteoradionecrosis.

Surgical Factors[2]

- Off axis placement
- Lack of initial stabilization
- Impaired healing and infection
- Over heating of the bone and exerting too much of the pressure :
- Minimal space between the implants
- Placing the implants in immature bone grafted sites
- Placement of the implant in an infected socket or pathologic lesion

Dental implants may fail because of[15]

- placement of the fixture into either an infected socket
- an existing pathological lesion (e.g., 'cyst); or
- migration of infection from a neighboring tooth via marrow space

Implant Selection[16,17]

Improper Implant Type in Improper Bone Type: Qualitative and quantitative considerations of bone must be evaluated before placing implant. The quality of bone supporting the implant is important for long-term success. The amount

of bone available 'and the position of anatomic structures ultimately define the design of implant to be used and its location in the arch.

Length of the Implant (Too Short, Crown Root Ratio Unfavorable): The long-term success of the implant is dependent on the amount of bone-implant contact. Therefore, the placement of a short implant where bone permits a longer length (i.e., an 8-mm implant in a 12-mm ridge) would result in higher stress concentration leading to subsequent failure of the implant. The crown-implant body ratio affects the appearance of the final prosthesis along with the amount of moment of force on the implant and the crestal surrounding bone. Greater the crown-Implant ratio, the greater the amount of force with any lateral force .

Width of the implant: Misch Stated that the primarv criterion affecting the long-term survival of endosteal implants is the width of a available bone. It has been recommended that not less than 1 mm of bone surrounding the fixture labially and lingually, is mandatory for the long term predictability of dental implants because it maintains enough bone thickness and blood supply.

Number of the implants: Misch stated that the use of more implants decreases the number of pontics and the associated mechanics and strains on the prosthesis and dissipates stresses more effectively to the bone structure (specially at the crest). It also increases the implant bone inter-face and improves the ability of the fixed restoration to withstand forces.

Improper implant design[2,15]

Hollow implants (i.e., the hollow basket) affect the success rate negatively) more than the solid cylinders because of the dead space that is susceptible to infection. It is suggested that solid implants are better than hollow implants for long-term success .

Restorative Problems

Excessive cantilever: For partially edentulous patients, it places offset loads to the implant abutments and results in greater tensile and shear forces on cement or screw fixation. Fracture of the prosthesis, loss of osseointegration and bone fracture.

Pier Abutments:

Because of the difference in mean axial displacement between natural teeth and implants the breakdown of supporting tissues is extremely rapid because the dental implant will take most of the load as a result of difference in mean of axial displacement.

No passive fit:

To reduce stresses in the superstructure, implant components and bone adjacent to the implant, a passive fit is essential. Achieving a proper abutment fixture interface fit is critical. Improper locking between the two parts of the antirotational implant device leads to increased microbial population and increased strain on the implant components with subsequent bone loss and rapid screw joint fracture.

Misch prosthetic consideration for final treatment plan[18]

- Interarch space
- Implant permucosal
- Existing occlusal plane
- Arch relationship
- Arch form
- Existing occlusion
- Existing prostheses
- Number and location of missing teeth
- Lip line
- Mandibular flexure

Improper occlusal scheme[19,20]

The occlusal pattern of dental implants was derived from the basic occlusal concepts of natural teeth. Occlusal trauma on dental implants is more offensive than on natural teeth because of the force dissipation difrerence and because of differences in proprioception.

Bending moments: Bending overload can be

defined as a situation in which occlusal forces on an implant supported prosthesis exert a bending moment on the Implant cross section at the crestal bone, leading to marginal bone loss and/or eventual Implant fatigue.

Connecting implants to natural dentition: Because of the difference between natural tooth and dental implant movements in vertical and lateral directions, because of the potential differences in the way-natural teeth and implants would react to static and dynamic loading. Because of the difference in Proprioception, rigid connections between Implants and teeth are questionable

Premature loading: Too rapid loading of the implant support system is considered to be one of the most common causes of prosthetic related failure. Branemark stated that strict protocol requires a stress¬free healing period of 3 to 6 months for osseoingration to occur.

Excessive torquing: Preloading of the implant components was first accomplished by hand. Then, a torque wrench was introduced to apply a fixed amount of torque. Acid-etched surfaces resisted counter torque more successfully than blasted or machined surfaces .

According to timing of failure[2]

? Before stage II (after surgery)

? At stage II (with healing head and/or abutment insertion)

? After restoration

Before stage Ii[21]

It usually occurs as a result of

? Implant misplacement i.e. placement of the implant in an infected socket, pathological lesion, or immature bone previously augmented or placement of a contaminated implant in the osteotomy

? Infection or soft tissue complications

? Lack of biocompatibility

? Excessive surgical trauma

? Lack of primary stabilization of the implant

? The failed dental implant may appear to be an exfoliating fixture accompanied by a purulent exudates.

At Stage II (With Healing Head and/or Abutment Insertion)[22].

Dental implants may fail at a certain stage of treatment that does not fall in either of the two categories of early and late failure. It can fail at the second stage of surgery, during healing or head placement, at abutment connection and before prosthetic placement. A contaminated implant may stay in a dormant condition until torque is applied to the cover screw. Then it comes out because of lack of integration, which can result from the implant being placed in a wide osteotomy, the implant being loaded before the recommended time, or traumatic placement of the implant.The implant can stay in place asymptomatically because of its biocompatibility and may not manifest signs of infection, or it may remain in a sub-acute condition, with failure being obvious at the time of uncovering. It cannot be considered an early failure because it is not early enough, and it is not a late failure because it happened before prosthetic placement.

After restoration[1]

This particular timing of failure is most common and it occurs due to occlusal trauma which starts after an integrated implant is loaded and leads up to the point of discovery of the failure. It has its own clinical manifestations, known as peri implantitis.

Peri-implantitis[23]

Bacterial invasion of the peri-implant tissues results in soft tissue inflammatory changes and rapid bone loss. The clinical signs of inflammation, bleeding, and purulence, in addition to increased mobility, peri implant radiolucency, and probing depths greater than 6 mm, are associated with failing implants.

One of the main cause of implant failure

? It begins as peri-implant mucositis

? Completely edentulous mouth are at lesser risk than Partially edentulous mouth Higher chance of cross infection from periodontitis sites to implant site

Prevention

? Selection of implant candidate

? Complete periodontal therapy before implant placement

? Maintenance of good oral hygiene

? Regular recall appointments

? Early intervention , treatment at the stage of mucositis

Retrograde peri-implantitis[24,25]

Retrograde implant failure can be due to bone micro fractures caused by premature implant loading or overloading, trauma or occlusal factors. These are characterized by periapical radiographic bone loss without gingival inflammation. The microflora is consistent with periodontal health. The mechanism by which retrograde peri implantitis induces implant failure could be explained by the fact that once the biomechanical demand has exceeded the load bearing ability of the bone, microfractures may occur. They may also occur if micro damages accumulate faster than they can be repaired, a fatigue fracture at the bone implant interface may result.

Meffert stated that implants move minimally in bone compared with their natural counterparts because the periodontal ligament hypertrophies with increased function, allowing greater movement in bone. Another fact is that with overload, microfracturing of the bone occurs. In contrast, mineralized bone volume may be reduced around natural teeth, but in the absence of inflammation or periodontal disease, the situation is reversible once the overload is eliminated or reduced. Finally, a reduced areas of support exists in the root form implant compared with the natural teeth because the periodontal ligament is attached to a natural tooth with greater surface area and allows off axis loading.

Prevention

? Careful analysis of occlusal forces

? Increased no of implants

? Precise placement and distribution of implants

? Proper follow up

According to failure mode[2]

? Lack of osseointegration

? Unacceptable aesthetics

? Functional problems

? Psychological problems

Lack of Osseointegration[26,27]

? Osseointegration is defined as a direct contact established between normal remodeled bone and an implant surface without the interposition of connective tissue.

Adell et al proposed that lack of osseointegration can be due to

? Surgical trauma

? Perforation through covering mucoperiosteum during healing

? Repeated overloading with microfractures of the bone at early stages

Lack of osseointegration can occur during the early stages of treatment because of the inability to mineralize, which can result from surgical trauma, premature loading, infection, and surface contamination.

Signs of a failed implant

? Mobile

? Easy to remove with a counter torque

? Thin radiolucent zone around fixture radiographically

? Thin layer of soft tissue seen upon fixture removal

Unacceptable esthetics[28,29,30]

The esthetic outcome is affected by 4 factors :

- Improper placement
- Soft tissue management
- Bone grafting considerations
- Prosthetic considerations

The dimensional difference between the implant head and cervical cross section of the implant will hinder the optimal esthetics in the anterior region. Improper placement of the implant and improper soft tissue management around the implant will result in a dramatic failure. Another factor is the contour of the ridge in which the implant placed. Failure of the prosthodontist to replicate the patient's natural dentition in the final prosthesis may result in unnatural appearance.

Positional failure

Implant placement must be controlled and precise in order to support tooth like restorations, the restoration should guide implant placement and planning for implant placement must take into account the form and position of the restoration. Malposition of the implant can lead to biomechanical problems to the screw joint or in severe situations to the implant itself due to overload. The implant should be placed with at least 1mm of bone circumferentially; this will allow for the crestal bone loss which can occur around the implant. When implants are not placed in relation to teeth in aesthetic areas, poor aesthetics will ensue.

Differing depths of implant placement will result in uneven exit of the implant restorations from the soft tissue, again yielding less than ideal results. In these multiple implant situations the most apically placed implant should dictate the positions of the other implants placed. If the most apically planned implant causes the other implants to be too apical, the area should be grafted prior to implant placement of the implant site not used.

Biomechanical failures

These faliures include :

a) loosening of screws

b) breakage of implant components and implants.

But these failures can be avoided with proper treatment planning, a good understanding of screw joint mechanics and knowledge of the implant system used. In implant-restoration connections the screw acts much like a spring, the torque applied to the screw causes the threads to engage and continued torque after the components are seated causes the screw to elongate. The rebound of the stretched screw clamps the implant components together; this is known as the preload.

Functional problems[31]

The masticatory efficiency of an implant supported restoration can be affected by several factors. If the implant supported prosthesis does not fulfill such a function, it is considered to have failed because of failure of function Proper function of the implants is dependent on two main types of factors, anchorage related and prosthesis related.

? Anchorage related factors: Osseo integration and Marginal bone height.

? Prosthesis related factor: Prosthesis design and Occlusal scheme .

Psychological problems[32]

Failure to fulfill the patient expectations and failure to gain the patient acceptance and satisfaction with such treatment will definitely be considered part of the failure. Educational tools (eg, slides, radiographs, models, pictures, real cases, and computer imaging) should be used before surgery to give the patient an image of what he or she will look like after treatment.

According to supporting tissue type2

? Soft tissue problems

? Bone loss

? Both soft tissue and bone loss

Soft tissue problems[33,34]

Tonetti and Schmid stated that the late failures that occur as a result of peri¬implantitis (infectious etiology) occur because of defective function of the soft tissues. Soft tissue proliferation may occur under supporting bars

of over dentures. It may require simple excision if there is adequate attached keratinised tissue apical to it, or an inverse bevel resection as used in periodontal surgery to thin out the excess tissue but preserve the keratinised tissue to produce a zone of attached tissue around the abutment.

The marginal peri-abutment tissues should constitute a functional barrier between the oral environment and the host bone sealing off the osseous fixture site from noxious agents and thermal and mechanical trauma. Continous recession around implant followed by bone loss leads to failure of implant due to soft tissue problems .

Bone loss[35]

Loss of marginal bone occurs both during the healing period and after abutment connection. The amount of bone loss differs between the two periods and between both jaws. Bone loss in mandible is higher during the healing period. In maxilla, bone loss is higher after abutment connection. These differences could be due to the higher vascularity of the maxilla, which allows faster remodeling during the healing period and the compact nature of the mandible, which withstands applied functional forces much better after abutment connection.

Factors that contribute to marginal bone loss

- ? Surgical trauma such as detachment of the periosteum and damage cased during drilling
- ? Improper stress distribution caused by defective prosthetic design and occlusal trauma
- ? Physiological ridge resorption
- ? Gingivitis, which if allowed to progress will lead to ingression of bacteria and their toxins to the underlying osseous structures.

Both soft tissue and bone loss[36]

Although they are independent, soft tissue and bone around dental implants are two separate entities. Each alone could affect the survival of the implant, and each has its own mechanism for protecting the implant. Soft tissue around the dental implant forms a biological seal that protects the supporting structure. The ultimate function of the soft tissue as a barrier is reflected in the long term changes of the marginal bone height, where as marginal bone height affects the peri implant soft tissue directly. If failure starts from soft tissue, then it usually is considered to be due to a bacterial factor. However, if failure starts at the bone level, then it is considered to be due to a mechanical factor. Both bone and soft tissue may be involved together.

According to condition of the failure[2]

Meffert proposed a classification of failure including ailing, failing, and failed implants. He described ailing implants those showing radiographic bone loss without inflammatory signs or mobility. Such implants do not pose any indication of failure but with the progression of bone loss they could be greater risk of failure. Failing implants are characterized by progressive bone loss, signs of inflammation, and no mobility. These implants are usually in a reversible state (condition can be treated). Failed implants are those with progressive bone loss swith clinical mobility and that are not functioning in the intended-sense. Failed implant are usually encapsulated in a fibrous capsule. Radiographically, failed implants are characterized by diffuse radiolucency around them.

CONCLUSION

Regular review and maintenance of patients are essential to maintain the health of implant supporting tissues, to prevent minor complications and measure one's own long-term success at providing this treatment. With proper patient selection and treatment planning, using dental implants to support restorations replacing missing teeth can provide long lasting functional and aesthetic restorations.

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NON-SURGICAL CORRECTION OF MILD VERTICAL MAXILLARY EXCESS USING ORTHODONTIC IMPLANTS – A CASE REPORT

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ABSTRACT

This case report illustrates straightforward non-surgical maxillary arch intrusion in a skeletal Class I facial profile to correct a gummy smile. Skeletal anchorage using orthodontic miniscrew implants can now be used to achieve full maxillary arch intrusion. For this patient, orthodontic treatment along with three microscrew implants achieved excellent aesthetics in 13 months, and the treatment results remained stable even 10 years post treatment.

Key words : Gummy smile, TAD, microscrew implant, maxillary arch intrusion.

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INTRODUCTION

Vertical Maxillary Excess(VME) commonly known as gummy smile is a problem encountered in orthodontic patients. VME is an excessive maxillary development in the vertical plane. Correction of mild VME is possible by intrusion of the entire maxillary arch using temporary anchorage devices (TADs).

Diagnosis

PST, a female who was 18-years and 9-months-old presented with a chief complaint of gummy smile (Fig. 1 A & B). There were no significant findings in her medical and dental history. On facial examination, her appearance was symmetrical, with a mildly convex profile, competent lips and Vertical Maxillary Excess.

Fig. 1 A

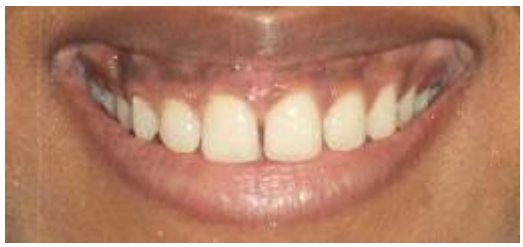

Fig. 1 B

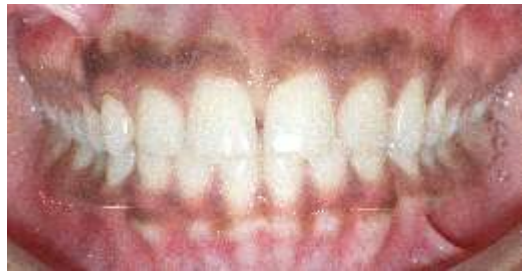

Fig. 2 A

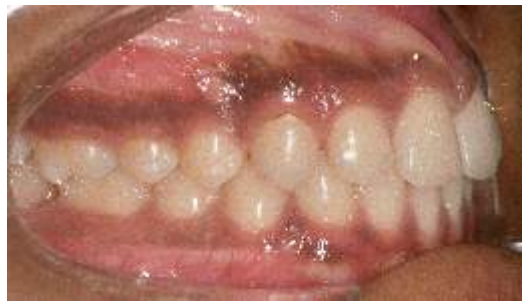

Fig. 2 B

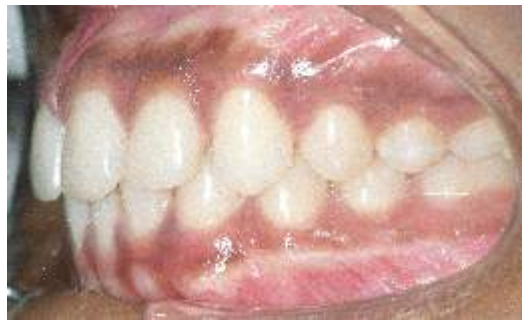

Fig. 2 C

On intraoral examination, her oral hygiene was good though she had some calculus deposits on the lingual of the lower anterior teeth. No caries was detected and her third molars were unerupted. She had Angle's Class I molar relationship on both sides and upper anterior spacing of 3mm (Fig. 2 A, B &C)

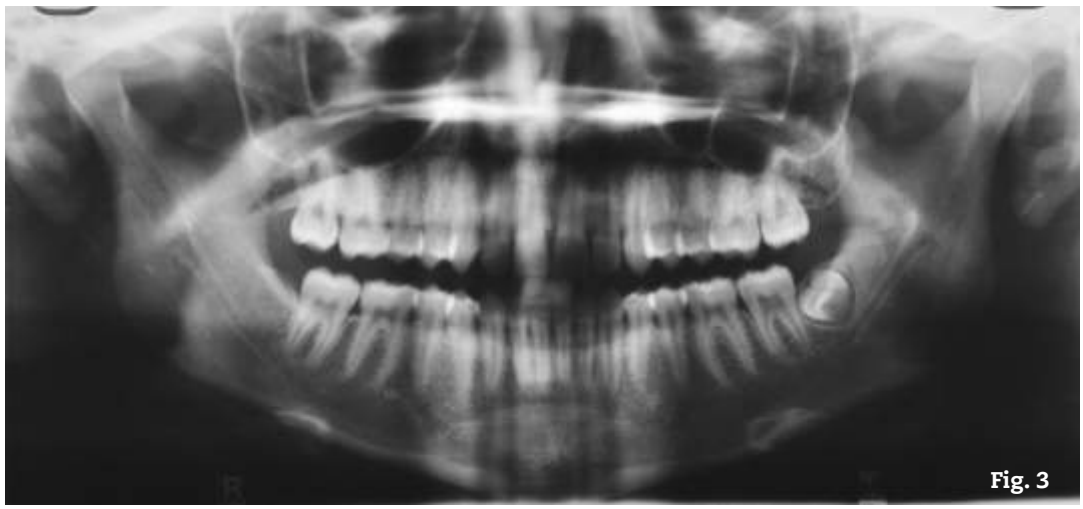

Fig. 3

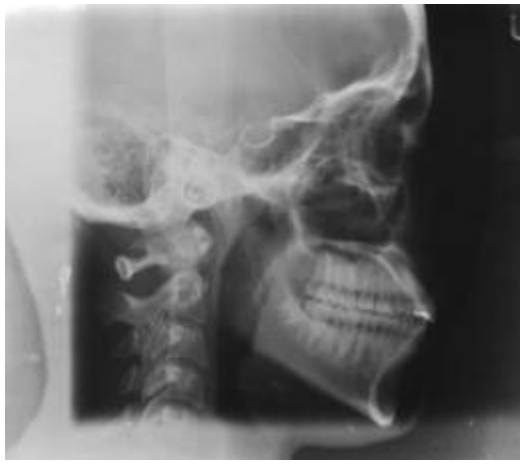

Fig. 4

OPG revealed no obvious pathology (Fig.3); all third molars except the lower left third molar were congenitally absent. Lateral cephalogram showed good skeletal pattern with mild dento-alveolar protrusion (Fig. 4).

The following measurements were taken during maximum smile: Alar base width, upper lip length from base of the nose, upper central incisor tip from base of the nose and amount of gingival display (from gingival margin of upper left central incisor to lower border of upper lip) (see Table 1).

Table 1

Measurements at maximum smile	Pre Treatment
Alar base width	43 mm
Upper lip length from base of nose	12mm
Upper central incisor tip from base of nose	26 mm
Gingival display	4mm

Treatment Objective

The main objective being correction of the gummy smile without orthognathic surgery, intrusion of the maxillary dental arch was to be done using three micro-screw implants after initial levelling and alignment.

Treatment Plan

Orthodontic treatment of both upper and lower arches using fixed orthodontic appliances. Levelling and alignment of the arches was to be followed by intrusion of the entire maxillary arch using three mini screw implants to reduce the Vertical Maxillary Excess. A soldered Trans-palatal arch kept 4mm away from the palate was to be used to prevent buccal flaring of the maxillary posterior segments.

After active treatment, bonded lingual retainers and removable Hawley's Retainers would be used.

Treatment Progress

After oral prophylaxis, orthodontic treatment was started with fixed pre-adjusted edgewise appliances in both arches (0.022" Roth prescription Mini Master by American Orthodontics Inc.). A soldered trans-palatal arch was cemented on the upper first molars. Initial levelling and alignment carried out using 0.016" NiTi arch wires and 0.018" Australian Premium Plus Stainless Steel archwire. Subsequently, 0.019"x0.025" Stainless steel archwires were placed.

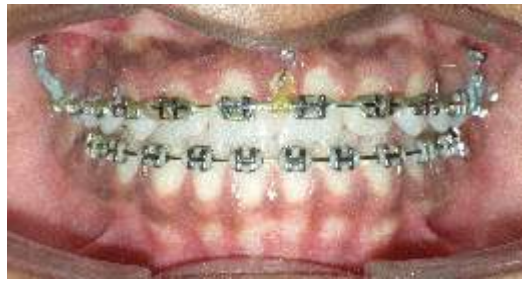

Fig. 5 A

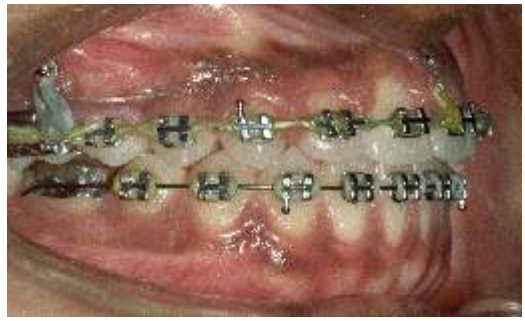

Fig. 5 B

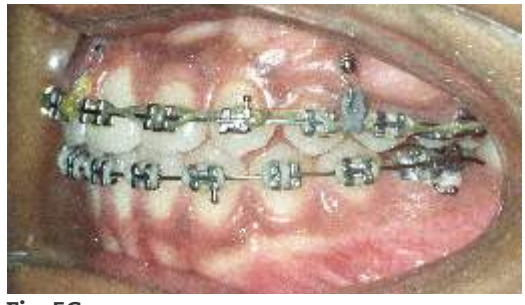

Fig. 5C

Three months into treatment 3 micro-screw implants (TAD) (Abso Anchor SH 1413-08, Dentos, Daegu, Korea) were placed in the upper arch under local infiltration anesthesia. One was placed 2mm to the left side of the upper midline and the other two between the first and second premolars on each side (Fig.5 A, B & C). Intrusion forces were delivered using elastomeric chains from the TADs to the maxillary archwire for the intrusion of the entire maxillary arch. The TAD on the right side failed after one month and was replaced after two days distal to the roots of the second premolar. The elastomeric chains were changed regularly every month. Lateral open-bite noticed after 3 months of intrusion mechanics were closed using vertical elastics worn at night only for 3 months. In all, active intrusion forces were applied for 8 months.

After adequate intrusion was obtained as determined visually, all intrusion mechanics was stopped for one month to allow settling of the occlusion before removing all appliances. The TADs were also removed using surface anesthesia. Lingual retainer wires were bonded on the upper incisors. Upper and lower Hawley retainers were given after 4 days, to be worn only at night.

Upper labial frenectomy was done within one week of completion of active orthodontic treatment. Progress OPG and Lateral Cephalograms were taken.

The patient was seen regularly for retention checks. Two years into retention, the lower left third molar was surgically removed as it was impacted. The last retention check was more than 10 years after completion of active treatment.

Treatment Results

The total active treatment time was 13 months. The post treatment records confirmed good results, and the gummy smile was fully corrected. The gingival display decreased from 4mm to-1mm. The upper lip length at

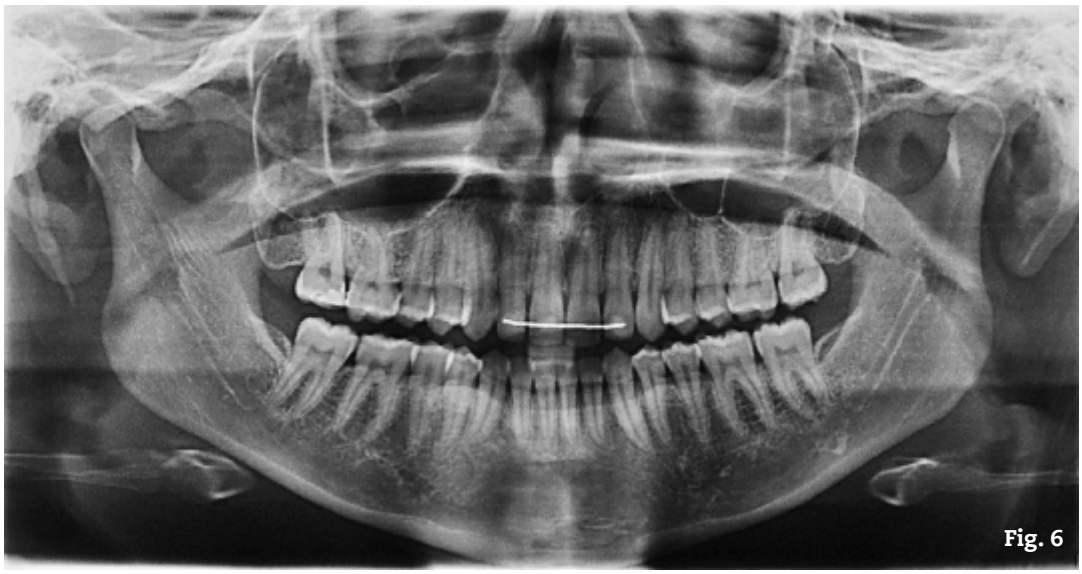

Fig. 6

Table 2

Measurements at maximum smile	Pre Treatment	Post Treatment
Alar base width	43 mm	43 mm
Upper lip length from base of nose	12mm	12mm
Upper central incisor tip from base of nose	26 mm	21 mm
Gingival display	4mm	-1mm

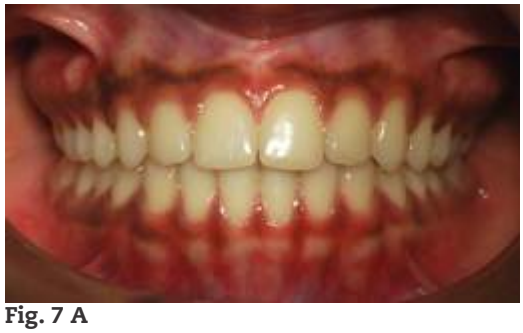

Fig. 7 A

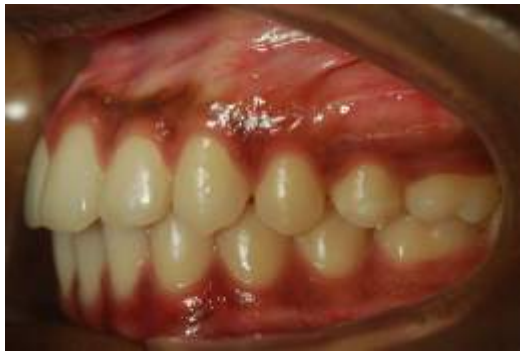

Fig. 7 B

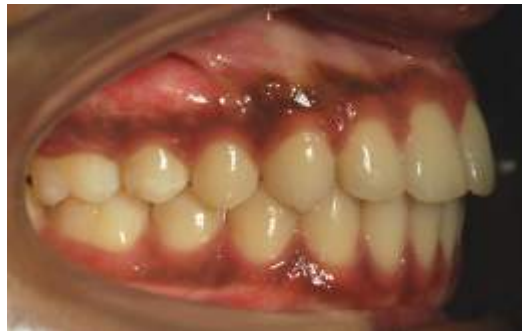

Fig. 7 C

Fig. 7 D

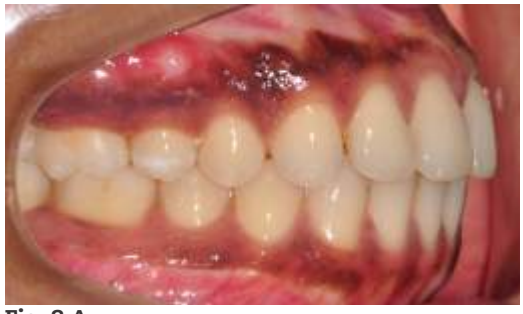

Fig. 8 A

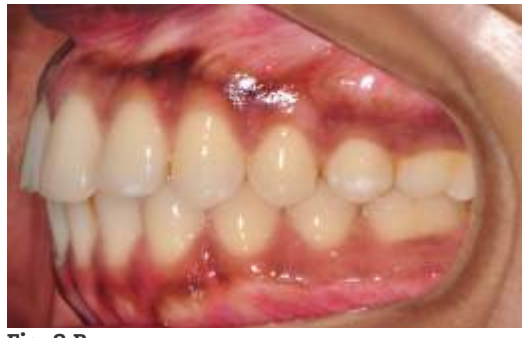

Fig. 8 B

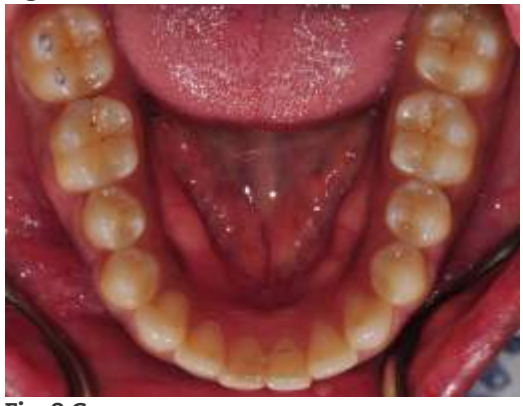

Fig. 8 C

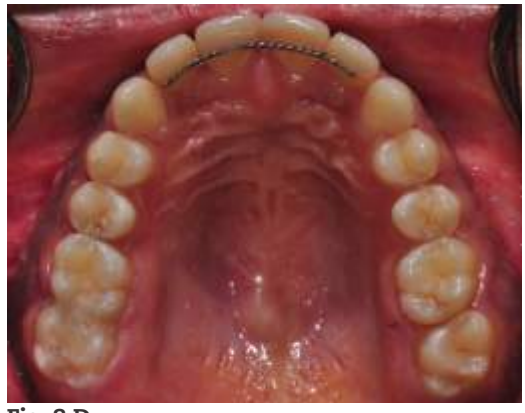

Fig. 8 D

Fig. 8 E

Fig. 8 F

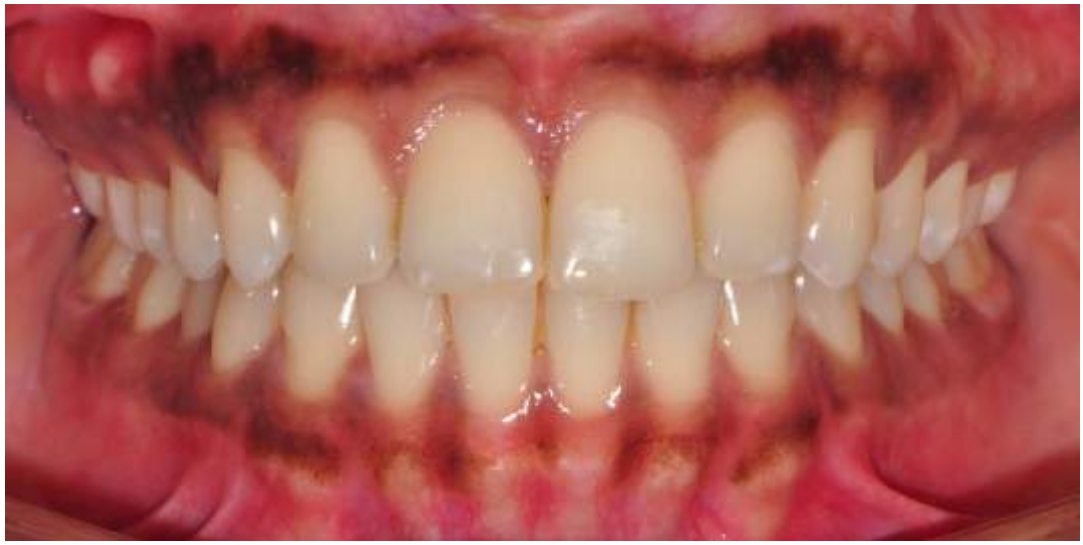

Fig. 8 G

Fig. 8 H

maximum smile remained stable, as did the alar base width (See Table 2).

OPG (Fig. 6) was taken after treatment to check for root resorption and no resorption was detected. Good stability of the treatment results was evident at retention checks done 1 year (Fig. 7 A, B, C & D) 2 years and 10 years after treatment (Fig. 8 A, B, C, D, E, F, G & H).

Discussion

Intrusion of the entire maxillary dental arch, using Microscrew orthodontic implants for anchorage, is an excellent non-surgical treatment option for correction of mild Vertical Maxillary Excess[1,2]. However, care should be taken to keep the forces light to prevent root resorption. After the intrusion, periodontal crown lengthening procedure (gingivoplasty) may be required if the gingival margin does not go up with the teeth or if there is gingival enlargement. For this patient, gingivoplasty was not required. There have been some reports of up to 30% relapse of the correction 14 months after treatment[3]. However, this case report shows long-term stability of the achieved correction. Use of miniscrew anchorage for maxillary arch intrusion should be considered as a viable alternative to orthognathic surgery for some patients who present with mild vertical maxillary excess and gummy smile.

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3. Hsu, S.P. and Liou, E.J.W.: Stability evaluation of en masse maxillary retraction and intrusion by using miniscrews: One year follow up, Taiwan Association of Orthodontists annual meeting, 2005.

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