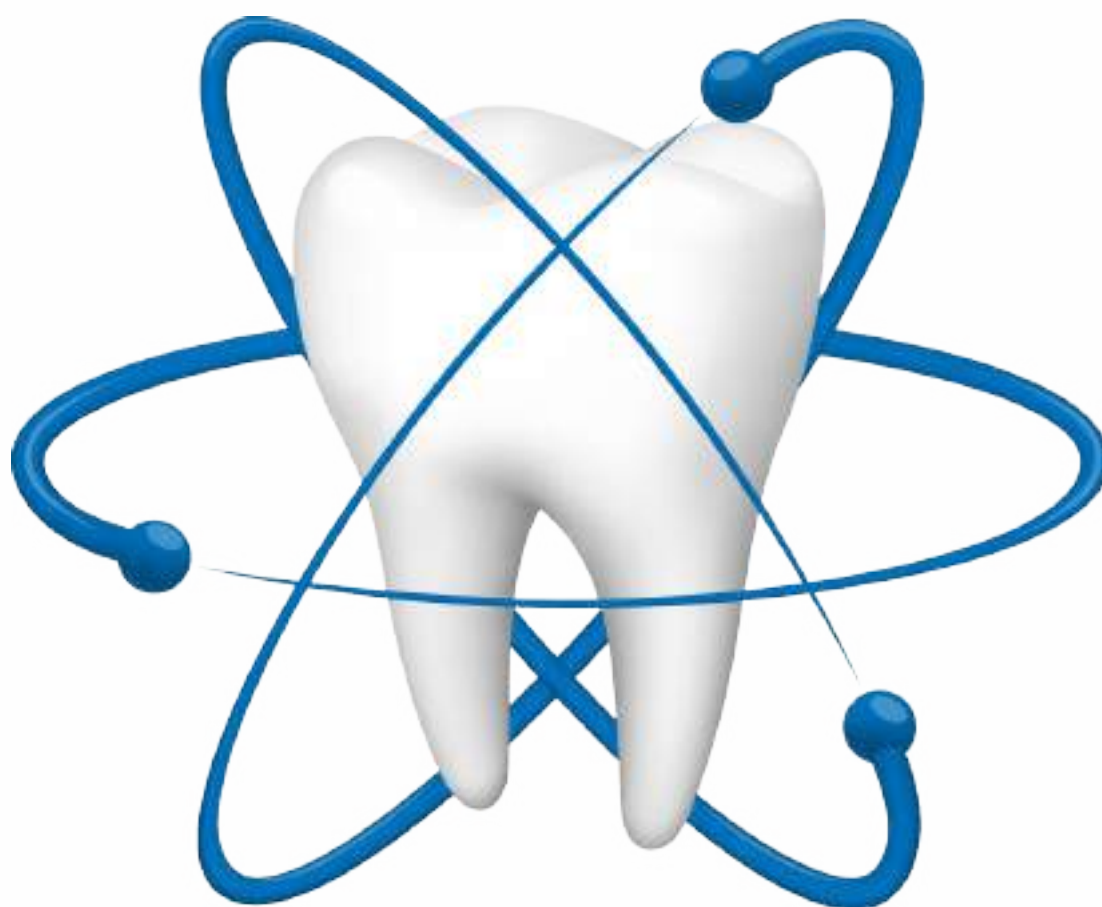


International Journal of Dental Sciences & Research

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Editors Desk

I am pleased to introduce the 2nd issue of Desh Bhagat University Dental Journal “International Journal of Dental Sciences & Research” under the guidance of Chancellor 'Dr. Zora Singh', Pro Chancellor 'Dr. Tejinder Kaur', Vice Chancellor 'Dr. Shalini Gupta' and Principal 'Dr. Sanjeev Soni'.

It is a multi disciplinary, peer-reviewed Open Access journal to provide a forum for the presentation and criticism of original, innovative and thought provocative ideas in dental and health sciences. The journal publishes new, challenging and radical ideas, so long as they are coherent and clearly expressed.

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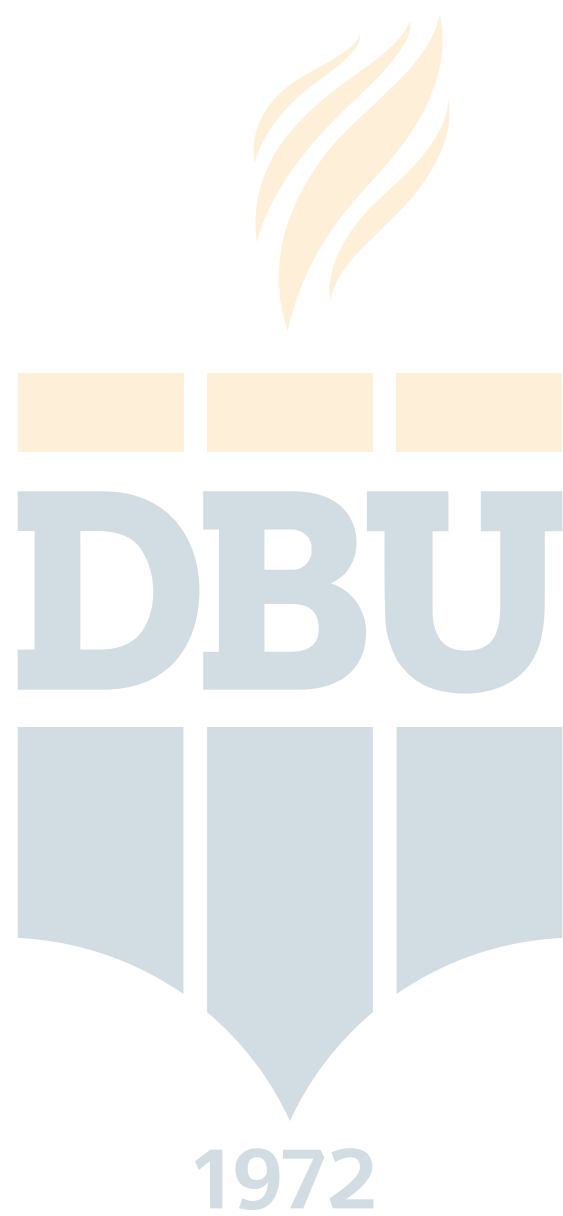
This journal offers an open access platform to the authors in Academics and Dentistry to publish their novel research. The journal focuses on providing most comprehensive and reliable information in advanced areas of dental sciences.

I take this opportunity to acknowledge the contribution of our team, especially Dr. Sukhpal Kaur, Reader, Department of Orthodontics during the final editing of articles published and the support rendered by the editorial assistants. Lastly, I would like to express my gratitude to all the authors, reviewers, the publisher, the advisory and the editorial board of the Journal, the office bearers for their support in bringing out another volume of Journal. Needless to say, any papers that you wish to submit, either individually or collaboratively, are much appreciated and will make a substantial contribution to the early development and success of the journal. We would like to thank all the contributors and respected reviewers for their valuable contributions.

International Journal of Dental Sciences & Research

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TRIGEMINAL NEURALGIA – A COMPREHENSIVE CLINICAL REVIEW

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Abstract

Trigeminal Neuralgia, also known as Tic douloureux, is a chronic neuropathic pain associated with the fifth cranial nerve (Trigeminal nerve) which carries sensation from the face to brain and some of the motor functions like biting and chewing. The aim of this review paper was to determine the current aspects about trigeminal neuralgia including its classification, etiology, diagnosis, and treatment options. The review was conducted using previous research, review, and case studies. The average onset for trigeminal neuralgia is between 50-70 years, although can be found in younger age too. A complete and thorough history is the most important diagnostic tool as well as for prognosis of the disease. Though vascular compression induced morphologic changes in the nerve being the most common cause of trigeminal neuralgia, other variants of its clinical phenotype and etiological factors must also be considered. New MRI methods have helped in proper diagnosis, providing insight about the TN pathogenesis and prognosis. Various new drugs have promising results though more larger scale studies are required. Microvascular decompression is the major and widely accepted method for long lasting pain relief in trigeminal neuralgia.

Introduction

Trigeminal neuralgia (TN) is a chronic condition characterized by pain coming from the one or the more branches of the fifth cranial nerve. It is clinically characterized as unilateral, bouts of electric shock like pain in one or more divisions of the trigeminal nerve¹. Based on etiology, the international classification of headache disorders (ICHD-3) divides TN into three distinct categories, classical, secondary, and idiopathic². The typical or “classic” form of the disorder (Type 1, or TN1) involves severe burning facial pain, electric shock bouts and each episode lasts from few seconds to two min. At times, onset of pain may occur in clusters that lasts for several hours at a time³. Contrary to this, the “atypical” form TN (Type 2, or TN2) is described as constant, characteristically burning, and stabbing pain though of lesser severity than TN¹. This type is mostly found in old age, but can be seen in patients of any age, as some rare cases are diagnosed in children too. TN is usually sporadic, but sometimes familial inheritance can also be seen^{4,5}. It mostly involves second and third division of the trigeminal nerve. In contrary, recent studies showed less than 5% cases of involvement of first division of trigeminal nerve and presence of autonomic

symptoms on the same side in 31% of patients including tearing, miosis, ptosis, sweating, and clogged nose along with intermittent pain⁶.

Etiology

Majority of patients (80–90%) are diagnosed with a vascular anomaly where the vasculature compresses the trigeminal nerve at its exit from the pons resulting in morphological changes in nerve⁷. This neurovascular compression can either be primary or secondary depending upon the progression of the vasculature. Primary compression is visual compression of the nerve by a vessel with no secondary cause. In secondary compression there could be brain tumors such as meningiomas, vestibular schwannomas, aneurysms, arteriovenous malformations, and even cysts responsible for neurovascular compression⁸. The compressing vessel is usually found in superior cerebellar artery, but it has also been reported involvement of anterior superior vein as the etiology of trigeminal neuralgia⁹.

In Secondary trigeminal neuralgia there is some neuropathic disease present like tumor at cerebellopontine angle or multiple sclerosis, etc. as etiological factor¹⁰. In 15% of patients, it has been reported that trigeminal neuralgia occurs due to tumor formation at cerebellopontine angle or multiple sclerosis¹¹.

Other predisposing factors which increase the risk of trigeminal neuralgia are chronic sinusitis, multiple sclerosis, and diabetes.

According to review (Andrew J. Arifin et al.), 15% of the cases were identified with some structural changes on imaging, as an etiological factor for trigeminal neuralgia. A literature search by them on trigeminal neuropathy secondary to lymphoma found a report of primary trigeminal nerve lymphoma, also a single case of sino nasal lymphoma with perineural spread. There are various modes of metastasis of tumors including direct invasion, hematologic and lymphatic spread and Perineural invasion (PNI). The metastasis through multitude of molecules in the nerve microenvironment results in perineural invasion. Examples of tumors showing PNI are head and neck squamous cell carcinoma, and salivary gland malignancies such as adenoid cystic carcinoma. In contrast, PNI of lymphomas is not readily described in the literature. Andrew J. Arifin et al. presented a rare case of a primary lymphoma of the tongue which was presented as trigeminal neuralgia. So thorough examination is important to know the exact etiology of trigeminal neuralgia⁷.

Diagnosis

According to American Academy of Neurology and European Federation of Neurology Society a complete history, physical examination, head imaging and electrophysiologic testing are the diagnostic tools of trigeminal neuralgia¹².

The clinical diagnosis of trigeminal neuralgia is confirmed by the presence of pain characteristics involving unilateral, transient, or paroxysmal episodes of pain in one, two or three divisions of the trigeminal nerve, lasting from few seconds to 2 minutes. Pain can be triggered by factors such as talking, chewing, touching, or shaving the face, brushing the teeth, or putting on makeup. These sensitive areas on patient's face when touched cause attack and are known as trigger points or zones. These trigger points are important for diagnosis. Frequency of the pain attacks may range from 1 to over 50 a day. This diagnosis should have pain-free breaks between the pain episodes and should not be continuous¹³.

Imaging

Once the diagnosis of TN is suspected clinically, neuroimaging is recommended to help distinguish classic from symptomatic TN. This can be accomplished with magnetic resonance imaging

(MRI) or computed tomography (CT). CT scan has limited use in evaluation of brainstem and cisterns. But is an important tool in visualizing the trigeminal nerve root entry zone and nearby vasculature when MRI is contraindicated in patients e.g., with artificial pacemaker. MRI with and without contrast is preferred for improved visualization of the trigeminal nerve and adjacent structures which can aid in diagnosing the neurovascular compression of the trigeminal nerve, which should not include a secondary cause for nerve compression¹⁴. MRI may reveal neurovascular contact in asymptomatic trigeminal nerve roots. As shown by a meta-analysis of 9 high-quality blinded and controlled studies, 36% of asymptomatic cases showed neurovascular contact¹⁵. So, MRI showed neurovascular contact is not only the diagnostic criteria. Imaging and special testing may be used to rule out alternative diagnoses such as herpes zoster, trigeminal nerve trauma, migraine, cluster headache, occipital or glossopharyngeal neuralgia, multiple sclerosis, temporomandibular joint pain, dental problems, cerebral aneurysms, tumors, and intracranial hemorrhage. The secondary TN diagnosis can be continuous or near continuous and is associated with a triggering pathology causing the pain. Most pain in these circumstances is caused by arteriovenous malformations, certain brain tumors, or multiple sclerosis. A third form, idiopathic trigeminal neuralgia, is diagnosed when symptoms occur but without a clear cause of neurovascular compression or secondary causes based on negative MRI and other neurophysiologic tests. In patients that cannot undergo MRI, trigeminal evoked potentials and neurophysiologic recordings of trigeminal reflexes are the alternatives for classifying the trigeminal neuralgia. By correctly identifying the trigeminal neuralgia as well as its classification type one can improve the treatment strategies as well as patient satisfaction to a larger extent⁵. Other conditions like malignancy, congenital malformations and multiple sclerosis may present with similar symptoms of trigeminal neuralgia but can be differentiated from it by the presence of neurologic symptoms in addition to the typical paroxysmal pain pattern¹⁶.

Advanced MRI

Advanced MRI techniques further allow for visualization of structural changes within the root that are highly suggestive of physical alteration and provide high predictive value for pain relief after decompression¹⁷. The degree of morphologic root changes is therapeutically relevant. Long-

term outcome after surgical revision of mere neurovascular contact is uncertain compared to the decompression of dislocated, distorted, or flattened nerve roots¹⁸.

The visualization of trigeminal nerve root and vessels can be improved using 3D reconstruction of special imaging techniques e.g., 3D T2-weighted MRI, for a detailed examination of cisternal and cavernous nerve segments, 3D time-of-flight magnetic resonance angiography for the visualization of arteries, and 3D T1-weighted MRI with gadolinium or phase-contrast MRI for the visualization of veins^{19,20}.

Neurophysiologic testing

This test is helpful in differentiating classic trigeminal neuralgia from secondary trigeminal neuralgia. In secondary trigeminal neuralgia, more abnormal neurophysiological finding has been found due to damage to the sensory pathway by the pathology than classic trigeminal neuralgia²¹.

Diffusion tensor imaging (DTI) and fiber tractography

In classic TN, Vessels compressing the nerve, causes focal axonal degeneration and demyelination of the nerve thus interrupt the transmission of normal nociceptive stimuli. Demyelination of the trigeminal pathway is the main cause of pain in MS related TN. DTI can reveal these microstructural changes in the nerve, improve diagnosing the type of TN, deciding patients which are more suitable for surgical treatment, as well as treatment outcome²². DTI can assess tissue integrity and changes in the trigeminal nerve. Fiber tractography (FT) is a 3D reconstruction technique to assess neural tracts using data collected by diffusion tensor imaging. According to a study DTI showed loss of anisotropy and increase in diffusivity in affected nerve. After surgery, Fraction of Anisotropy (FA) remains the same while Apparent Diffusion Coefficient (ADC) normalized suggesting improvement in diffusion of the nerve²³. DTI has the potential in understanding the pathophysiology of trigeminal neuralgia and treatment effects and merits further research.

Treatment

Certain (63%) trigeminal neuralgic patients resolve their symptoms spontaneously, completely for many years, which is not found in other neuropathic diseases⁵.

Treatment should be according to diagnosis. According to classic trigeminal neuralgia, treatment begins with medication then MVD

surgery or other surgical procedures and if secondary TN find out the cause and treat accordingly e.g., if lymphoma of the nerve or any other structure is causing the trigeminal neuralgia, then treatment of lymphoma or respective treatment will relieve the patient from pain. In a case report, by Arifin et al. lymphoma of the tongue, presented primarily as trigeminal neuralgia, was treated with combination of medicines e.g., R-CHOP (rituximab, cyclophosphamide, hydroxydaunorubicin, oncovin, prednisone). Patient completed 4 cycles of chemotherapy and positron emission tomography demonstrated complete disease response. At the time of this report, the patient found minimal return of sensation to the left tongue and mandibular area of her face; however, her pain was completely subsided⁷.

First Line Medications

For treatment of Trigeminal neuralgia medical pharmacotherapy is considered as first step. Drugs such as anticonvulsants and tricyclic antidepressants comes under first line of treatment with medications. Carbamazepine is the most relevant and drug of choice for TN⁵. Mechanism of Carbamazepine is stabilizing the sodium channels in an inactive state. It has been reported by a high-quality meta-analysis to be the most efficacious drug for the trigeminal neuralgia²⁴. 70% of the patients showed complete relief from the symptoms as shown by a study²⁵. Common side effects are dizziness, nausea, diplopia, ataxia, increase of enzyme transaminases and reduction in sodium level. Dose of the drug starts from 100 mg showing effects in some patients to maintenance dose of usually 300-800 mg daily divided into two or three doses. Usually, high dose of this medication given for pain relief results in disabling side effects. Some of the potentially serious though uncommon side effects are allergic rash, myelosuppression, hepatotoxicity, lymphadenopathy, systemic lupus erythematosus, Stevens-Johnson syndrome²⁶.

The alternative first line of therapy is oxcarbazepine which has lesser side effects. Its dose ranges from starting with 150 mg twice daily to maintenance dose of 300-600 mg twice daily²⁷.

Second Line Medications

Patients' refractory to first line of treatment, or due to major side effects are treated by Second-line medications including baclofen, a GABAB

receptor agonist, lamotrigine, a sodium channel inhibitor.

Baclofen, used alone or in combination with carbamazepine, shows effect by depressing excitatory neurotransmission by acting as an agonist on GABA receptors²⁸. Maintenance dose ranges from 60-80mg per day⁹. Side effects of this drug includes drowsiness, sedation, lassitude, nausea. Sudden withdrawal of this drug causes seizures and hallucinations. Baclofen is considered as the most scientifically proven drug next to CBZ, in the treatment of trigeminal neuralgia.

Lamotrigine, an anticonvulsant, which is mainly used for the treatment of bipolar disorder. In an open label study of 15 trigeminal neuralgic patients, this drug showed a beneficial response proportionate to a maximum dose of 400 mg/day²⁹. There was a double-blind placebo-controlled crossover trial performed, which showed that combination of carbamazepine and 400 mg lamotrigine was more effective than placebo³⁰. The dose is initiated at 25mg per day to a maintenance dose of 200-400 mg twice daily. Side effects associated with this drug are dizziness, blurred vision, headache, ataxia, nausea. Skin rashes are seen in 7-10 % of patients, that get resolved with continued therapy. While 1 in 10,000 patients develop Stevens- Johnson syndrome require prompt discontinuation of the treatment³¹.

Third line treatment

The third line drug therapies include levetiracetam, topiramate, gabapentin, pregabalin, and botulinum toxin A³². In refractory cases, drugs such as baclofen, gabapentin, lidocaine, and misoprostol are found efficient⁵.

Gabapentin, another drug, shows minimal interactions with other medications and lesser side effects³³. It is a new generation antiepileptic drug, used in the treatment of epilepsy, postherpetic neuralgia & diabetic peripheral neuropathy. There are not many studies on its efficacy in the treatment of trigeminal neuralgic pain. A retrospective study was conducted on 92 patients, observed it as an alternative treatment option and as a safe profile³⁴. There was another study reviewing Randomized controlled trials (RCTs) of Gabapentin in the treatment of Idiopathic Trigeminal Neuralgia. This study identified only 2 RCTs studying the efficacy of GBP in the management of idiopathic TN. One study was by Debta et al. which showed efficacy of

GBP was 60-80% on newly diagnosed trigeminal neuralgic patients and it was 50-60% in refractory patients. Despite this, they found GBP to be inferior to Oxcarbazepine³⁵. Second study was conducted by Lemos et al. which showed five months after 28 days research found combination of ropivacaine, and GBP showed least no. of daily pain episodes than GBP alone³⁶. So, from these 2 studies it was concluded that GBP is an effective alternative to CBZ and OXC only when these first line drugs are intolerable to patients. As this study involved only 2 RCTs, so more evidence is required to show the efficacy of GBP. Gabapentin is efficient both alone and in combination with ropivacaine to block trigger points in patients of Trigeminal Neuralgia. Dose of this drug is usually 300-1800 mg per day.

Pregabalin is analog of GABA that is structurally related to gabapentin. In an open label study of 53 patients with 1-year observational period, pregabalin was found to be effective in reducing pain by more than 50% in 74% of patients. Treatment was more effective in patients without accompanying facial pain than patients with chronic facial pain³⁷.

Topiramate blocks voltage gated calcium channels by binding to non- benzodiazepine GABA receptors. Its usual dose is 100-400 mg per day. In a small (8 patients) sample of study, drug was effective in 75 % of cases³⁸.

Levetiracetam shows less drug interactions and no routine blood tests while treating TN patients. Usual dose of the drug is 1000-4000mg per day. In an open label study of 10 trigeminal neuralgic patients, 40 % patients showed improvement of 50-90%³⁹. Though more studies are required to prove these findings.

The next studied drug is Botulinum toxin. BTX deactivate sodium channels and inhibit the release of mediators of inflammation and peripheral neurotransmitters from sensory nerves⁴⁰. BTX-A changes the sodium flow of excitable membrane of a neuron, and it controls sodium current with a non-concentration dependent manner that differentiate it from other drugs like antiepileptics, tetrodotoxin and local anesthetics⁴¹. The meta-analysis of 10 Randomized Controlled Trials (RCTs) on the efficacy and safety of Botulinum Toxin A (BTX-A) in treating Trigeminal Neuralgia (TN) and Peripheral Neuropathic Pain (PNP) was conducted by Jiangshan Wei et al. In these 10 RCTs, method of conducting trial was quite variable including duration of follow up ranging from 8-24 weeks, administration route

(sub cutaneous, sub mucosal, intradermal), injection site, dosage of BTX-A from 25 U in study of Zhanget et al. (2014) to 300 U in study of Attal et al. (2016). The final analysis was that there was remarkable reduction in pain score for BTX-A group than placebo(at the 3rd month). Adverse reactions were also mild, transient and nonsystemic. It was concluded from this study that BTX-A is safe and efficacious in treating trigeminal neuralgia and peripheral neuropathic pain compared with placebo⁴². No doubt there is risk of bias in this meta-analysis because of moderate evidence due to limited studies and small sample size. More future trials are required to know the exact dose and duration of treatment and route of administration of botulinum toxin for pain relief.

Surgical treatment

Patients who failed medical treatment with at least 3 medications, or suffered from some intolerable/serious side effects, or symptoms coming back again are the candidates for surgical management of TN5. Though right time for surgical intervention over medical treatment is still to be determined. While some patients may consider surgery as an option beside getting relieved by the medication because of the fear of the severe pain and side effects of medication⁴³. Surgical treatments are either destructive, where trigeminal nerve sensory functions are destroyed (percutaneous rhizotomy) or non-destructive to trigeminal nerve, where sensory functions are preserved (MVD)⁵. The decision to perform either treatment should be made based on both clinical and neuroimaging findings.

MVD (Micro Vascular Decompression)

This is the treatment of choice in young patients and individuals showing neurovascular conflict (NVC)⁴⁴. Though it is the most invasive procedure but most successful treatment too in terms of permanently treating the pain. It is a major surgery involving retro sigmoid craniotomy to reach the trigeminal nerve. Offending artery is identified and dissected free from the nerve and Teflon pledget is placed between the nerve and the vessel⁹. If surgeons do not find neurovascular compression, they perform sectioning (retrogasserian rhizotomy) or briefly compress the nerve. It has been proved by many studies that MVD has long lasting pain relief in more than 70% of the treated patients^{45,46}. This treatment

results in immediate pain relief in 90% of patients, after 5 years in 68-88% of patients and after 10 years in 61-88% of patients⁴⁷. Complications associated with this procedure includes aseptic meningitis (11%), sensory loss (7%), hearing loss (10%), cerebrospinal fluid leakage, infarcts/hematoma (4%), death (0.2- 0.5%)⁴⁸. MVD shows better treatment response in classic trigeminal neuralgia and arterial compression of nerve. Patients of atypical facial pain shows less response rates with MVD as compared to classic TN⁴⁹. In case of venous compression, vein is divided to decompress the nerve. Endoscopic MVD is also suggested as an alternative option to microscopic MVD especially in cases of bony ridge obscuring the view of trigeminal nerve or with a very distal vascular compression or both⁵⁰. It was reported that 8.5% of cases which were not solved by microscopic MVD showed better visualization with endoscopic MVD.

Percutaneous Rhizotomy

In this surgical technique, selective destruction of A-delta and C pain nerve fibers is performed while A-alpha and beta sensory nerve fibers are preserved. The rhizotomy can be performed by three methods including mechanical by balloon compression of the gasserian ganglion, chemical by glycerol injection of the trigeminal cistern, and radiofrequency thermal in which heat is applied to damage the trigeminal nerve ganglion⁵. In all these techniques foramen ovale, located through radiological guidance, is used to gain access to the trigeminal ganglion⁵¹. So, locating the foramen ovale under fluoroscopic guidance, correctly, can leads to success or failure of the treatment. Many studies described the methods to locate foramen ovale but has limitation of poor reproducibility. Kang Sup et al. did a retrospective analysis on 72 3D facial computed tomography scans of anatomically normal skull base to come out with a method to locate foramen ovale. According to them, the mandibular angle and the occipital cortical line were overlapped and then turned by 15° oblique rotation using the software package. They found a good grade of visibility of foramen ovale⁵². But this study is still lacking clinical applications and comparative data to the submental view.

In 80-90% of patients, surgical intervention by balloon compression provides a significant relief from the pain without any medication in a period of 2-3 years⁵³.

Glycerol rhizotomy results in high but short-term rate of success with more than 90% of patients showing initial pain relief and more than 50% of patients remained symptom free after three years⁵⁴. Radio frequency thermocoagulation (RFT) is used in elderly, unilateral or bilateral pain, recurrence after MVD or other neurosurgeries, TN with atypical facial pain, vertebrobasilar dolichoectasia and multiple sclerosis⁵⁵. Previous studies showed recurrence after RFT ranging from 17.2% to 46%⁵⁶. After RFT adverse events like facial numbness, absence of corneal reflex, and masseter muscle weakness were observed⁵⁷. To check long term outcome of recurrence free survival (RFS) after RFT and risk factors associated with recurrence, a multicenter retrospective analysis of data from 1481 patients with TN, underwent treatment with RFT from 2005-2017 in 2 large teaching hospitals in China, was performed by Shuyue Zheng, Xiuhua Li, et al. It showed initial efficiency rate of pain relief after RFT of 92.39%. The median RFS was 136 months, and rates of RFS was 85.5% at 1 year, 74.6% at 3 years, 68% at 5 years and 54.9% at 10 years and 35.18% in a 14 year of follow up period, respectively. There are independent risk factors associated with recurrence of TN after treatment with RFT which includes atypical facial pain at baseline, past RFT treatment, at least 2 past neurosurgeries and existing facial hypesthesia of BNI class II (mild facial numbness, not bothersome). The risk is 17fold with atypical facial pain, 1.642fold with MVD, 2.808fold with history of RFT, 3.832fold with previous neurosurgeries, 2.473 fold/ 3.288 folds for patients with BNI class II/III facial hypesthesia before RFT, respectively. Adverse event like facial hypesthesia of scale II was observed in 54.56%, class III in 36.33% and class IV in 4.52% of cases, respectively. Rate of facial numbness was higher with increase in RFT temperature i.e., in 80° C group than in 70 and 75 degrees. While 18.20% showed resolution of their facial numbness gradually during follow up. Rate of masseter muscle weakness was also found to be higher in 80° C group than in other groups. It was found that temperature range of 68°-70°C showed good results with less complications and efficiency was better at 66-80° C⁵⁵. Though future larger scale long term randomized studies are needed to approve these values, but these findings would be helpful in some way to perform RFT procedure. These percutaneous procedures are considered less invasive as compared to microvascular

decompression surgery but have its own disadvantages including risk of sensory loss in the trigeminal distribution (50%), dyesthesias (6%), anesthesia dolorosa (4%—a feared complication consisting of numbness and pain in the targeted dermatome), corneal numbness leading to keratitis. Gamma knife radiosurgery (GKRS) is an alternative procedure for patients reluctant to invasive procedures or poor candidates for surgical treatments⁵⁸. In this stereotactic, outpatient procedure high doses (70–100 Gy) of submillimeter radiation beams is focused on the trigeminal root entry zone causing necrosis over time, thus decreasing pain⁵⁹.

Neuromodulation

Motor Cortex Stimulation & Deep Brain Stimulation are the two types of neuromodulations suggested as possible treatment options for refractory cases of trigeminal neuralgia. According to some studies MCS has resulted in pain relief in 75-100% of patients of neuropathic pain^{60,61}. Similarly, several experiments are conducted over the use of DBS using posterior hypothalamus as the target organ in the brain since 1997⁶²⁻⁶⁵. As posterior hypothalamus has been hypothesized as controlling unit between neuropsychological circuits of pain behavior and neurovegetative system. According to a systematic review patient of refractory trigeminal neuralgia due to MS get benefitted from DBS within the first trigeminal branch⁶⁶. Yet, limited studies are done on the use of MCS and DBS, merits further research.

Peripheral nerve/field stimulation

Though it is used to treat variety of conditions like chronic, neuropathic, and refractory pain but limited studies are done in the treatment of TN. A case report described a refractory trigeminal neuralgia case treated with peripheral nerve stimulation with a supraorbital, infraorbital, and frontoparietal leads, resulted in complete pain relief⁶⁷. Peripheral nerve stimulation could be a promising result though more future studies are required.

Transcranial magnetic stimulation

An emerging technology that assesses the outcome of treatment by direct epidural cortical stimulation by estimating the response by this noninvasive method of cortical stimulation. In a study it showed 45% reduction in pain in patients undergoing treatment with repetitive transcranial magnetic

stimulation at motor cortex for 2 weeks at 20 Hz⁶⁸. In another study on 12 patients, it was found to be effective in relieving more than 30% pain in 58% of patients⁶⁹.

Conclusion

Detailed history and examination are the prime requirements for diagnosing the type and etiology of trigeminal neuralgia. A case discussed in this review, of oral lymphoma presented as trigeminal neuralgia, highlights the importance of complete history and examination as there are multiple differentials for this condition. Advanced MRI has helped a lot in understanding the pathogenesis of the disease. Though neurovascular conflict is the most common etiological factor in pathogenesis of trigeminal neuralgia, but other factors should always be considered for successful and alternative treatment options. Recent studies have found Carbamazepine to be 100% effective in relieving pain in 70% of patients. Alternative oxcarbazepine, of similar efficacy and lesser side effects is used. Failure or intolerance to these drugs can be minimized by switching to or Combination therapy with lamotrigine, pregabalin, topiramate drugs. Drugs with better tolerability should be explored. For middle aged and elderly people, where drug side effects and complications of surgery are Intolerable, BTX-A provide efficient and safe treatment option, lasting several months.

The right time to start surgical intervention is yet to be decided. Microvascular decompression is safe, reliable, and effective treatment option in classic trigeminal neuralgia due to neurovascular compression and especially in young patients who want to preserve facial sensitivity. Modern high resolution T2 imaging is quite helpful in diagnosing such neurovascular contact. Patients who fail medical treatment, Classic trigeminal neuralgia secondary to multiple sclerosis, or patients not able to tolerate MVD surgery, where etiology is not neurovascular compression, percutaneous rhizotomy and radiosurgery are effective treatment options. Gamma knife radiosurgery has proved to be effective in relieving pain in 69% of patients up to 1 year and in 52% of patients up to 3 years. Neuromodulation, emerging technique needs more data to support its usefulness in the treatment of trigeminal neuralgia. Similarly peripheral nerve stimulation has proved effective in various neuropathic and chronic pain conditions, but more research is needed regarding its use in trigeminal neuralgia.

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ANTIMICROBIAL EFFICACY OF BIO DENTINE, MTA AND THERACAL LC AGAINST ENTEROCOCCUS FECALIS AND CANDIDA ALBICANS

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Abstract

Background: Microorganisms play an essential role in pulpal and periapical diseases. The present study compared antimicrobial efficacy of calcium silicate based material bio dentine, MTA and Theracal LC.

Materials & Methods: The present study comprised of three materials such as MTA (Group I), Biodentine (Group II) and Theracal LC (Group III). The antibacterial efficacy of these materials was evaluated and minimal bacterial count (CFU's) against *Enterococcus fecalis* and *candida albicans* was tested using tube dilution method.

Results: The mean CFU of *candida* in group I was 69.2, in group II was 70.4 and in group III was 76.3. The difference was significant ($P < 0.05$). The mean CFU of *E. fecalis* in group I was 46.5, in group II was 59.2 and in group III was 54.1. The difference was significant ($P < 0.05$).

Conclusion: Antibacterial activity of Biodentine was superior than anti-bacterial as compared to MTA angelus and theracal LC.

Key words: Bio dentine, *E. fecalis*, MTA

Introduction

Microorganisms play an essential role in pulpal and periapical diseases. Periapical pathosis is considered an endogenous infection caused by the oral microflora. Therefore, many investigators have attempted to isolate and identify various microorganisms from root canals or periapical regions.¹

Studies have shown that there is a difference between the microbial flora of root canal in cases of primary endodontic infection and in cases of reinfection. The microorganisms in retreatment cases possess greater resistance to intracanal medicaments. Also, it is found that microbes not only grow in planktonic cells or in aggregates but also forms biofilms. It was in 1894 when WD Miller first published his observations on microflora. Since then, studies have shown that the endodontic environment is selective and it supports the specific microorganisms to grow.²

The other common organism which persists in post treatment apical pathology is *Candida albicans*. These resemble *Enterococci* in some characteristics. Both these organisms can survive as mono-infection and invade dentinal tubules. Hence, amongst the 24 million endodontic treatment performed on an annual basis, 5.5% procedures involve endodontic surgery and

perforation repair.³

The hydraulic self-setting cements involve calcium silicate-based cements (CSC), such as mineral trioxide aggregate (MTA). Mineral trioxide aggregate (MTA) was introduced as a root-end filling material. Till date it is being used as a material of choice for root-end filling. MTA has wide applications in operative dentistry and endodontics.⁵ MTA has the disadvantages of long setting time and poor handling properties. The powdered form of CSC contains tricalcium and dicalcium silicate. Calcium hydroxide is most commonly used for the treatment involving direct and/or indirect pulp capping. The high pH (12.5) gives calcium hydroxide an important antimicrobial activity.⁵ The present study compared antimicrobial efficacy of calcium silicate based material bio dentine, MTA and Theracal LC.

Materials & Methods

The present study comprised of three materials such as MTA (Group I), Biodentine (Group II) and Theracal LC (Group III). One scoop of MTA BIODENTIN, AND THERMAL LC was taken. And all the procedure were done under sterilization protocol. The culture media used were Brain heart infusion broth, Mac Conkey's agar, sabouraud dextrose broth, and sabouraud

dextrose. Ten microliter of standardized *Enterococcus faecalis* was added to tubes. These tubes were then incubated at 37°C. Subcultures on Mac Conkey's agar were made on each of the tubes. Readings were noted at the end of 24 hours of incubation. The antibacterial efficacy of these materials was evaluated wherein ten different strains of *Enterococcus faecalis* and antifungal

efficacy were analysed. The Minimum Inhibitory Concentration (MIC) and minimal bacterial count (CFU's) against *Enterococcus faecalis* and *Candida albicans* was tested using tube dilution method. Results thus found were clubbed for statistical assessment using chi-square test, where p value less than 0.05 was considered relevant.

Results

Groups	Group I	Group II	Group III
Material	MTA	Biodentine	Theracal LC
Number	10	10	10

Table I: Distribution of materials

Table I shows distribution of materials in different groups.

Groups	Mean	P value
Group I	69.2	0.05
Group II	70.4	
Group III	76.3	

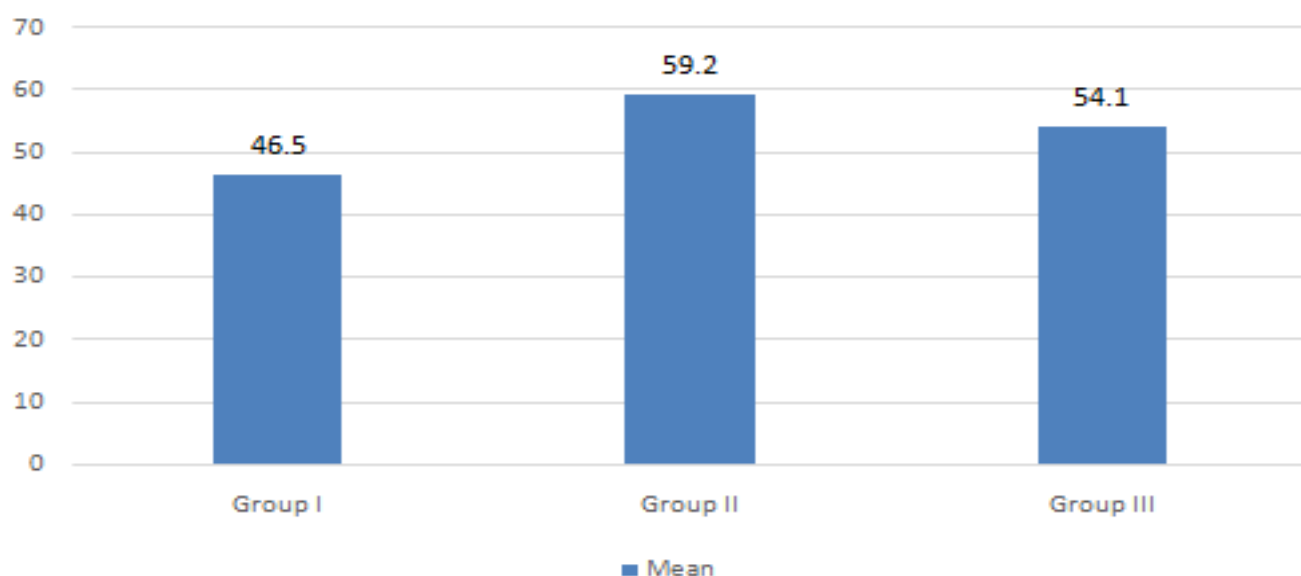
Table II: CFU counts of candida

Table II shows that mean CFU of candida in group I was 69.2, in group II was 70.4 and in group III was 76.3. The difference was significant ($P < 0.05$).

Groups	Mean	P value
Group I	46.5	0.04
Group II	59.2	
Group III	54.1	

Table III: CFU counts of E.fecalis

Table III, graph I shows that mean CFU of *E. faecalis* in group I was 46.5, in group II was 59.2 and in group III was 54.1. The difference was significant ($P < 0.05$).



Graph I: CFU counts of E.fecalis

Discussion

Microorganisms play a key role in the development of pulpal and periapical diseases. Pulpal diseases leading to inflammation of periapical tissues show the presence of bacteria in the root canal system.⁶ Teeth with pulpal or periapical pathology have a complex microbial flora consisting of cocci, rods, spirochetes, and fungi. *Enterococcus faecalis* can withstand high pH of intracanal dressings like calcium hydroxide, and is hence found in higher concentration in reinfection cases. Enterococci survive very harsh environments including extreme alkaline pH & salt conc.⁷ Other common organism identified in post treatment apical pathology is *Candida albicans*. Both survive as mono-infection and invade dentinal tubules. *Candida albicans* also showed the ability of colonization root canal walls and penetration into dentinal tubules. The colonization of fungi in the root canals and various other factors affecting this colonisation are not fully understood.⁸

MTA can be used in regeneration procedures and repair procedures like root-end filling, apexogenesis, pulpotomy, apexification, pulp capping and perforation repair involves usage of calcium silicate-based cements. Their biocompatibility and sealing ability synergistic to the physicochemical reaction and interaction with the surrounding local environment contribute to be the specific factors in achieving suitability in difficult clinical situations.⁹ Pulp-capping agents have been developed over the years. Most commonly used are calcium hydroxide-based materials. The antimicrobial efficacy of ProRoot MTA is due to release of calcium ions and hydroxyl ions which results in increase in pH. This release of calcium is when calcium silicate gets hydrated and calcium hydroxide is released as a byproduct. Also, the dissociation of calcium hydroxide leads to release of calcium ions¹⁰. The present study compared antimicrobial efficacy of calcium silicate based material bio dentine, MTA and Theracal LC.

In present study, we found that mean CFU of candida in group I was 69.2, in group II was 70.4 and in group III was 76.3. Kawle et al¹¹ evaluated and compared the antimicrobial efficacy of MTA Angelus, Biodentine and Theracal LC against *Enterococcus faecalis* and *Candida albicans*. Their antimicrobial efficacy was evaluated using Tube dilution method and their Minimum inhibitory concentration (MIC) and Bacterial

counts (CFU's) were assessed and compared. The MIC was highest and CFU's were lowest with Biodentine in comparison with other two materials. There were statistically significant differences noted between Biodentine and MTA angelus.

We found that mean CFU of *E. faecalis* in group I was 46.5, in group II was 59.2 and in group III was 54.1. MBC is defined as the lowest concentration of antimicrobial agent needed to kill 99.9% of the final inoculum after incubation for 24h under a Standardized set of conditions. Molander et al¹² stated that the predominant bacteria which are able to survive at high pH values are *Enterococcus faecalis* and thus treatment may require use of calcium hydroxide intracanal dressing.

Hiremath et al¹³ evaluated and compared the antimicrobial efficacy of two new materials MTA Plus and Biodentine with ProRoot MTA using tube dilution method.

Doubling dilutions of the material were prepared in Sabouraud's dextrose broth (SDB) and Brain Heart Infusion (BHI) broth for *Candida albicans* and *Enterococcus faecalis*, respectively. The minimal concentration at which inhibition of microorganism occurred was measured and noted as minimal inhibitory concentration (MIC) of the material.

There was no statistically significant difference between the materials against *C. albicans*. Biodentine was statistically significant than MTA Plus against *E. faecalis*. ProRoot MTA was statistically significant at different time intervals against *E. faecalis* (P-value-0.001). ProRoot MTA and Biodentine proved to have antimicrobial property. MTA Plus proved as a good antifungal agent. Gomes et al¹⁴ showed that *Enterococcus faecalis* was more frequently recovered from the canals in later appointments after biomechanical treatment procedures.

Conclusion

Authors found that antibacterial activity of Biodentine was superior than anti-bacterial as compared to MTA angelus and theracal LC.

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A RE-INNOVATIVE RADIOGRAPHIC TECHNIQUE FOR THE EVALUATION OF MARGINAL BONE LOSS AROUND IMPLANTS

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Abstract

Standard dental radiographs allow the clinician to make an assessment of marginal bone loss around implants. Radiovisiography is useful as it produces an instant image at a lower radiation dose. Only a relatively small deviation from the correct angulation may make it difficult to compare with the baseline radiographs and evaluate marginal bone loss. In this article a radiographic technique with the help of intra-oral grid was used to evaluate the bone loss around the implants. The conventional intra-oral holder with intra-oral grid was indexed by the use of soft putty which helped in reproducing positioning of the holder for evaluation of crestal bone loss after the implant placement around the implants.

Key words: Hawe X-Ray Sensor Holder System, Dental X-Ray mesh gauge, Crestal Bone loss

Introduction

Implant dentistry is unique in its ability to restore the patient to normalize the contour, function, patient comfort, esthetics, speech and health regardless of the atrophy and disease. Preservation of the tooth structure, preservation of bone, provision of additional support, resistance to disease are some of the merits implants therapy has over conventional fixed or removable treatment options. Implant supported prosthesis definitely has an edge over the other treatment options as its longevity is greater than fixed partial denture, no preparation required for adjacent teeth, decreased risk of caries and endodontic therapy of the adjacent teeth, improved hygiene and esthetics of abutment teeth leading to decreased risk of abutment tooth loss, it provides an added psychological advantage to the patient with maintenance of bone in edentulous region¹.

The long term success of dental implants is evaluated radiographically by the absence of any pathology and an unusual rate of bone loss around the implants.² For adequate diagnosis and review of crestal bone changes many diagnostic methods have been evaluated^{3,4} in which intraoral radiographs play an integral part, however reproducing positioning is very difficult.

Various film holding devices have been documented that attach to implant abutment or prosthesis to standardize image geometry.⁴⁻⁷ With

digital enhanced radiographs numerous techniques adjunct with computer-assisted measurements, ruler, caliper, and supra bony thread evaluation have shown to give permissible results.^{8,9}

This article describes a re-innovative technique in which digital sensor holder with dental X-Ray mesh gauge is indexed to the adjacent dentition by putty which helped in reproducing the position for future evaluation of crestal bone changes post-operatively and post-prosthetic phases.

Clinical report:

A 45 years old female patient with good general health and well being reported to the Department of Prosthodontics, Jaipur Dental College, Jaipur, Rajasthan for replacement of lower posterior teeth. The patient's dental history revealed that she has lost her teeth due to decay and has been partially edentulous for the past 6 months. Various treatment modalities of a removable partial denture, an acid etched resin – retained prosthesis, maintenance of missing teeth orthodontically, a fixed partial denture and implant supported prosthesis were explained to the patient. Taking into consideration the various factors, implant supported prosthesis was planned for the patient. As part of the pre-surgical treatment planning, radiographic stent was prepared with a metal ball incorporated in it and patient was asked to take an orthopantomograph (Kodak 8000C Digital Panoramic and Cephalometric System with voltage of 71Kv,

electricity of 6.3 Ma and exposure time of 13.2 sec) with stent in place and magnification was noted and exact implant length was determined. Exact mesio - distal and bucco - lingual width was determined by ridge mapping procedure.¹² After length and width was determined a surgical template was made for the patient which helped in proper angulation to guide in implant placement. Surgical procedure was performed with sequential osteotomy as recommended by the manufacturers and the implants were placed at the predetermined depths. After adequate soft tissue healing, the implant abutments were connected and if any preparation was required it was done, impressions were made and provisional crowns were fabricated and cemented with temporary cement Templute eugenol free (Prime Dental Products Pvt. Ltd.) taking into care that the contacts are centrally oriented with no contact on light bite and light contact at heavy bite.¹³

Technique for Radiographic Evaluation:

- The sensor holder system with the dental X-Ray mesh gauge is tried in the patients mouth (**Fig 1**).
- Soft putty is mixed and placed distal to the sensor holder system and occlusal registration of the maxillary and mandibular teeth distal to the implant placement is made.
- Once the occlusal registration is positioned properly against the adjacent teeth, the digital sensor orientation should not be altered.
- Conventional paralleling cone technique is employed for making digital radiographs (**Fig 2**).
- The putty index can be isolated from the sensor holder system and is re-attached with the sensor holder system when further evaluation of crestal bone is done post – operative or post – prosthetic phase (**Fig 3**).
- Provisional crowns were removed, custom trays fabricated and final impressions made with putty and light body with a closed tray technique. Porcelain fused to metal crowns were fabricated and cemented with temporary cement Templute eugenol free.



Fig 1. Sensor holder system with dental X-ray mesh

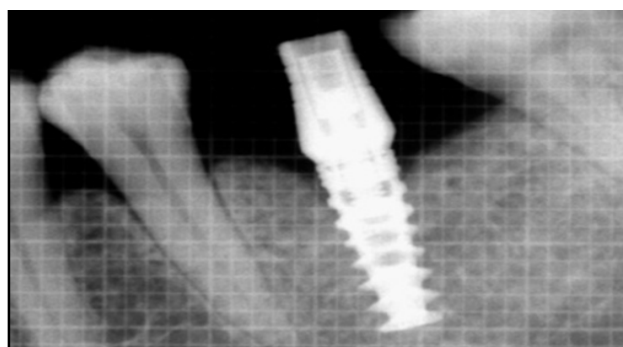


Fig 2. Conventional paralleling cone technique



Fig 3. Putty index re- attached with sensor holder system

Discussion:

Assessing peri-implant marginal bone levels play an integral part in the evaluation of the implant patient. For monitoring of marginal bone levels at implants and diagnosing interproximal bone loss radiographic technique including panoramic radiography and intra-oral radiography using long cone paralleling technique have been widely used.¹⁴ Panoramic radiography allows visualization of the entire implant, panoramic radiography has limitations which include image resolution and distortion, it also has inability to monitor facial and lingual/ palatal bone levels, low sensitivity in the detection of early bone changes and underestimation of bone loss.¹⁵ In conjugation with intra oral radiographs, grid calibration has been used which is superimposed on the scanned radiographs using CorelDraw software.¹⁶ In this particular study long cone paralleling technique with putty index was used so as to reduce the magnification and resolution error during any mesial-distal or bucco-lingual movement of follow up radiographs. A dental X-ray mesh gauge with a fine grid of pitch 1mm was used with the radiovisiograph so as to standardize the bone loss measurement procedure which was measured from the first macro thread of the implant.

The technique described is appropriate for single or short span multiple unit implant restorations. Long span or completely edentulous arches, shallow lingual sulcus, presence of tori, palatal vault contours, prominent gag reflex and psychological factors are some of the limitations in which this particular technique cannot be applied accurately.

Summary

The Hawe X-Ray sensor holder system is indexed to the adjacent dentition with the help of soft putty and accurate radiovisiograph is made to evaluate the changes in the bone at the crestal level.

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PROCEDURAL ERRORS AND ENDODONTIC MISHAPS DURING ROOT CANAL TREATMENT: A REVIEW

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Abstract

Procedural errors in endodontics, or alternatively, any mistake that occurs at some point in the process of root canal treatment of a tooth can be a result of factors which the operator has both control, as well, no control over. For the majority of these mistakes the operator is at fault, either through lack of operator knowledge or concentration during treatment. This is fortunate in the sense that this means these errors are, in the main, preventable. Keeping in mind that dentists, being human, will commit errors at some point in their career, knowledge as to how to manage these situations is indispensable. As there exists a multitude of possible procedural errors, the areas that are going to be focused on are those which occur more commonly, and those with more disastrous sequelae.

Keywords: Endodontic mishaps, Root canal treatment,

Introduction

Endodontic mishaps or procedural accidents are those unfortunate occurrences that happen during treatment, some owing to inattention to detail, others totally unpredictable. Recognition of a mishap is the first step in its management; it may be by radiographic or clinical observation or as a result of a patient complaint. Correction of a mishap may be accomplished in one of several ways depending on the type and extent of procedural accident. Re-evaluation of the prognosis of a tooth involved in an endodontic mishap is necessary and important. The re-evaluation may affect the entire treatment plan and may involve dentolegal consequences.¹

According to Ingle and Bakland¹ endodontic mishaps can be access related which are due to treating the wrong tooth, missed canals, damage to existing restoration, access cavity perforations, crown fractures; Instrumentation related which are due to ledge formation, perforations, separated instruments and foreign objects, canal blockage; Obturation related due to over/under-extended root canal fillings, nerve paresthesia, vertical root fractures and other forms such as post space perforation and irrigant related². The fact that these mistakes are preventable is fortunate since, as the old age "prevention is better than cure" states, it is preferable to having to manage the situation³.

Classification:

According to Ingle (5th Edition):

a) Access Related:

- Treating the wrong tooth
- Missed canals
- Damage to existing restoration
- Access cavity perforations
- Crown fractures

b) Instrumentation Related:

- Ledge formation
- Cervical canal perforations
- Midroot perforations
- Apical perforations
- Separated instruments and foreign objects
- Canal blockage

c) Obturation Related:

- Over- or underextended root canal fillings
- Nerve paresthesia
- Vertical root fractures

d) Miscellaneous:

- Post space perforation
- Irrigant related
- Tissue emphysema
- Instrument aspiration and ingestion

Access-Related Mishaps:

(a) Treating the Wrong Tooth:

If there is no question about diagnosis, treating the wrong tooth falls within the category of inattention on the part of the dentist. Obviously, misdiagnosis may happen and should not be

automatically considered an endodontic mishap. But if tooth #23 has been diagnosed with a necrotic pulp and the rubber dam is placed on tooth #24 and that tooth opened, that is a mishap.¹

Recognition: In the first instance, the error was probably a misdiagnosis; in the second instance, a tooth adjacent to the one scheduled for treatment was inadvertently opened.¹

Correction includes appropriate treatment of both teeth: the one incorrectly opened and the one with the original pulpal problem.¹

Missed Canals: Canals can be missed due to poor access and visibility of the canal orifice, lack of knowledge concerning tooth and pulpal anatomy and/or not thoroughly inspecting for extra canals; that is, having assumed that all the canals have

been located.³

Etiology: Lack of thorough knowledge of root canal anatomy along with its variations. Inadequate access cavity preparation.⁴

Common Sites for Missed Canals: Maxillary premolars may have three canals (mesiobuccal, distobuccal and palatal); Upper first molars usually have four canals; Mandibular incisors usually have extracanal; Mandibular premolars often have complex root anatomy; Mandibular molar may have extramesial and/or distal canal in some cases.⁴

Correction: Re-treatment is appropriate and should be attempted before recommending surgical correction.¹

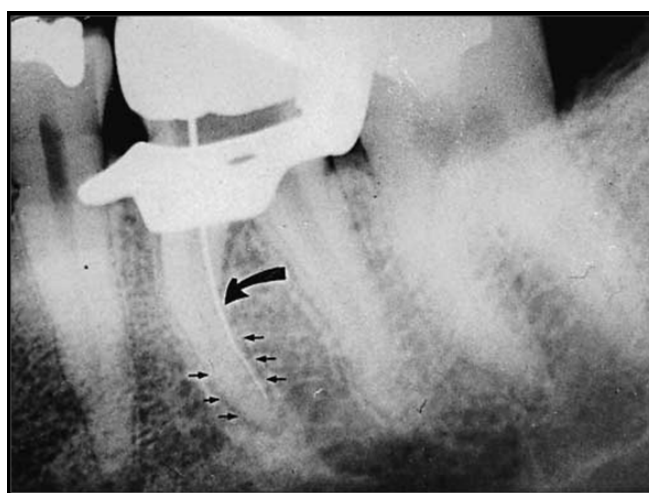


Fig.1: Radiograph indicating the presence of a second, or missed, canal. By following the lamina dura of the root (small arrows), the eccentric position of the file (large arrow), with relation to the outline of the root, suggests the presence of a missed canal. In this case, a perforation is confirmed: the file is in the periodontal ligament, and the mesial canals have not been negotiated.

c) Damage to Existing Restoration:

Extra-coronal restorations do not rule out root treatment or retreatment, but it should be noted that working through a crown is always more difficult, and that damage can be done.⁵

Correction: Minor porcelain chips can at times be repaired by bonding composite resin to the crown. However, the longevity of such repairs is unpredictable.¹

d) Access Cavity Perforations:

They may occur during preparation of the access cavity, root canal space, or post space.¹

Causes: Lack of attention to the degree of axial inclination of a tooth in relation to adjacent teeth and to alveolar bone may result in either gouging or perforation of the crown or the root at various levels.⁶

Recognition: If the access cavity perforation is above the periodontal attachment, the first sign of the presence of an accidental perforation will often be the presence of leakage: either saliva into the cavity or sodium hypochlorite out into the mouth, at which time the patient will notice the unpleasant taste.⁷ When the crown is perforated into the periodontal ligament, bleeding into the access cavity is often first indication of an accidental perforation.¹

Diagnosis: Radiographs from multiple angles, including bitewing radiographs, will dramatically improve the clinician's diagnostic acuity.⁷

Correction: Several materials have been recommended for perforation repairs such as cavit, amalgam, calcium-hydroxide paste, super ethoxy-benzoic acid (EBA), glass-ionomer

cement, gutta-percha, tricalcium phosphate or hemostatic agents such as gelfoam and MTA

which has shown convincing results in apical cavity perforations.⁷



Fig. 2: A misdirected bur created severe gouging and near-perforation during an otherwise routine access cavity preparation.

(e) Crown Fractures:

The tooth may have a preexistent infraction that becomes a true fracture when the patient chews on the tooth weakened additionally by an access preparation¹. Such fracture is usually recognized by direct observation.⁷

Recognition of such fractures is usually by direct observation. When infractions become true fractures, parts of the crown may be mobile.¹

Treatment: Crown fractures usually have to be treated by extraction unless the fracture is of a “chisel type” in which only the cusp or part of the crown is involved; in such cases, the loose segment can be removed and treatment completed.⁷

Instrumentation Related:

(a) Ledge formation:

Among the complications most commonly observed during root canal instrumentation is a deviation from the original canal curvature without communication with the periodontal ligament, resulting in a procedural error termed ledge formation or ledging.⁸

Recognition: There might be a loss of normal tactile sensation of the tip of the instrument binding in the lumen of the canal. This feeling is supplanted by that of the instrument point hitting against a solid wall, that is, a loose feeling with no tactile sensation of tensional binding.⁹

Management: When a ledge is suspected, root canal instrumentation should immediately cease, and efforts should be concentrated on regaining access to the apex using small-sized hand stainless-steel instruments.⁶

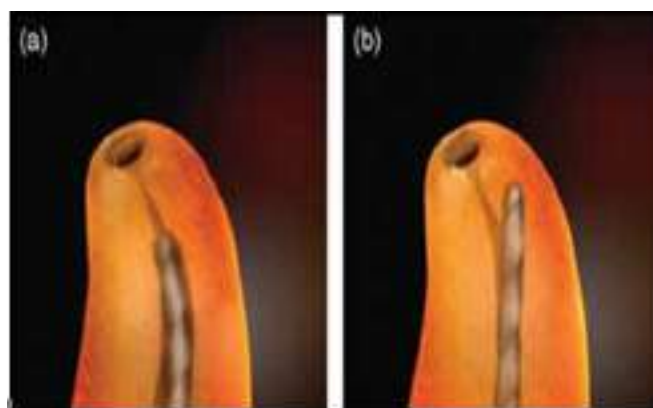


Fig.3: (a) Ledge formed within the original canal path as a result of skipping instrument sizes or erroneous working length estimation. (b) False canal and a ledge as a result of misdirection of files.

(b) Canal transportation:

According to the Glossary of Endodontic Terms of the American Association of Endodontists, Canal transportation is defined as “Removal of canal wall structure on the outside curve in the apical half of the canal due to the tendency of files to restore themselves to their original linear shape during canal preparation; may lead to ledge formation and possible perforation.”¹⁰

Etiology: Insufficiently designed access cavities, inflexible canal preparation instruments, instrumentation technique like crown down preparation using hand instruments, degree and radius of a canal curvature.¹¹

Recently a categorization of apical canal

transportation has been proposed:

- Type I: only a minor movement of the position of the physiological foramen, resulting in slight iatrogenic relocation.
- Type II: moderate movement of the physiological position of the foramen, resulting in a considerable iatrogenic relocation on the external root surface. In this type, a larger communication with the periapical space exists, and attempts to create a more coronal shape may weaken or perforate the root.
- Type III: severe movement of the physiological position of the canal, resulting in a significant iatrogenic relocation of the physiological foramen.¹²

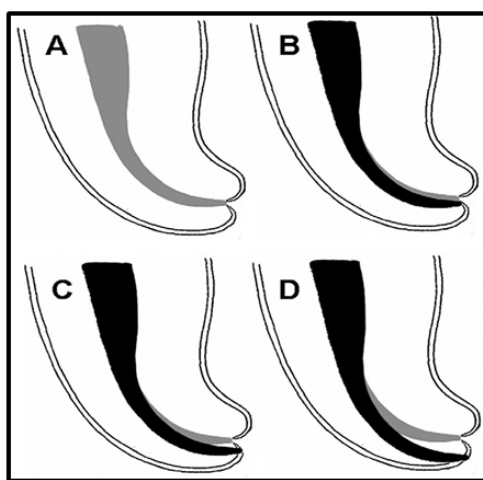


Fig.4: Types of canal transportation. (A) Regular canal shape; (B) Type I (minor movement of apical foramen; (C) Type II (moderate movement of apical foramen; (D) Type III transportation (severe movement of apical foramen).

Management: Canals exhibiting Type I transportation may be cleaned and obturated conventionally, if sufficient residual dentin is maintained and a continuously tapered canal is created above the foramen. Type II cases are managed by placing a biocompatible barrier (e.g. MTA) to permit an obturation against them in order to avoid uncontrolled extrusion of root filling material from the root canal into the periapical tissues. In Type III situations, a barrier technique is usually not feasible; these canals require obturation as best as possible followed by corrective apical surgery.¹²

© **Perforations:** Perforation is an artificial opening between the root canal system and the surrounding tissues of teeth, which are either created by the clinician during entry into the root canal system and during cavity preparation or by a

biological event such as resorption or caries, resulting in communication between root canal and periodontal tissues.¹³

Etiology: Iatrogenic perforation occurs due to lack of knowledge about the internal anatomy of tooth structure and in the failure of analyzing possible variations in root canal system. Non-iatrogenic perforation occurs due to internal/external resorption, trauma, and caries involving the furcal area.¹³

Recognition often begins with the sudden appearance of blood, which comes from the periodontal ligament space. Rinsing and blotting (with a cotton pellet) may allow direct visualization of the perforation; magnification with either loupes, an endoscope, or a microscope is very useful in these situations.¹

Management: The aim of perforation

management is regeneration of healthy periodontal tissues against the perforation without persistent inflammation or loss of periodontal attachment.¹⁴ There are only two options in this case: repair or extraction.¹⁵

Materials Used for Perforation Repair:

Indium foil; Amalgam; Plaster of Paris; Zinc-Oxide Eugenol; Super EBA; IRM (Intermediate

Restorative Material); Gutta-Percha; Cavit; Glass-Ionomer Cement; Metal-Modified Glass-Ionomer Cement; Composite; Dentin chips; Decalcified Freezed Dried Bone; Calcium-Phosphate Cement; Tricalcium-Phosphate Cement; Hydroxyapatite; Calcium-hydroxide; Portland Cement; MTA; Biodentine; Endosequence; Bioaggregate; New Endodontic Cement.¹⁵

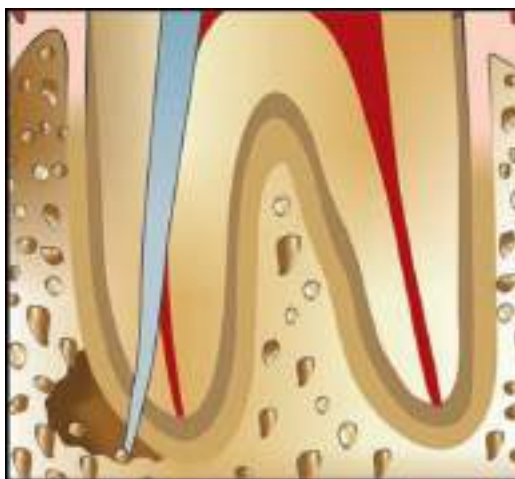


Fig.5: Perforation caused by use of stiff instruments in a curved canal

(a) Separated instruments and Foreign Objects:

The term “broken instruments” applies not only to separated files, but it could also apply to a sectioned silver point, files, reamers, a segment of lentulo spiral, GG drill, lateral or finger spreaders. Limited flexibility and strength of intracanal instruments combined with improper use may result in an intracanal instrument separation.⁷

Recognition: Removal of a shortened file with a

blunt tip from a canal and subsequent loss of patency to the original length are the main clues for the presence of a separated instrument. A radiograph is essential for confirmation.⁶

Management: An immediate periapical radiograph is recommended so as to confirm the separation of the instrument, locate the instrument in the root canal, evaluate the anatomy of the root canal and measure the length of the fragment. The management of a separated instrument can be conservative and/or surgical.¹⁶



Fig.6: Apical third fracture of an instrument.

(a) Canal Blockage:

When a canal suddenly does not permit a working file to be advanced to the apical stop, a situation sometimes referred to as a “blockout” has occurred.¹

Etiology: packed dentinal chips, tissue debris, cotton pellets, restorative materials or presence of fractured instruments,⁴

Recognition: When the confirmed working length is no longer attained canal blockage is recognized. Evaluation radiographically will demonstrate the file is not reaching near the apical terminus.⁷

Correction: is accomplished by means of recapitulation.¹ Copious irrigation with sodium-hypochlorite and a chelating agent can assist in dissolving tissue remnants and dentinal shavings blocking the root canal. Fine instruments (ISO

sizes 06 to 10) can be used to stir up the debris and to relocate the root canal up to its entire length.¹⁷

Obturation Related:

(a) Over or under extended root canal fillings:

Traditionally, poor obturation has been considered the primary cause of root canal treatment failures.¹⁸

Recognition: of an inaccurately placed root canal filling usually takes place when a post-treatment radiograph is examined.¹

Correction: An attempt to remove the overextension is sometimes successful if the entire point can be removed with one tug¹. Periradicular surgery is indicated in case of significant overextension of filling material resulting in periradicular pathosis with symptoms.¹⁹ Removal of underfilled gutta-percha and retreatment is preferred.⁶



Fig.7: Underfilled root canals

(b) Nerve paresthesia:

Paresthesia is defined as a burning or prickling sensation or partial numbness caused by neural injury. Patients have described it as warmth, cold, burning, aching, prickling, tingling, pins and needles, numbness and formication.²⁰ Overextensions or over instrumentations are the causative factors most often found in paresthesia secondary to orthograde endodontic therapy.¹

Diagnosis: require a combination of a thorough anamnesis, a proper clinical evaluation, and an adjunct radiographic evaluation when indicated.²¹

Management: Early administration of anti-inflammatory drugs, such as corticosteroids or non-steroidal anti-inflammatory drugs may be

beneficial, even as a preventive approach in absence of a definitive diagnosis.²¹

(c) Vertical root fractures:

Vertical Root Fracture is defined as a longitudinal fracture confined to the root that usually begins on the internal canal wall and extends outward to the root surface. Diagnosis is challenging as signs and symptoms are often delayed.²²

Etiology: Traumatic occlusion causes Fatigue Root Fracture. Gold inlays, large amalgam restoration undermining tooth structure, Excessive removal of tooth structure in endodontically treated teeth, Long term calcium-hydroxide as a root canal dressing may increase risk of root fracture.²²

Clinical diagnostic tests: include Direct

visualization, Staining, Pulp testing, Bite test, Transillumination test, Periodontal probing test, Tracing the sinus tract.²³

Management: When a diagnosis of vertical root fracture is made, a quick decision to extract the

tooth or root is necessary since, inflammation in the supporting tissues can lead to periodontal break-down, followed by development of a deep osseous defect and resorption of the bone.²⁴

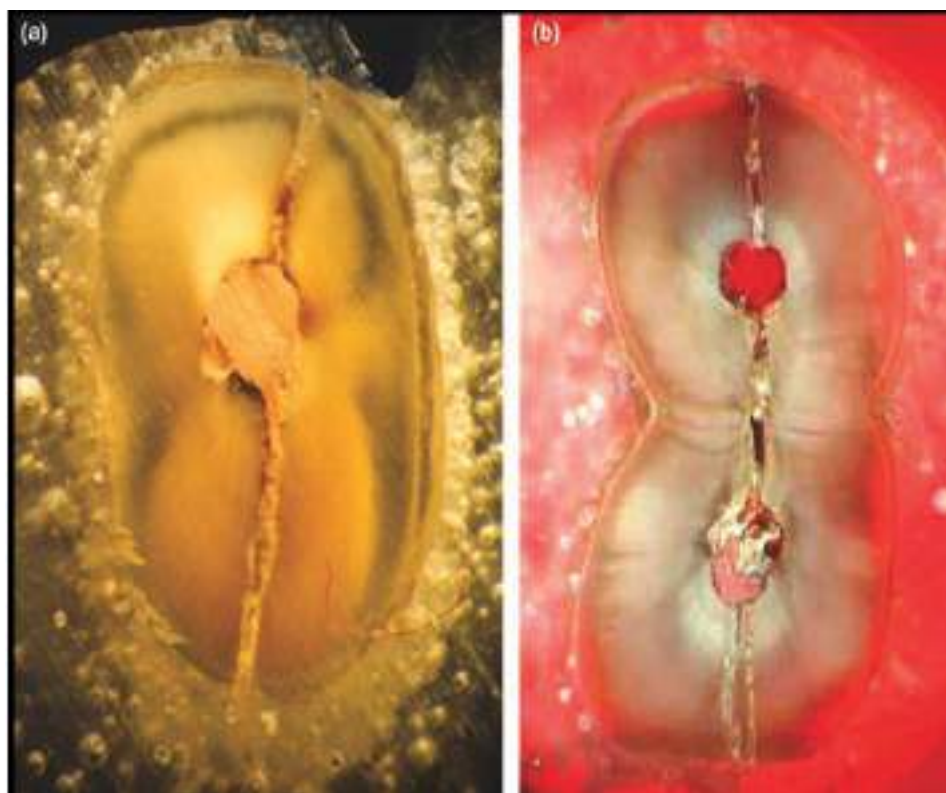


Fig.8: Cross-section of a vertically fractured maxillary premolar showing a complete fracture from the buccal to the lingual aspect (A). (B) Complete fracture from the buccal to the lingual aspects of a maxillary premolar with two root canals is shown.

Miscellaneous

(a) Post space perforation:

Following obturation, careless post space preparation may result in perforation. Sometimes the post is not placed into the root canal but the adjacent dentine, resulting in catastrophic consequences.¹⁴

Diagnosis: If no local anaesthetic is given, sudden unexpected pain during treatment may also indicate a perforation. Apex locators, Operating microscopes, CBCT are becoming increasingly popular in identifying perforations.¹⁴

Management: Is surgical if the post cannot be removed. If the post can be removed, non-surgical repair is preferred.⁶

(b) **Irrigant Related:** Efficacy of root canal irrigation depends on several factors, such as depth of needle insertion into the canal, final diameter of the prepared canal, canal curvature, volume and

properties of the used solution.²⁵ Hydrogen-peroxide, chlorhexidine, saline are some of the irrigants used; among which sodium-hypochlorite is the commonly used effective antimicrobial and tissue dissolving irrigant.²⁶ The most common complication is accidental injection into the periapical tissue. Injection of NaOCl solution beyond the apical foramen may occur in teeth with wide apical foramina or when the apical constriction has been destroyed during root canal preparation.²⁷

Management of sodium hypochlorite accident:

- Stop treatment immediately and explain the situation to the patient.
- No further irrigation of the canal.
- Remove as much sodium-hypochlorite from tooth via an empty syringe to aspirate or use of paper points.
- Dress tooth with non-setting calcium hydroxide.

- Administer steroids (e.g. Intra-muscular 100 mg HYDROCORTISONE NA SUCCINATE) immediately.
- Oral antibiotics should be taken immediately and continued for 3 days. AMOXICILLIN 250mg TDS or METRONIDAZLE 200 mg TDS (in apenicillin allergic patient).
- Appropriate analgesia prescribed.²⁸



Fig.9:Significant right-sided facial swelling, bruising present explaining that a hypochlorite accident had occurred during root canal treatment

(c) Tissue emphysema:

Subcutaneous emphysema (SCE) is defined as the abnormal presence of air under pressure, along or between fascial planes. The most common dental etiology of SCE is the introduction of air via the high-speed handpiece during restorative procedures or during the surgical resection of impacted teeth.²⁹

Clinical features: Often seen is localized swelling, discomfort, and crepitus, with soft tissue radiographs or CT scans displaying tissue distension. Later sequelae are wide-spread edema, erythema, pyrexia, and sometimes pain.²⁹ Information of Subcutaneous

Emphysema: Broad-spectrum antibiotic coverage is advised in all dental-related cases, since the introduction of air may include microorganisms. In severe cases, immediate medical attention is mandatory. Tracheostomy

may become necessary in case of retropharyngeal -space emphysema with consecutive airway compromise.³⁰

(d) Instrument Aspiration and Ingestion:

Any object routinely placed into or removed from the oral cavity during dental or surgical procedures can be aspirated or swallowed. 31Aspiration of an endodontic instrument happens only when the rubber dam is not in place. Ingested objects of dental origin include dental bridges, transpalatal arch, crowns and removable dentures, dental floss, bands, impression materials, orthodontic arch wires, retention appliances and various endodontic instruments like broaches, files and reamers, restorations, restorative materials, instruments, implant parts, rubber-dam clamps, gauze packs.³¹

Investigation methods: Abdominal and Chest X-ray, Endoscopy, CT scans.³²



Fig.10: Root canal instrument into the trachea

Management: When any dental instrument is aspirated / swallowed:

- Act quickly to locate and remove any object that may be causing acute upper airway obstruction.
- Keep the patient's head low, turn it to the side, and ask the patient to cough. Administer sharp blows on the patient's back.
- If object is visible, grasp it with small forceps, or use a suction tip, being careful not to push it deeper into the throat.
- If it is not possible to grasp the object, or if it is evident that the object is lodged in the airway (difficulty in breathing), the Heimlich manoeuvre may be attempted³².

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DIE SYSTEMS IN FPD : A REVIEW

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Abstract

An accurate working cast with removable dies is essential to make a well fitting restoration. The prepared tooth, the surrounding soft tissues & the adjacent & opposing teeth should be accurately reproduced to decrease the number of clinical steps and to improve the accuracy of working cast/die system. A cast die system captures the necessary information so that it can be transported to the laboratory.

Keywords: DI-lock, Pindex, Accutrac, Die systems, Dowel pins.

Introduction

Removable die systems are frequently used to facilitate the manipulation of dies during the laboratory phase of fixed prosthesis fabrication¹. The successful construction of long span fixed partial dentures and implant prosthesis depends on the accurate fabrication of the removable die. The removable die technique requires an accurate reproduction of the prepared tooth, the surrounding soft tissues, the adjacent and the opposing teeth. The die system captures this necessary information so that it can be transferred to the laboratory for fabrication of wax pattern. Precise relocation of the die in the master cast is critical to the system's success².

The fabrication of removable dies is an important step in the realization of the master cast, and it is necessary to know the existing systems available with their respective qualities and imperfections. Many methods for the indirect technique of constructing a working cast with removable dies have been reported in the literature, and some investigators have experimentally established the accuracy and comparative stability of the different systems.

A die has been defined as the positive reproduction of the form of a prepared tooth in any suitable material.

A cast is defined as a life size likeness of some desired form. It is formed within or is a material poured into a matrix or impression of the desired form.

Prerequisites for a good cast

- It should duplicate both prepared and

unprepared surfaces.

- The unprepared teeth adjacent to the preparation should be free of voids.
- The occlusal surface of unprepared teeth and the teeth involved in anterior guidance should allow proper articulation of both the casts.
- All soft tissues must be properly duplicated in the working cast, that will be involved in fixed prosthesis.
- Edentulous space & residual ridge contours)

Prerequisites For A Good Die

- The prepared tooth must be exactly reproduced.
- All surfaces should be duplicated accurately.
- There should be no bubbles or voids.
- The unprepared tooth structure immediately cervical to the finish line should be easily visible on the die, (0.5-1 mm).
- There should be adequate access to the margin.

Requirements Of Cast & Die Materials

- They should allow a dimensionally accurate cast.
- Die materials should be strong & resistant to abrasion.
- It should be compatible with separating agent.
- All the surface details should be reproduced accurately.
- Should get easily wettable by wax.
- It should be compatible with impression materials.
- Die materials should have a contrasting color.

Classification of dies:

According to the material used for fabrication of die:

● Non metallic

A. Gypsum dies

- B. Resin dies
- C. Silicophosphate dies
- D. Ceramic dies
- E. Flexible dies

- **Metallic dies**

- A. Electroplated dies
- B. Low fusing alloys
- C. Amalgam dies
- D. Metal sprayed dies

Cast And Die Systems

There are two basic cast and die systems available.

- A working cast with a separate die which is also referred to as sold cast with immovable die/ multiple pour technique.
- A working cast with a removable die.

Working Cast With A Separate Die

Advantages

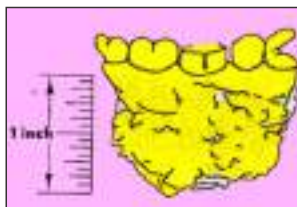
- It is the simplest means of fabricating a working cast & die, because no procedures are required to create a die other than making a sectional cast and a full-arch cast.
- The relationship between abutments is fixed & immovable.
- gingival tissue & all other landmarks are intact so it is easier to obtain physiologically

Procedure

- Impression is made.
- Stone is added to the impression in small increments.



- Stone is build upto a height of approximately 1.0 inch above the preparation to allow bulk for handle on the die.



- Cast is wet thoroughly and excess stone is trimmed from the working casts on the model trimmer



harmonious restoration contours while fabricating wax patterns.

Disadvantages

- The disadvantages faced in the use of a working cast with a separate die is that the wax pattern must be transferred from one to the other.
- This technique, unfortunately, can be used only with elastomeric impressions, because hydrocolloid impression materials get torn & distorted easily and cannot be used for accurate second pour.

Steps Of Fabrication:

Armamentarium

- 500-cc Vac-U-Mixer & vacuum tubing
- Vibrator
- Water measuring tubes.
- Large & small spatulas
- Die stone (Silky-Rock, Vel-Mix)
- Humidor
- Model trimmer apparatus
- Straight hand piece & pear-shaped acrylic bur
- Bp blade (no.25) and handle
- Tanner carver
- Colorbrite red pencil

- The diameter of the handle should be larger than the preparation.
- The handle should be octagonal in cross section and sides should be parallel or tapered.



- Final trimming of the die is done with a sharp 25 no. blade



- A die hardening agent (cyano-acrylate or acrylic resin lacquer) is applied to the finish line area of a die to avoid abrasion by waxing instruments while the fabrication of the wax pattern.

Working cast with a removable die

Advantages

- They are convenient to use because while transferring the wax patterns or copings to the working cast they need not be removed from their respective dies.
- It is important while making ceramic restorations, because unfired material is quite fragile.
- A removable die eliminates mismatch between a separate die & working cast that may be caused by impression distortion or deterioration between pours, or by a cast & die made from separate impression which are not identical.

- The main disadvantage of a removable die system is in the pattern if the die does not reseat accurately in the working cast.

Systems included are:

1. Wet pinning systems

- A. Straight dowel pin
- B. Curved dowel pin

2. Dry pinning systems

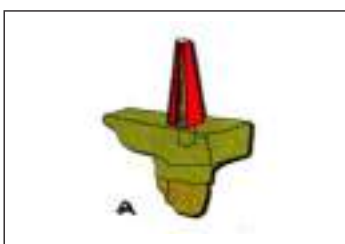
- A. Pindex system
- B. Dilok system
- C. DVA system
- D. Zeiser system
- E. Accutrac system

Disadvantages

Wet pinning system

A) STRAIGHT DOWEL PIN :-

- o The brass dowel pin is the most accurate system in resisting horizontal displacement and the second lowest in vertical deviation.



- o A dowel pin is placed over each prepared tooth in the impression.

Summary And Conclusion

The choice of a specific technique depends on operator preference, and after assessment of advantages and disadvantages of each method one should choose accordingly. If they are conducted carefully and properly all methods achieve clinically acceptable accuracy. The die of prepared tooth can be made removable by using dowels/pin or a solid working cast & a separate die can be used.

Whatever system is chosen it should articulate exactly with an accurately made opposing cast.

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ANTIBIOTIC PRESCRIPTION PRACTICE IN DENTISTRY – A SURVEY STUDY

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Abstract

Aims: The aims of study were: 1. To analyze the most commonly prescribed antibiotics 2. Conditions in which antibiotics are being prescribed 3.. Awareness of antibiotic resistance among the dental practitioners of Punjab

Methodology: It was an observational cross-sectional study. Dental practitioners of Punjab were selected for the study. A total sample of 200 was taken for study. A questionnaire was prepared containing questions such as the most commonly prescribed antibiotics, conditions where antibiotics are indicated, antibiotic resistance and reasons for prescribing antibiotics etc.

Results: It was found that most of dentists were aware of antibiotic resistance. Most common conditions for prescribing antibiotics were localized intraoral swelling, pericoronitis, irreversible pulpitis etc. Most common prescribed drug was amoxicillin clavulanic acid and second was amoxicillin

Conclusion: Dental practioners should have thorough knowledge about antibiotic prescription, their side effects, antibiotic resistance, and exact condition for use of antibiotics. Dentists should prescribe antibiotics to the patients only according to the latest guidelines of antibiotic prescription, where it is indicated. It should not be a first-line treatment modality.

Introduction

Most human oro-facial infections originate from odontogenic infections and prescribing antibiotics has become a ubiquitous phenomenon.¹⁻⁵

Antibiotics are commonly prescribed by dentists in their practice. This is leading to antibiotic resistance in our population and other health issues occurring related to the over-prescription of antibiotics.⁶ The World Health Organization (WHO) has noted the inaccurate and irrational use of antibiotics which leads to antibiotic resistance that becomes a global problem.⁷⁻⁸. Dental practioners are prescribing antibiotics between 7% and 11% of all common antibiotics. According to the National Center for Disease Control and Prevention, one-third of antibiotic prescriptions to the patients are unnecessary.⁵

Antibiotics have emerged as a boon to humanity and this advancement has led to a better quality of life along with an overall reduction in morbidity and mortality. Antibiotics are basically chemical substances having capability of destroying and inhibiting the growth of specific microorganisms. Dental infections are polymicrobial that is caused by variety of microorganisms. Most of the infections of orofacial region require both systemic and local treatment.⁹⁻¹² Systemic management is mostly by antibiotics, and hence, these antibiotics are pharmacotherapeutic

adjuncts prescribed by dentists.¹³⁻¹⁵

Antibiotics resistance has developed due to their inappropriate and excess use. Even more alarming is the rates at which bacteria develop resistance.¹⁶⁻¹⁸ Microorganisms exhibiting resistance to new drugs often are isolated soon after the drugs have been introduced. The main reason behind antibiotic resistance is due to over-prescription by the health-care workers, inappropriate use by patients, and resistance also developed by the bacteria.¹⁹⁻²⁰ There is a significant relationship between the increase of antibiotic resistance and utilization, higher resistance to antibiotics in bacteria was seen in areas where antibiotic utilization is more. Dentistry's contribution to antibiotic resistance is unknown. Increased use of antibiotics and development of bacterial resistance, leads to introduction of newer drug combinations. Therefore, it is needed to assess the knowledge of antibiotic use and practice among dental practitioners. Only few studies observed the knowledge of dentists regarding the antibiotic prescription pattern and development of antibiotics resistance among in India.

It was observed that the greatest threat to future human health is Antimicrobial resistance with increased microbial resistance reported each year across in both developed and developing countries.

Efforts have been practiced over many years to regulate the 'rational use of drugs', for example through the WHO's International Network on the Rational Use of Drugs program (INRUD), the antibiotic use is increasing day by day.¹⁵⁻¹⁷ An increase in antibiotic resistance (ABR) worldwide, specifically in developing countries, so attention should be given to antibiotics prescription knowledge and also to make the dental practitioners aware of Antibiotic Resistance.¹⁻² In May 2015, the World Health Assembly made an agreement to handle the increased Antibiotic Resistance globally, and the first objective of it, was to increase Antibiotic Resistance awareness and understanding among the health care workers.³ In developing countries, antibiotics can be readily purchased without any control, such countries usually experience more cases of antibiotic resistance, in contrast to what occurs in western countries where strict guidelines of antibiotic use are practiced.⁴⁻⁷ Hence, the study was conducted with the objective to assess dental practitioner's knowledge and practices regarding antibiotic prescription and development of resistance.⁷⁻¹⁰

Methodology

The study that conducted among dental practitioners of Punjab. A sample of 200 dental practitioners was selected. Both BDS and MDS practitioners were included in the study. A questionnaire was prepared and given to each dentist included in the study. Ethical clearance was taken for the study from college the ethical committee. Consent was also taken from each dentist to include them in the study survey. All practitioners were registered with state Dental council. They were practicing since 5-10 years.

Both male and female dentists were included in study with no specific proportion.

Results

Awareness about antibiotic resistance is adequate. Table-1 showed percentage of dentists who prescribe antibiotics and in which conditions they prescribe antibiotics. Most common condition where antibiotics prescribed was localized intraoral swelling (78.74%), next is pericoronitis (72.85%) and then is apical periodontitis (68.89%).

Table 2 showed awareness among dentists regarding antibiotic use, antibiotic resistance and other factors related to antibiotic prescription. 73% practitioners were aware of antibiotic resistance, 52% about side effects of antibiotics and 65% about contraindications to use of antibiotics. Only 56% dentists took allergic history to medicines before prescribing antibiotics and 61% advised the patient to complete the course of antibiotic.

Graph 1 showed percentage of different antibiotics used by dentists. The most commonly prescribed antibiotic is amoxicillin and clavulanic acid combination (52%) which is a second line drug. Whereas first-line drug amoxicillin was prescribed less (18%). Cephalosporins were prescribed least (1%) in dentistry as found in our study.

Graph 2 showed the reasons, why dentists prescribed antibiotics. The most common was that the patient wants only medicine for his/her problem (50%). Next reason found was long waiting appointments and last is to sustain the patient till the specialist availability to treat the patient.

Conditions	Dentists prescribing the antibiotics	
	Yes	No
Localized intra oral swelling	78.74%	20.26%
Pericoronitis	72.85%	27.15%
Simple extractions	60.53%	39.47%
Irreversible pulpitis	65.89%	33.11%
Apical periodontitis	68.89%	31.11%
Reversible pulpitis	60.77%	39.23%
Dry socket	25.15%	73.85%

Table 1: Conditions where antibiotics are prescribed

No.	Questions	Yes	No
1	Are you aware of the term antibiotic resistance?	73%	27%
2	Are you aware of major side effects of antibiotic prescribed	52%	48%
3	Do you take allergic history before prescribing antibiotics?	56%	44%
4	Do you advise your patient to complete antibiotic course.	61%	39%
5	Do you know self medication cause drug resistance.	55%	45%
6	Are you aware of the contraindications of the antibiotics prescribed	65%	35%

Table 2: Awareness about antibiotics among dentists

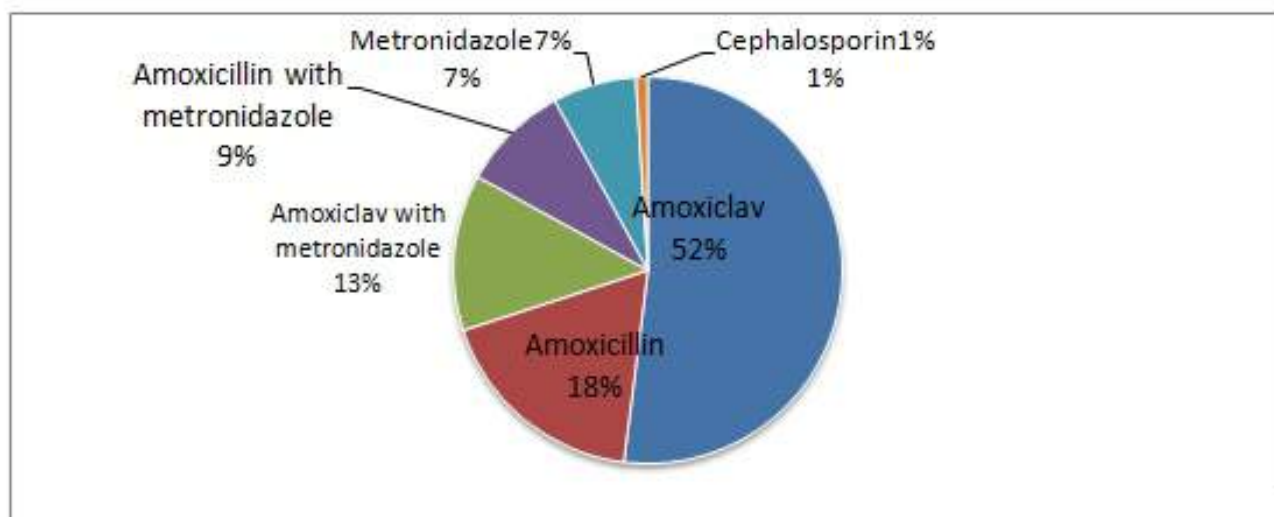


Figure 1: Most commonly prescribed antibiotics

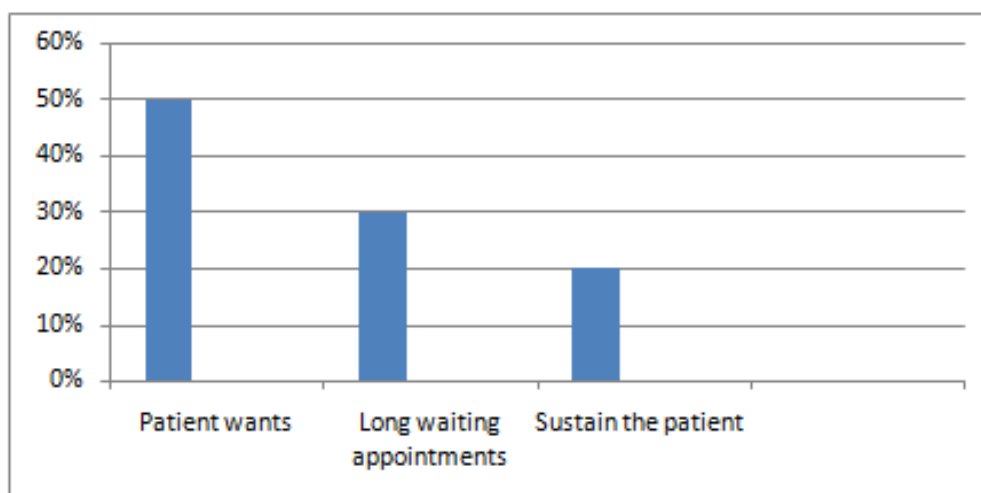


Figure 2: Reasons for antibiotics prescription

Discussion

In our study most commonly prescribed antibiotics was Amoxicillin and clavulanic acid combination (52%). Sapna Konde et al conducted a study in the sample of 100 BDS and 100 MDS practioners, and they observed that amoxicillin was the regularly used antibiotic, 86% of BDS practioners and 70% of MDS practioners prescribed Amoxicillin in their daily practice.⁵ Thornhill et al also found that amoxicillin is the most frequently prescribed antibiotic.²¹ Yu et al²² observed that in common dental conditions such as acute pulpitis, diffuse swelling, acute apical abscess, Amoxicillin is widely used drug. Amoxicillin has a wider spectrum against Gram-negative bacteria and it is easily digested and can be taken with food. It is the principal antibiotics prescribed in dentistry in USA.²³

Amoxicillin with clavulanic acid is a broad-spectrum antibiotic that is considered to be the second most prescribed antibiotic in dentistry. But in the case of amoxicillin resistance, the administration of Amoxicillin with clavulanic acid or metronidazole is prescribed.^{24,25} Metronidazole is the second number drug prescribed by dentists. It is highly active against anaerobes but it has no activity against aerobes.²²

Amoxicillin and clavulanic acid combination is a second line Antibiotic according to the current guidelines⁷⁻⁹, A large number of dentists are prescribing it in Punjab. Dentists practicing in the public health care system of Valencian Community prescribed a total of 43,490 containers of antibiotic in year 2005, with a total antibiotics cost of 274,439.82 euros. This counts 0.94% part of the total antibiotic containers and it costs 0.51% of total expenditure of the public health care system. Amoxicillin and amoxicillin clavulanic acid accounted for 67.8% of all prescriptions and 59.4% of the global cost²⁶. Similar to this study, our study also found that amoxicillin clavulanic acid was most commonly prescribed. But in contrast to present study, Mainjot A et al found that the most common antibiotic that is prescribed in dental practice is Amoxicillin followed by Amoxicillin and clavulanic acid.²⁷

Present study showed that dentists are prescribing antibiotics most commonly in dental conditions such as localized intra oral swelling, pericoritis, extractions, apical periodontitis, irreversible and reversible pulpitis. Salako et al. in Kuwait studied a sample of 200 dentists and

observed that 78.57% of dentists are prescribing antibiotics in conditions such as dry socket, pericoritis, simple extraction and localized intraoral swelling.¹⁶ In 51.9% cases of periodontal abscess, antibiotics were given in Belgium²⁷. In Spain, for irreversible pulpitis, 40% of endodontists have habit to gave antibiotic prescription to patients.²⁸

In present study only 73% dentists were aware of antibiotics resistance issue and 52% know about side effects of antibiotics. Similarly Segura et al found over prescription of antibiotics and lack of knowledge of side effects of antibiotics.²⁸ In France and Scotland, D.Nathwani found that 63% of junior doctors and 95% of senior doctors are aware of Antibiotic Resistance and considering it while prescribing antibiotics.¹⁹⁻²⁰

The findings of study conducted by Abdullah Ali et al revealed that antibiotics were prescribed in various conditions for which they are not recommended, including gingivitis, chronic apical abscess, preapical cysts, caries, periodontitis, pulpal necrosis, reversible and irreversible pulpitis.²⁹ These results were consistent with survey study on American endodontists and survey study conducted in Brazil.^{30,31} Present study also observed that dentists are prescribing antibiotics in some of the above said dental conditions without justifying its use, just for some reasons such as patient's request for medication, long waiting appointments, more workload so as to sustain patients. Yu et al found that endodontist with experience from 1 to 5 years overprescribed analgesics and antibiotics as compared to endodontist with experience of more than 10 years. These results were supported by a similar study conducted by Marra et al.³² Analgesics and antibiotics were overly prescribed by the most of the dentists and only 1/4th of the dentists are prescribing antibiotics and analgesics appropriately. To regulate overuse of analgesics and antibiotics, the dentist must aware of endodontic and other dental conditions very well, so as not to contribute the global issue of antibiotic resistance.^{22,33}

Conclusion

Antibiotic prescription is an integral part of medicine and dental practice. In patients with infective endocarditis, immunocompromised conditions, dental procedures may produce bacteremias. An antibiotic prophylaxis should be given in such patients before performing Invasive

dental procedures. Special consideration should also be given before any dental treatment is carried out and prescribing any medication in organ transplant and pregnant patients. Special caution needs to be addressed in such patients to provide the required antibiotic or any other medicine and its dose adjustments to prevent the complications. Recommendations on antibiotic prescribing are essential to prevent over prescribing of antibiotics. The correct information of odontogenic infections, causative micro organisms and the pharmacokinetics of antibiotics, decreases the risk of incorrect antibiotic use in dental practice. There should be Antibiotic awareness programs. Also there should be strict rules about purchasing the Antibiotics in pharmacy. Antibiotics shouldn't be over the counter sold the drug. Compliance towards the guidelines should be monitor via policy.

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A COMPARATIVE STUDY TO CHECK THE EFFICACY OF PRF IN TISSUE REGENERATION AFTER SURGICAL EXTRACTION OF IMPACTED MANDIBULAR THIRD MOLARS

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Abstract

Aim: The study conducted aimed at PRF efficacy in the soft tissue healing and bone regeneration after surgical removal of impacted mandibular 3rd molars.

Material and Method- This study includes 16 patients, who were randomly selected in the Department of Oral and Maxillofacial Surgery. Patients who were selected had bilaterally impacted third molars and were indicated for surgical extractions bilaterally.

The post extraction sockets were divided into 2 groups, Group A (study group) was grafted with PRF and then primarily closed and Group B (control group) was primarily closed without any PRF graft.

Postoperatively patients were reviewed for soft tissue healing on 1st, 3rd and 7th day and bone healing on 1st, 2nd and 3rd month.

Results: It was found that soft tissue healing was better in the group A as compared to group B. The difference in trabecular pattern showed significant increase in healing speed at the end of third month postoperatively in study group as compared to control group.

Conclusion: In this study, the clinical and radiological findings clearly indicate that PRF can be used as a sole graft material to improve soft tissue healing and bone regeneration.

Introduction

Third molar is the last tooth to erupt, so it may readily become either impacted or displaced if there is insufficient room for it within the dental arch. One of the major concerns in Surgery is the regeneration of bony defects resulting after various surgical procedures which may cause severe aesthetic and functional problems. In such cases the use of bone grafts, derivatives or bone substitutes are indicated to promote healing and bone regeneration¹.

Different bone grafts used for enhancing the rate of bone formation and augmentation of the bone quality include autografts, allografts, xenografts or alloplastic bone substitutes. Autogenous bone grafts till date are the "gold standard" for bone grafting as they alone offer the three necessary components for bone repair- osteoinduction, osteogenicity and an osteoconductive matrix.

Platelets play a key role in wound healing. There is release of certain substances from platelets that promotes tissue repair, angiogenesis, inflammation, immune response, bone regeneration, stimulation of cell migration, differentiation and repair².

PRF belongs to a new generation of platelet concentrates customized to a preparation without

biochemical blood handling. It is a second-generation platelet concentrate, prepared from centrifuged blood, is an autogenous source of various growth factors obtained by sequestering and concentrating drawn venous blood. Platelet rich fibrin enhances wound healing by increasing the availability of critical growth factors that are released by platelet degranulation which in turn also help in accelerated bone regeneration³.

Materials and Methods

Sixteen patients with bilaterally impacted mandibular third molars, were randomly selected from those reporting to the Outpatient Department of Oral and Maxillofacial Surgery, National Dental College And Hospital, Dera bassi, Punjab. All the patients were informed regarding the surgical procedure and consent was obtained before the surgery. The present comparative, prospective study was conducted as a controlled clinical trial using split mouth design (in vivo), where in the effect of PRF grafted extraction socket of impacted mandibular third molar was compared with non-grafted extraction socket of impacted mandibular third molar in the same patient.

The extractions sockets were divided into two groups.

Group 1- The socket was grafted with PRF (study group) and primarily closed.

Group 2- The socket was not grafted with PRF(control group) and primarily closed.

Soft Tissue Healing was evaluated using Landry⁴ et. al. index. Clinical evaluation was done on 1st, 3rd and 7th postoperative days. Bone healing was assessed radiographically using a standard reproducible Intraoral Periapical Radiograph (IOPA) with a film holding device, exposure parameters being same. IOPA radiographs were taken immediately post operatively, by the end of first, second and third month. A particular area was selected on IOPA films which included new bone and adjacent old bone to compare the new bone formation. The bone healing criteria and the scoring system in this study were based on a modification⁵ of the method used by Kelley⁶ et al. in which base line radiographic score was taken as 0. The gross variance from baseline radiological score is represented by +2 or -2 and the significant variation from normal is +1 or -1.

Prf Preparation Protocol

Dohan and Choukroun² et al suggested that PRF is derived from a natural and progressive process of

polymerization that occurs during centrifugation of blood. The absence of anticoagulant activates most platelets of the blood sample in contact with the tube walls and the release of the coagulation cascade in a few minutes. Therefore, blood collection and its transfer to centrifugator is important, as with delay, the fibrin will polymerize in a diffuse way in the tube and only a small blood clot without consistency will be obtained. To get the PRF clot which is clinically useful, proper handling and accurate protocol is required. The results of the study by Chen Yao Su⁷ et al supported that preparing the PRF immediately before using it to allow for continuous release of growth factors over the subsequent 300 minutes.

5-10 ml blood was drawn, according to the size of defect, from a peripheral vein. Blood was collected in 10 ml pre sterilized test tubes without an anticoagulant and centrifuged immediately at 3000 rpm (approx) for 10 minutes.

As a Result, test tube consists of following three layers:

1. Upper most layer consists of Acellular Platelet poor plasma.
2. Middle layer consists of PRF clot .
3. Lower most layer consists of RBC's.

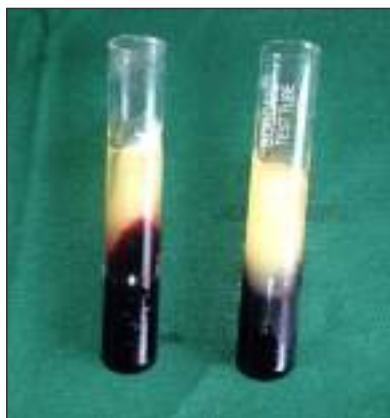


Fig.1: Blood immediately after centrifugation. Three layers representing top layer as platelet poor plasma, middle layer as PRF and bottom layer as red blood cells.



Fig. 2: PRF Clot with RBC layer.



Fig.3: PRF Layer separated from RBC layer.

Surgical procedure

After surgical extraction of bilateral third molars in a single visit all patients were given antibiotics Cap.amoxicillin (500 mg every 8 hrs for 5days) or Tab.Erythromycin (500 mg every 6 hrs for 5 days, for patients allergic to penicillin) and Tab.

Metronidazole (400 mg every 8 hrs for 5 days), analgesic Tab. Ibuprofen (400mg every 8 hrs for 5days), Chlorhexidine digluconate mouth rinses (0.2% twice for 2 weeks) and post surgical instructions.



Fig.4: Placement of PRF in socket of study side



Fig.5: Primary closure of the wound

Soft Tissue Healing- assessment by Landry⁴ et. al.

● **Very poor**

- Tissue color > or =50% of gingiva red.
- Response to palpation: bleeding.
- Granulation tissue: present.
- Incision margin: not epithelised, with loss of epithelium beyond incision margin.
- Suppuration present.

● **Poor**

- Tissue color > or =50% of gingiva red.
- Response to palpation: bleeding.
- Granulation tissue: present.
- Incision margin: not epithelised, with Connective tissue exposed.

● **Good**

- Tissue color : > or =25% and < 50% of

gingiva red.

- Response to palpation: no bleeding.
- Granulation tissue: none.
- Incision margin: no connective tissue exposed.

● **Very good**

- Tissue color : < 25 % of gingiva red.
- Response to palpation: no bleeding.
- Granulation tissue: none.
- Incision margin: no connective tissue exposed.

● **Excellent**

- Tissue color: all tissues pink.
- Response to palpation: no bleeding.
- Granulation tissue: none.
- Incision margin: no connective tissue exposed.

Radiographic assessment^{5,6}

Lamina dura

- +2 lamina dura essentially absent, may be present in isolated areas.
- +1 lamina dura essentially thinned, missing in some areas.

- 0 within normal limits.
- -1 portions of lamina dura thickened, milder degrees.
- -2 entire lamina dura substantially thickened.

Overall density

- +2 severe increase in radiographic density.
- +1 mild to moderate increase in radiographic density.
- 0 within normal limits.
- -1 mild to moderate decrease in radiographic density.
- -2 severe decrease in radiographic density.

Trabecular Pattern

- +2 all trabeculae substantially coarser.
- +1 some coarser trabeculae to milder degrees.
- 0 within normal limits.
- -1 delicate finely meshed trabeculations.
- -2 granular, nearly homogenous patterns, individual trabeculations essentially absent.

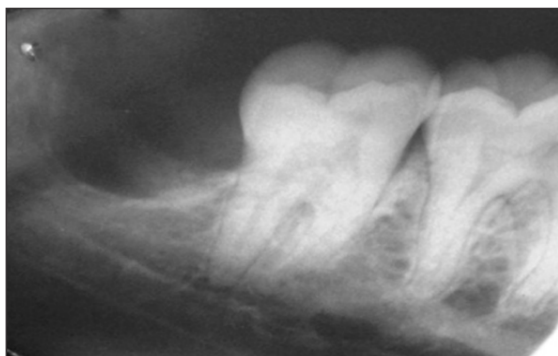


Fig.6: Immediate post operative IOPA picture of socket



Fig.8: 2nd month postoperative IOPA

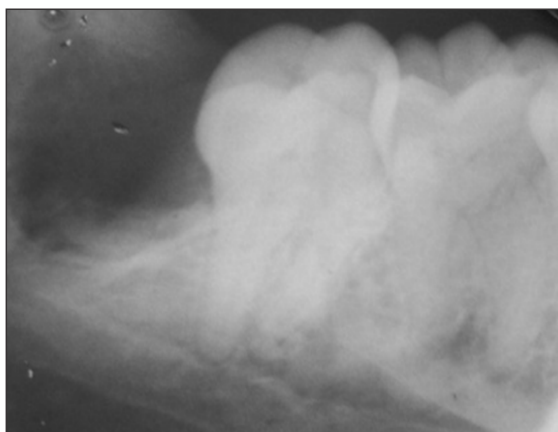


Fig.7: 1st month postoperative IOPA

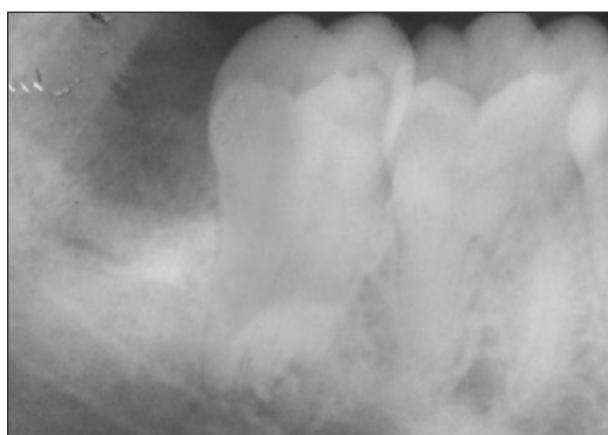


Fig.9: 3rd month postoperative IOPA

Results

Statistical analysis showed that the mean difference in healing of the soft tissues on 1st day was 0.625 which has statistically highly significant (p 0.016). On 3rd postoperative day it was 0.500 which is statistically significant (p

0.048). On 7th postoperative day it was 0.500 which was statistically non significant (p 0.102). Hence, it can be concluded that soft tissue healing was better on the side grafted with autogenous PRF (Group I) as compared to the non grafted sites (Group II) which acted as control.

Group Statistics								
	Group	No.	Mean	Std. Deviation	Std. Error Mean	Mean Difference	p-value	Significance
Soft tissue healing (1st day)	Study site	16	3.9375	.57373	.14343	0.625	.016	HS
	Control	16	3.3125	.79320	.19830			
Soft tissue healing (3rd day)	Study site	16	4.2500	.57735	.14434	.50000	.048	S
	Control	16	3.7500	.77460	.19365			
Soft tissue healing (7th day)	Study site	16	4.5625	.62915	.15729	.50000	.102	NS
	Control	16	4.0625	.99791	.24948			

Table 1-Difference in healing

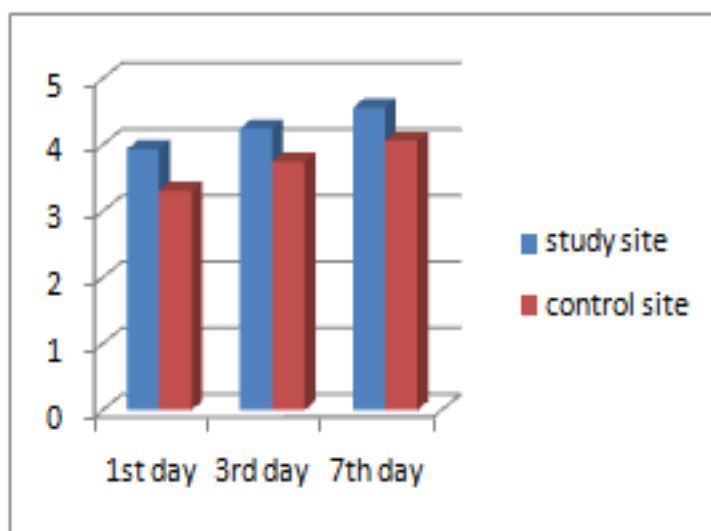


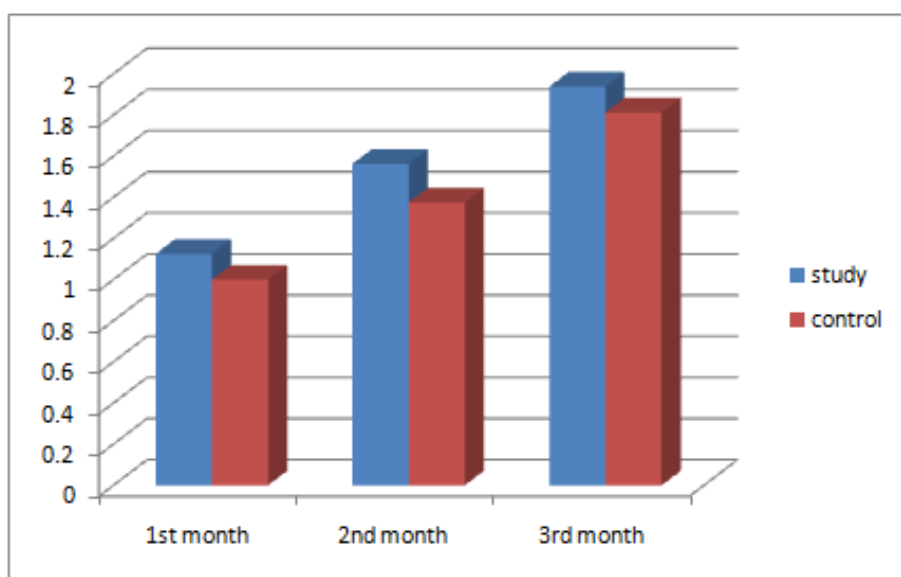
Table 1-Difference in healing

Statistical analysis showed that mean values of Lamina dura at the end of 1st, 2nd and 3rd postoperative months in Group I were 1.12 ± 0.34 , 1.56 ± 0.51 and 1.93 ± 0.25 respectively and in Group II they were 1.00 ± 0.00 , 1.37 ± 0.50 , 1.81 ± 0.40 respectively. The mean difference in resorption rate of lamina dura in the two groups at the end of 1st, 2nd and 3rd month postoperatively

was 0.125 (p 0.164), 0.187 (p 0.303) and 0.125 (p 0.302) which was statistically non significant. It was concluded that lamina dura resorption and acceleration of formation of cortical bone in periphery of the sockets grafted with PRF was non significant as compared to the non grafted sockets during post operative period.

	Group	No.	Mean	Std. Deviation	Std. Error Mean	Mean Difference	p-value	Significance
Lamina dura (immediate)	Study site	16	.0000	.00000a	.00000	--	--	
	Control	16	.0000	.00000a	.00000			
Lamina dura (1st month)	Study site	16	1.1250	.34157	.08539	.12500	.164	NS
	Control	16	1.0000	.00000	.00000			
Lamina dura (2nd month)	Study site	16	1.5625	.51235	.12809	.18750	.303	NS
	Control	16	1.3750	.50000	.12500			
Lamina dura (3rd month)	Study site	16	1.9375	.25000	.06250	.12500	.302	NS
	Control	16	1.8125	.40311	.10078			

Table 2-Difference in lamina dura



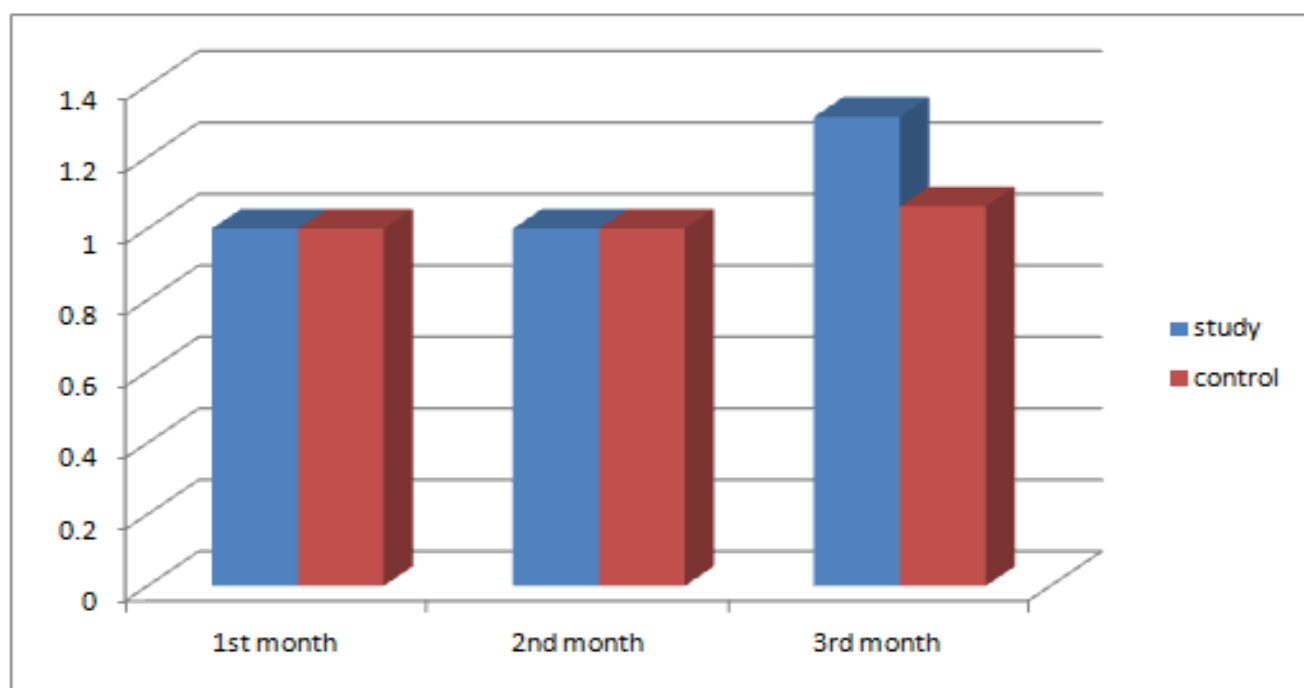
Graph 1-Difference in healing

Statistical analysis revealed that the scores of overall density in sockets of the site grafted with PRF was non significant as compared to the non grafted sockets during post operative period of 3

months, although it was observed that the rate of increase of overall density was more in PRF group as compared to control group.

	Group	No.	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P-value	Significance
Density (immediate)	Study site	16	.0000	.00000a	.00000	--	--	
	Control	16	.0000	.00000a	.00000			
Density (1st month)	Study site	16	1.0000	.00000a	.00000	1.00	1.00	NS
	Control	16	1.0000	.00000a	.00000			
Density (2nd month)	Study site	16	1.0000	.00000a	.00000	1.00	1.00	NS
	Control	16	1.0000	.00000a	.00000			
Density (3rd month)	Study site	16	1.3125	.47871	.11968	.25000	.077	NS
	Control	16	1.0625	.25000	.06250			

Table 3-Difference in density



Graph 3-Difference in density

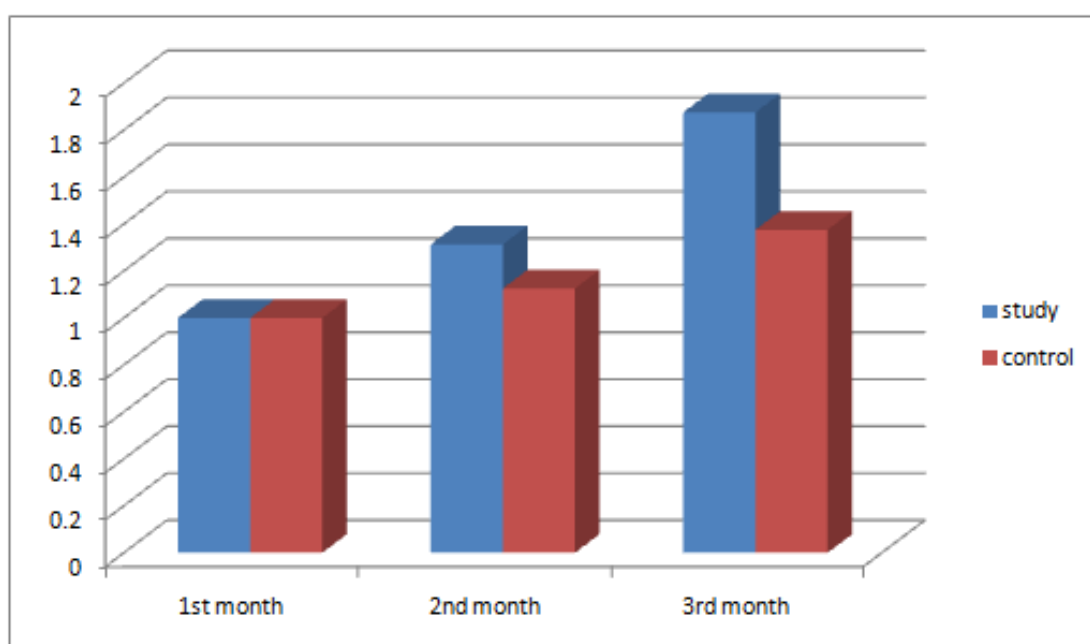
-Mean value related to trabecular pattern on end of 3rd postoperative month in Group I was 1.87 ± 0.34 and in Group II was 1.37 ± 0.25 . The mean difference in trabecular pattern was 0.500 which was statistically significant ($p = 0.03$).

although the results were non significant for first two months, postoperatively. The difference in trabecular pattern showed significant increase at the end of 3rd month, postoperatively in the study group as compared to the control group

	Group	No.	Mean	Std. Deviation	Std. Error Mean	Mean Difference	p-value	Significance
Trabecular pattern (immediate)	Study site	16	.0000	.00000a	.00000	--	--	
	Control	16	.0000	.00000a	.00000			
Trabecular pattern (1st month)	Study site	16	1.0000	.00000a	.00000	1.00	1.00	NS
	Control	16	1.0000	.00000a	.00000			
Trabecular pattern (2nd month)	Study site	16	1.3125	.47871	.11968	.18750	.213	NS
	Control	16	1.1250	.34157	.08539			
Trabecular pattern (3rd month)	Study site	16	1.8750	.34157	.08539	.50000	.03	S
	Control	16	1.3750	.50000	.12500			

a. t cannot be computed because the standard deviations of both groups are 0.

Table 4-Difference in trabecular pattern



Graph 4-Difference in trabecular pattern

Discussion:

The majority of complications associated with third molar surgery are inflammatory with alveolitis and prolonged bleeding. It is assumed that growth factors can be used to promote wound healing which minimize postoperative complications and enhances bone regeneration, thereby improving patient comfort¹.

The study of materials to promote bone regeneration is a key issue in oral surgery. Bone regeneration promotion can be done with variety of treatment modalities like bone substitute the use of autogenous bone grafts, guided tissue regeneration (GTR) with the use of barrier membranes and growth factors have been proposed to promote bone regeneration. Recently, Platelet Rich Fibrin (PRF) has come up as a second generation platelet concentrate with tissue regeneration properties and which is more biocompatible as well. It is a fibrin matrix in which platelets cytokines, growth factors and trapped cells are released enhancing healing and has excellent regeneration potential.

In this study, PRF was chosen as the sole grafting material without any additive material. It is assumed that the combination of bone grafts with PRF may give better results but the purpose of judgement of PRF as a sole grafting material would have been lost had any graft material been added to PRF in the extraction socket.

PRF is like a cell scaffold that can effectively direct the migration of stem cells to the wound, especially to induce epithelial cells to migrate to the wound surface and accelerate the healing process. In addition, PRF fibrin regulates the wound healing process by combining various growth factors, such as initial angiogenesis, epithelial coverage, and immune regulation. It also regulates the metabolism of fibroblasts and accelerates the healing of soft tissues. The concentration of platelets in PRF is 3-7 times higher than normal blood. The α -granules in platelets can release a variety of growth factors that promote wound healing, such as epidermal growth, platelet-derived growth, vascular endothelial growth, which not only have synergistic effects, but other cell-promoting activities. These factors interact with each other, making soft tissue wounds heal faster and better whereas TGF- β 1 promote new bone formation by stimulating collagen and fibronectin synthesis.¹⁹

In a study by Jiing-Huei Zhao et al,⁸ Soft tissue healing was better on the side grafted with PRF.

Concurrent to our results similar clinical results were found, in which clinical healing occurred without any infectious episode nor untoward clinical symptoms. Taken together, the use of PRF for grafting may improve the clinical healing of a fresh extraction socket. Neovascularisation forms through the PRF clot and an epithelial covering develops in spite of the infections and inflammation of sockets. Rapid healing of the wound is observed without pain, dryness or purulent complications.²

A study conducted by Olufemi et al⁵, in this study radiographic assessment of bone regeneration is done to assess Lamina dura, overall density, and trabecular pattern scores, which were higher in the case group (grafted with PRF) compared with the control group (non grafted with PRF), indicating a greater bone density in the study group. This difference was not statistically significant between the two groups.

The use of platelet concentrates in oral and maxillofacial surgery; particularly in bone regeneration is a current and interesting trend. Various uses have been reported e.g. its use in fat graft¹⁷, sinus lift augmentation¹⁸, surgical healing enhancement of the extraction socket, gingival recession treatment⁴, filling up of intrabony defects, implant dentistry and bone regeneration³ in pre prosthetic surgery etc.

Conclusion

In this study, the clinical and radiological findings clearly indicate that PRF can be used as a sole graft material to improve soft tissue healing and bone regeneration. PRF has emerged as a promising material which can be used as a graft for socket preservation and its regeneration. It is concluded that application of the present study should be carried out with large sample size and longer duration follow up to get more informative and conclusive results.

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GENETICS AS A TOOL FOR ORAL HEALTH DIAGNOSIS AND DISEASE PREVENTION: A FAMILY BASED STUDY

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Abstract

Objectives:

To account the cumulative effects of genes on dental caries between the sexes and to assess the heritability of midline diastema, melanin pigmentation, frenal attachment and tongue tie in family trees.

Materials and methods: A descriptive study was conducted among 100 families selected conveniently from Udham Singh Nagar, Uttarakhand. Pre structured performa was drafted to record demographic data and clinical examination of dental caries, frenal attachment, melanin pigmentation, midline diastema and tongue tie. Findings was compared within the pairs: grandparents- grandchildren pair and parent-offspring pair, to access heritability.

Results: Among grandfather-grandchildren pairs 36.76% had dental caries when compared with grandmother was 33.72%. Grandparent pairing with granddaughter had higher prevalence as compared to their pairing with grandson. Similar result was seen in parents-offspring pair. While it was vice versa in case of melanin pigmentation and no differences in its prevalence was seen in son & daughter pairs. In midline diastema, was higher in father son pair. Types of Frenal attachment was found to be statistically significant within all pairs and tongue tie was found clinically acceptable for all individuals

Conclusion: Genetics influence should be considered, in efforts to understand the multi-factorial nature of the diseases and can act as a vital tool in the easy diagnosis and prevention of these diseases.

Keywords: Grandparents, Parents, Children, inheritance

Introduction

A recent mammoth body of work concerning the systematic analysis for the global burden of diseases, injuries and risk factors with regard to oral diseases for the past 25 years has indicated that there is no change in the trend of the oral disorders. On a global scale, it is reported that the age standardized prevalence of oral conditions remained relatively stable between 1990 and 2015. Indian oral disorder burden has not changed over the years. As per the manuscript, India lost 2656292.55 (1583657.57–4095978.39) disability adjusted life years (DALYs) with an annual change of about 0.3% per year. Currently in India, 1.09% (1.00–1.19) or 0.83% (0.81–0.86) of all DALYs are contributed by oral disorders while during the same period, the DALYs for all causes were –0.12 (–0.16––0.09).¹¹ This indicates that other branches of medicine were successful in combating and reducing the DALYs while dentistry as whole has failed. Drastic changes in dental sector and increase in dental workforce in India, opening of

private dental sectors, community water fluoridation, school-based programs and preventive health educational programme etc, it is logical to believe that oral disease burden should be reduced. Probably as a result of numerous preventive interventions, burden of oral diseases has not changed over the years. Apart from above mentioned factors, genetics could be one of the factor in determining health and disease in families and interplay of such factors with environmental factors³

Your parents may have given you more than just your eye color and your sense of humor. You might also have inherited an increased risk for dental problems. Yes, dental issues can run in the family. And it's not just because you've learned bad habits from your family, or passed on oral bacteria by sharing silverware. Many oral health conditions have a hereditary basis. That means you may be at higher risk for developing certain conditions, in spite of your habits. These familial aggregations may result from shared genes, environmental exposures and similar socio-economic influences.¹

Dental caries is a multifactorial complex disease, remains the most common chronic disease. Although a decline in dental caries rates in the United States and other industrialized nations was found until the mid-1980s, later reports have suggested that this decline has slowed or even reversed in the U.S. and elsewhere. This has also been supported by recent NHANES data (NHANES surveillance summaries on oral health, 2005). The etiology of dental caries involves a complex interplay of environmental and genetic factors. Epidemiological studies have tried for many years to understand fully the mechanisms of this disease, with the eventual goal of prevention. Thus, identifying the underlying genetic and environmental risk factors is a crucial step toward that goal.⁴

Moreover, caries prevalence was observed to vary among different racial groups, with non Hispanic whites having the lowest caries prevalence and severity (NHANES, 2005). However, this could be partly due to different genetic factors as well. Pioneering twin studies investigating the heritability (i.e., proportion of variation due to genes) of dental caries in children have clearly supported the key role of genetics in tooth decay. Caries heritability estimates for children based on twins range from 64–85%. In recent, heritability study based on larger families, heritability of dental caries in the primary dentition was over 50%⁴.

Larger families help in the clustering of several diseases within families. In fact, this clustering is often the first indication that a disease may have a genetic component. A pattern consistent with genetic factors occurs when the similarity or correlation of a trait among closely related individuals, for example, siblings, is greater than for more distant relatives and/or greater among relatives than unrelated individuals².

Therefore, the present family based study was planned to assess the genetic influence on dental caries pattern, frenal attachment, melanin pigmentation, midline diastema and tongue tie.

Methodology

A descriptive study was conducted with a convenient sample of 100 households comprising 454 individuals, from Sikh community, from the district Udham Singh Nagar, Uttarakhand, India, who fulfilled the following eligibility criteria. Families included should have at least 2 generations representation in same house or

within same locality and biologically related with each other, who gave the written informed consent was included in the study. Handicapped and bed ridden, Individuals undergoing orthodontic treatment, patient undergone any mucogingival surgery or depigmentation and children in ugly duckling stage were excluded from the study. The study was reviewed and approved by the institutional ethics and review board of the of Kothiwal dental college and research centre with Ref No.KDRC/ IERB/ 11/2016/06

Before the commencement of the study, the examiner were trained in the department of Public Health Dentistry. The Kappa coefficient value for inter – examiner reliability during examination was found to be 0.92 for D and F component/d and f component of DMFS index, 0.82 for Melanin pigmentation, 0.84 for Frenal attachment, and 0.81 for Tongue tie. These values reflect a high degree of conformity in observations. A pre-structured Proforma was used to record demographic and clinical details of the variables mentioned below:

The subjects were examined by type III clinical examination in respective households for dental caries using DMFS/dmfs index. Midline diastema was recorded using CPI probe; space of more than 0.5 mm was considered as midline diastema. Melanin pigmentation, Frenal attachment and tongue tie was recorded by index given by Takashi et al, Plecek Mirko and Kotlow's classification. Final analysis was performed on relative pairs of: Parent – offspring pair and Grandparent – Grandchildren pair.

Statistical methods:

Data was analyzed using IBM SPSS Statistics version-19. Descriptive data was expressed as numbers (%). Chi square test was used to test the association of non parametric data between relative pairs. Statistical significance was set at a $p < 0.05$.

Results:

The present study was done to assess the genetic influence on Dental caries pattern, Frenal attachment, Melanin pigmentation, Midline diastema and Tongue tie.

100 households comprising a total of 454 individuals were enrolled in the study. Families consisting of confirmed biological relation ranged from 4-6 individuals. (Table: 1)

Sample size	454
Number of families with 3 generations	66 families
Number of families with 2 generations	34 families
Both grandparents present	38 families
Only grandfather present	11 families
Only grandmother present	17 families
Number of relative pairs	
Grandfather-grandchild	68 pairs
Grandmother-grandchild	86 pairs
Father-children	199 pairs
Mother-children	205 pairs
Siblings	50 pairs

Table 1: Demographic characteristics of the study sample

In case of Dental caries, the prevalence was higher in granddaughter pairing with grandparents, which were found to be statistically significant ($p < .00001$), whereas in Midline diastema, the prevalence was similar in grandson and granddaughter when paired with grandfather, which was statistically non-significant. The prevalence was highest in granddaughter-grandfather pair in case of melanin pigmentation, which was found to be statistically significant and the prevalence of both the frenal attachment in grandson and granddaughter was found similar when being paired with each of grandparent. (Table 2)

Variables	Pairs, n (%)	Grandson, n (%)	Granddaughter, n (%)	P- value
DENTAL CRIES	Grandfather-grandchildren 25/68 (36.76)	5/38 (13.15)	20/30 (66.66)	<.00001
	Grandmother-grandchildren 29/86 (33.72)	7/48 (14.58)	22/38 (57.9)	<.00001
MIDLINE DIASTEMA	Grandfather-grandchildren 16/68 (23.52)	9/38 (23.62)	7/30 (23.33)	.338352
	Grandmother-grandchildren 7/86 (8.1)	2/48 (4.16)	5/ 38 (13.51)	1
MELANIN PIGMENTATION	Grandfather-grandchildren 26/68 (38.23)	11/38 (28.94)	15/30 (50)	.3828
	Grandmother-grandchildren 21/86 (24.41)	19/48 (39.5%)	2/38 (5.26)	.112
	Grandmother-grandchildren 107/205 (52.19)	65/131 (49.61)	42/74 (56.75)	.0001

MARGINAL FRENAL ATTACHMENT	Grandfather- grandchildren 96/199 (48.24)	55/125 (44)	41/74 (55.4)	36.48
	Grandmother- grandchildren 72/205 (35.12)	43/131 (32.82)	29/74 (39.18)	.5168
GINGIVAL FRENAL ATTACHMENT	Grandfather- grandchildren 115/199 (57.78)	72/125 (57.6)	43/74 (58.10)	.088

·Tongue tie: No relevant cases detected

Table 2: Prevalence of Dental caries, Midline diastema, Melanin pigmentation and Frenal attachment in Grandparents and grandchildren pairs

The prevalence of dental caries is highest in daughter-mother pair, which was statistically non-significant. Whereas in Midline diastema, it is in Son-father pair and in Melanin pigmentation, it is highest in Daughter-mother pair, which was statistically non-significant. The prevalence of both the frenal attachment in Son and daughter was found similar when being paired with each of parent. (Table 3)

Variables	Pairs, n (%)	Son, n (%)	Daughter, n (%)	P- value
DENTAL CARIES	Father-children 64/199 (32.16)			
		35/125 (28)	29/74 (39.18)	<.00001
	Mother-children 42/131 (32.06)	42/131 (32.06)	48/74 (64.86)	.639
MIDLINE DIASTEMA	Father-children 36/199 (18.9)	29/125 (23.2)	7/74 (9.45)	.022
	Mother-children 20/205 (9.75)	10/131 (13.15)	0 / 74 (13.51)	.4917
MELANIN PIGMENTATION	Father-children 96/199 (48.24)	55/125 (44)	41/74 (55.4)	.003
	Mother-children 106/205 (51)	61/131 (46.56)	45/74 (60.81)	.1792
MARGINAL FRENAL ATTACHMENT	Father-children 68/199 (34.17)	41/125 (32.8)	27/74 (36.48)	36.48
	Mother- children 72/205 (35.12)	43/131 (32.82)	29/74 (39.18)	.5168
GINGIVAL FRENAL ATTACHMENT	Father-children 115/199 (57.78)	72/125 (57.6)	43/74 (58.10)	.088
	Mother-children 107/205 (52.19)	65/131 (49.61)	42/74 (56.75)	.0001

·Tongue tie: No relevant cases detected

Table 3: Prevalence of Dental caries, Midline diastema, Melanin pigmentation and Frenal attachment in Parents and Children

Discussion

Present study was carried out in district of Udham Singh Nagar, India. Sample composed of Sikh community emigrated from Pakistan during partition in 1947. These families with 2-3 generations had agriculture background therefore were living in the same locality, all bound by the common relationship. So it was convenient to collect sample for our study to assess the heritability patterns with in generations of Dental caries, midline diastema, frenal attachment, pigmentation of gingiva and tongue tie.

In present study, daughter pair had higher inheritance of dental caries from parents as compared to son pair. Many Epidemiological and clinical studies, through the use of tools such as DMFT and DMFS scores, have revealed a consistent trend in caries development, with female child having higher prevalence than males. The mechanisms of any genetic contributions to the increased prevalence of caries in females versus males can be speculated to reside in the sex chromosomes, exhibiting sex-linked modes of inheritance. The Amelogenin (AMEL-X) gene resides on the p arm of the X chromosome. Its locus is Xp22.31-p22. This gene and its protein product contribute to enamel formation in the dentition. Many studies explain that in females, it is possible for this kind of variation in AMELX to occur through the mechanisms of X inactivation and mosaicism. Normally, the inactivation of one X chromosome is random, with 1 : 1 distribution of the two AMELX genes inherited in females on the X chromosomes (mosaicism in regards to the X chromosome, since one comes from one parent and the other comes from the other parent)

Another way to explain the role of AMEL-Y in caries susceptibility is to consider its production of the amelogenin protein. AMEL-Y gene only expresses 10% of amelogenin that is expressed by AMEL-X. However, this additional 10% is not attained by females exhibiting X inactivation. Therefore, males may be expressing a greater amount of amelogenin,

contributing to the strength of the tooth and less caries susceptibility of the host. These proposed mechanisms of AMEL-Y may be one way to explain why when exploring the role of amelogenin on caries formation, females exhibit greater prevalence than males¹⁶

In our study, children of parents with dental caries also had higher prevalence of dental caries. Heredity has been linked with dental caries incidence in scientific literature for many years. One of the earliest studies was in 1946 when Klien reported on 5400 people in 1150 families of Japanese ancestry, demonstrating that the decayed, missing, filled teeth (DMF) that occurred in offspring was quantitatively related to that which had been experienced by their parents. It was found that a high DMF father and a high DMF mother produced offspring, both sons and daughters, with a high DMF rate. The authors concluded that dental caries is strongly familial based with probable genetic and sex-linked associations. Similarly, Book and Grahnen selected the parents and siblings of subjects from the Vipeholm study who were highly resistant to dental caries and found they also had significantly lower caries experience than the parents and siblings of the remaining subjects^{4,5}. The strong influence of the role of genes/heredity was observed in these historical landmark studies which laid the foundation for further research.

In our study, we found that prevalence of dental caries was higher in mother-children pair as compared to father-children pair. As dental caries is a transmissible disease and *S. mutans* bacterium can be transmitted both vertically and horizontally. In vertical transmission *S. mutans* spread mainly from mothers to their children. Therefore, we can assume that these familial aggregations may be a result of shared genes as well as from environmental exposures.

When the data was analyzed for pattern of inheritance of dental caries, by Pedigree analysis, it showed that if both the parents have dental caries it conferred risk of inheriting dental caries in offspring (Figure:1)

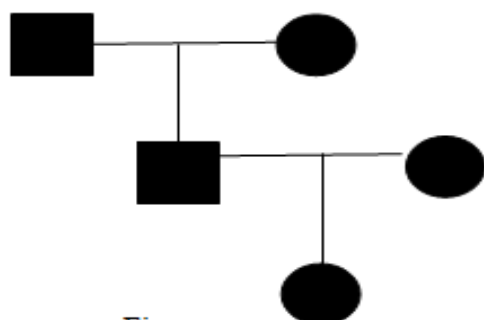


Figure: a

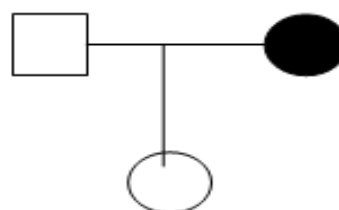


Figure: b

Fig 1: Pedigree of families showing most repeated patterns of dental caries (Shaded symbol represents a family member reported to be affected).

Gardiner discusses the etiology of the persisting midline diastema and noted that there is “almost no limitation concerning contributing factors. Undoubtedly, hereditary causes are found high up the list and we have all seen parents and offspring with this feature” (Taylor JE.,1939) similar results were found in our study. Grandfather-grandchildren pair had higher midline diastema prevalence as compared to grandmother-grandchildren pair. Higher prevalence was also seen in father-son pair.

In 1995, Muller et al. studied the mode of inheritance by drawing ¹⁵ pedigree charts. The proband always had a parent also positive for the trait. Eight of the probands inherited the trait from

the father and other seven inherited from the mother, indicating complete penetrance of the gene.¹⁵

In 6 pedigrees, the trait was transmitted from father to daughter. Transmission was from father to son in 2 and from mother to daughter in ⁴. The mother transmitted the trait to the son in only 3 pedigrees excluding X lined recessive inheritance. These findings demonstrate that the transmission of median diastema to follow an autosomal dominant with full penetrance similar results were found in our study, when the data was analyzed by Pedigree analysis, that proband always had a parent also positive for the trait (Figure: 2)

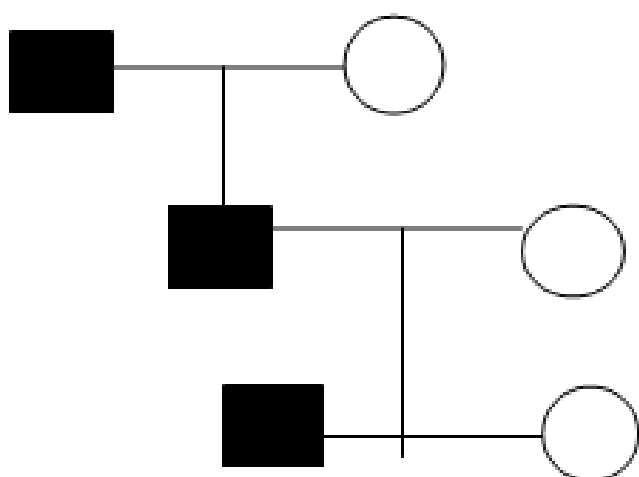


Figure: a

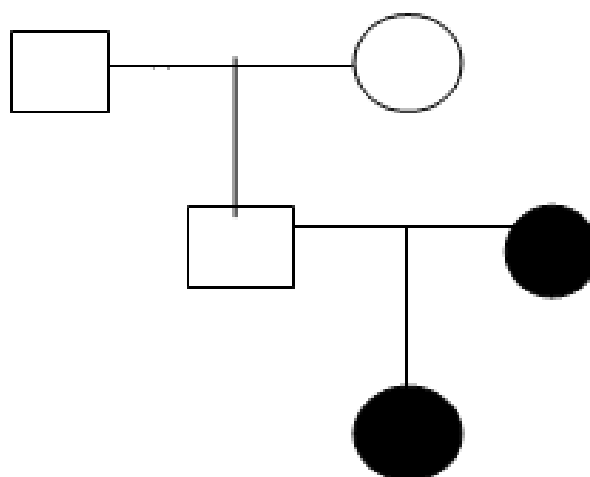


Figure: b

Fig 2: Pedigree of families showing most repeated patterns of Midline diastema (Shaded symbol represents a family member to be affected).

Study done by Gass JR et al on 30 extended families in Cleveland, USA, suggested a possible genetic basis for maxillary midline diastema and a greater role of environmental factors.

Melanosis universalis hereditaria, universal acquired melanosis, and familial universal are just some of the other terms coined by various authors to describe patients with a generalized diffuse hypermelanosis without systemic symptoms, but often with a familial pattern ⁷. This condition has been described mostly in blacks, Hispanics, and oriental individuals, with both the sexes being affected equally. Mode of inheritance is still debated upon since a number of inheritance

patterns are recognised, mainly: autosomal dominant autosomal recessive with germ-line mosaicism ²⁰. Though such cases have been previously reported in dermatology, no such case has been reported in dental literature even though there are significant oral findings in these patients. Gingival hyper-pigmentation also known as racial gingival pigmentation is accepted to be a genetic trait similarly in our present study, we found parents and their successive generations with melanin pigmentation of gingiva. When the data was analyzed by Pedigree analysis it also showed that that probands with melanin pigmentation had a parent also positive for the trait (Figure:3).⁹

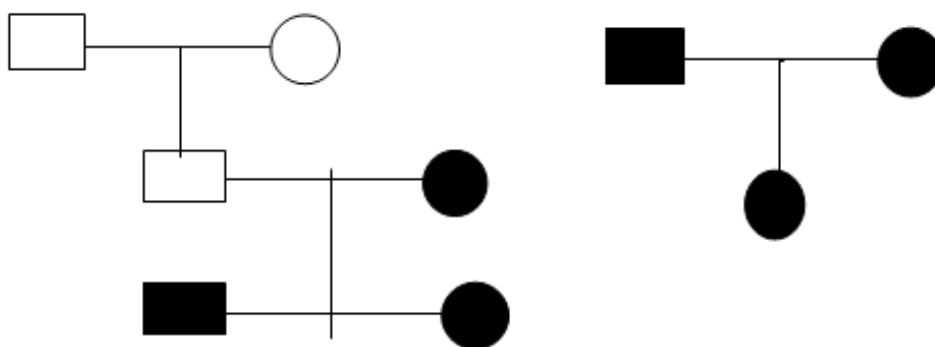


Figure: a

Figure: b

Fig 3: Pedigree of families showing most repeated patterns of Melanin pigmentation (shaded symbol represents a family member to be affected).

In 1979, Durnmet included genetic as one of the etiological factor for melanin deposits and the diversity of range of pigmentation depends on geographical location and genetics.¹⁶

Tongue-tie appears as a sole anomaly, though it is sometimes accompanied by other congenital anomalies such as cleft palate. As it has a hereditary nature, it occurs more commonly in male children and has been suggested to be related to the X-chromosome. The exact pathological mechanism of ankyloglossia remains unclear, and its conclusively hereditary nature has yet to be elucidated, though numerous relevant studies have been performed. But in our sample, we found that all the individuals had clinically acceptable, normal range of free tongue = >16 mm. No indeed tongue tie case was not diagnosed in our sample, so on the basis of our findings we cannot conclude that tongue-tie shows inheritance pattern or not. But previous literature reports that tongue tie has a hereditary nature.

In our sample, we found marginal and gingival frenal attachments in majority of cases, that showed the inheritance of marginal and gingival frenal attachment was around 35% and 55% respectively from parents to their offspring's through the clinical examination across the three generations in a family.

There are few limitations in our study, firstly, we took homogenous sample that might have some effect on results when sample were heterogenous. Secondly, age differences among sample size (different age people may subject to different exposure variables that were time dependent).

Lastly we can conclude that, these diseases/ conditions have some correlations of inheritance. The pedigree analysis of genetic inheritance thus gives a valuable insight into genetic epidemiology and leads to better understanding of the pattern of occurrence of diseases. This study is one of the few attempts at defining the genes implicated in oral disease process, and lead to improved understanding and prevention of the factors leading to the disease.

Conflicts of Interest: None of conflicts present

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