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## Orthodontics: Advent Era of 3D Technology



Orthodontic technology has come a long way since the days of simply wrapping wires around your teeth to hold them into a new position. From types of braces to the kind of imaging there are so many more options for your orthodontic care today and treatment is so much more effective and comfortable to go through.

Here are the 11 top advances in orthodontic technology:

- 1. Digital X-rays and 3D Dental Imaging**  
Digital x-rays have a lot of benefits to them that orthodontists can now enjoy. They are better quality and allow orthodontists to get a more detailed look at the structure of the mouth. And because they are digital, orthodontists can gain immediate access to the images. No more waiting around for the images to be developed. There is also the i-Cat Cone Beam 3D Dental Imaging System which can provide a full set of x-rays in one 360 degree scan and create 3D images of the teeth. Another plus is that there is less radiation with this type of x-rays.
- 2. Itero Scanner for Digital Impressions**  
Creating the braces has also gotten a lot of easier. The iTero scanner allows orthodontists to create the teeth impressions digitally instead of manually. They simply scan the patient's mouth and then they can view the impressions on the computer just a few minutes later. In addition digital impressions are more accurate reducing the number of fit issues with the braces.
- 3. Nickel and Copper-Titanium Wires**  
Instead of stainless steel wires, more orthodontists are now using nickel or copper-titanium wires because they respond to the heat the mouth and will bend and tighten more naturally as the teeth shift. This will cut down on the need for more tightening appointments.
- 4. Temporary Anchorage Devices**  
Temporary anchorage devices are mini screws or mini implants that can be used to help shift more stubborn teeth when braces can't do it alone.
- 5. CAD/CAM and Robotic Wire Bending Technology**  
While lingual braces have been around for a while, they have become much more effective with CAD/CAM and robotic wire bending technology used in combination with digital scanner. Getting the brackets and wires on the backs of the teeth can be challenging and used to only be the purview of the certain orthodontists. It is a lot easier to perfect now with the robotic wire bending assistance.
- 6. Invisalign Aligners**  
Invisalign braces has also changed the face of orthodontic care. When metal braces were your only options, you were forced to deal with a mouth full of metal and wires for long periods of time. This can be really hard especially for tweens and teens who are very appearance focused. Concerns about how braces make you look now though is not as big of a problem because of innovative technologies like Invisalign. Unlike metal braces, Invisalign clear braces are almost invisible inside your mouth. People will really need to look inside your mouth to notice them compared to the blaring glare of metal that comes with more conventional braces. Invisalign braces were designed with the wearer's comfort in mind and are more flexible. With these braces, you can remove them on your own for short periods of time, like for instance, when you want to eat or drink something or when you are cleaning and flossing your teeth. And with Invisalign there are no barriers to getting a proper clean. Remember though that the longer you go without wearing them, the longer the teeth straightening process will take so only remove them when absolutely necessary. It is recommended that you wear them at least 20 to 22 hours a day.
- 7. Six Month Smiles**  
Six Month Smiles is an orthodontic treatment that involves clear adult braces that concentrate just on realigning the teeth that show when you smile. These braces are meant to only improve the cosmetic appearance of your smile, not correct the bite. The biggest benefit is that you won't be tortured with a mouth full of braces and that treatment lasts 6 months instead of the 2-3 years traditional braces usually have to be worn. Most adults with crooked or gapped teeth are good candidates for Six Month Smiles. The most common dental issues that can be treated with Six Month Smile are crooked front teeth, extrusions, rotations and intru-

ions. It also works for diastemas and spacing issues as well as overbites, open bites and crowded and overlapping teeth. However if you have serious misalignment or bite issues, regular braces or Invisalign will be better because they will actually correct those issues instead of just focusing on cosmetic appearance.

Another great benefit of choosing Six Month Smiles is that with them it is easier to maintain proper hygiene. Because the braces are only a few teeth, it will be easier to get in there and brush and floss making sure you get rid of all the plaque and bacteria. And because you only have to wear them for six months, there is less of a risk of developing cavities or gum inflammation which can sometimes happen with regular braces.

## 8. Lasers

Lasers can be used on both soft and hard tissues (depending on the laser wavelength).

For example, intraoral lasers are used to contour the gum tissue to its right position, improving its appearance. As gums can sometimes cover erupting teeth, some lasers can also be used to enhance the accuracy of bracket placement.

- Some other advantages of this technology include
- Better treatment efficacy
- Alleviated orthodontic pain
- Higher orthodontic treatment success

## 9. 3D Dental Imaging with CBCT

One of the latest trends in 3D imaging is the application of cone beam CT (CBCT) scanners. These scanners spread X-rays out in a cone shape, providing a detailed 360-degree overview of a patient's jaw and oral structure.

With such a precise and complete scan, doctors can create custom implants and plan better treatments, addressing orthodontic problems more efficiently.

This technology has become so advanced that it can even detect cancerous formations and other dental conditions that would otherwise not be detected with regular X-rays.

## 10. Dental Monitoring with AI

Nobody likes waiting at the dentist's office. It costs a lot of time, nerves, and money. But monitoring your treatment progress doesn't have to be as painful, at least not any-more!

In 2023, AI technology can help you do your dental monitoring remotely. That's right!

Some advanced AI-based solutions allow you to scan your mouth with your phone and send the images to your orthodontist. Additionally, AI-based dental monitoring apps can detect different oral conditions,

predict tooth movement, and even track your treatment progress.

The evolution of AI in orthodontics is a testament to how digital innovation is reshaping our approach to dental health, providing unprecedented precision in treatment planning and execution.

## 11. Accelerated Orthodontics

*Your patients want beautiful straight teeth but don't have the patience for it?*

Faster treatment is becoming a reality in 2023!

Accelerated orthodontics is a newer treatment approach that uses advanced technology (e.g., microosteoperforations and high-frequency vibration) to speed up the movement of teeth.

This technology can significantly reduce treatment time and is a good option for patients with busy schedules or those who want to see results faster.

## Final Thoughts

Orthodontic technology has progressed tremendously in recent years, offering patients a wide range of treatment options to choose from.

The latest orthodontic technology advancements have taken orthodontic treatment to a whole new level of precision and efficiency. With 4D aligners, itero scanners, and accelerated orthodontics, patients can enjoy faster and more personalized treatment plans.

Whether you're a patient or a practitioner, it's an exciting time to be part of the world of orthodontics, with advanced technology and innovation paving the way for a brighter, healthier smile.

And if you're an orthodontist searching for a cutting-edge software solution for your orthodontics practice, Scopis is here to help! We create modern, HIPAA-compliant software to bring your business to the next level.

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# Review of the Extraction vs. Non-Extraction Debate

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## Abstract

Orthodontics boasts a rich history intertwined with controversies that seem to persist indefinitely, unlike disputes, due to their inability to be conclusively resolved through scientific evidence alone. One of these enduring controversies revolves around the choice between extraction and non-extraction treatment modalities. There has been a noticeable decline in the use of extraction in orthodontic care, partly driven by increased pressure from referring dentists to opt for non-extraction approaches, often without full awareness of the supporting literature for extractions in specific cases over the past two decade. This review aims to provide a comprehensive overview, including the historical background of the controversy, perspectives from various authors, the reasons behind the decline in extraction cases, and the current state of understanding regarding this ongoing debate .

## Introduction

From the perspective of the layperson, malocclusion is more commonly associated with crowding than with spacing issues. Addressing a crowded dental arch typically involves creating space, which can be accomplished through either extraction or non-extraction methods. The concept of extracting teeth to make room for the remaining crowded teeth dates back to at least 1771 and was considered innovative at the time, though it is now a well-established practice.

## History

Since the dawn of civilization, deciduous tooth extraction has been a common procedure. When Celsus and Pierre Fauchard proposed the extraction of deciduous teeth to make room for permanent successors, there was little to no resistance (Hunter et al 1865)<sup>1</sup>. When dentists began extracting permanent teeth in order to undergo the procedure, disagreements emerged. The leading author, Hunter (Natural History of Teeth, 1771), was against it because he believed it to be a development inhibitor. Class II division 1 malocclusions were typically treated in the early 1800s by extracting the maxillary first premolars. However, Delabarre cautioned against its unfavorable consequences in 1818<sup>2</sup> (Brodie et al 1934). "Teeth extractions are much easier to do than

determining whether they are absolutely necessary," he remarked. Davenport, Isaac B. (1887)<sup>2</sup>. gave a speech in opposition to extractions in New York, claiming that the procedure resulted in "A loss of an important organ." (Davenport et al 1887)<sup>3</sup>

The most important, energetic, and powerful person in orthodontics was Edward H. Angle. As the "Father of Modern Orthodontics," he is revered. (Wahl et al)<sup>4</sup> At first, Edward Hartley Angle thought that the only way to address orthodontic treatment issues was to extract teeth. The sixth edition of Angle's book, "Treatment of Malocclusion of the Teeth and Fractures of the Maxillae-Angle System," was released in 1900 and included a tonne of information and case studies on tooth extractions. Angle promoted extraction as a way to enhance face<sup>5</sup> (Angel EH 1903)

## The Extraction Debate

Angle's theories were not without opposition. Calvin Case, his fiercest professional adversary, contended that most patients would not find the stability and esthetics adequate in the long run, even if the arches were stretched to align all of the teeth (Wahl N 1988)<sup>6</sup>. Martin Dewey, an Angle student, and Calvin Case engaged in a highly public-

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ized argument as the controversy's climax. This struggle began in 1911 and resulted in "The Extraction Debate of 1911." During a 1911 National Dental Association meeting in an article titled "The Question of Extraction in Orthodontia," Association member Calvin Case expressed his strong disagreement with the creationist beliefs of the Angle School, citing their ignorance of heredity as a cause of malocclusion and their belief that malocclusion was caused by local factors and that correcting teeth in their intended positions would produce a harmonious facial structure. (Wahl N, C, Busch LS 2014)<sup>4,7</sup>

### Reasons For Controversy

**Facial Profile:** When selecting between extraction and non-extraction therapy modalities, the patient's soft tissue profile is the primary consideration. (Rushing SE, Stephens CK, Erdinc AE 2007)<sup>12-14</sup> Some people disagree with extractions, arguing that they "dish in" the face. On the other hand, extractionists assert that in some situations, not getting extractions will worsen periodontal health and make the profile look fuller. The inability of general dentists and orthodontists to differentiate between the facial profiles of patients treated with extraction and those treated without it is supported by studies done by Rushing et al in 1995, Stephens et al in 2005, and Erdinc et al in 2007. (Rushing SE, Stephens CK, Erdinc AE 2007)<sup>12-14</sup>

**Extractions & Temporomandibular Joint Disorders (TMD):** In 1987, a groundbreaking district court case concerned a sixteen-year-old girl who had been diagnosed with division 1 malocclusion, or Angle's Class II. Her orthodontist designed the course of therapy, which included headgear and premolar extractions. Her family then sued the orthodontist, claiming that the procedure was the cause of her TMD. Their family dentist argued that the usage of headgear and extractions led to internal derangement and excessive incisor retraction as a result of the mandible's distal displacement. The jury found the orthodontist guilty of mistreating patients, and dental professionals discussed the matter extensively. The majority of orthodontists did not think that premolar extractions could cause TMD, but if they recommended extraction therapy, their risk of being sued for malpractice increased. The orthodontic scientific community took the lead in the early 1990s and presented strong evidence that orthodontic therapy and TMD are not causally related. The idea that all orthodontic treatments have a neutral impact is also covered and supported by the literature. (Gianelly AA, Brodie AG)<sup>21,2</sup>

### Reasons for Decline in Extractions

**Bonding:** More patients were able to have non-extraction therapy thanks to the bonding of fixed appliances, which largely replaced banding because band thicknesses tended to encourage crowding.

**Expansion:** Expansion has been promoted since long to treat posterior crossbite. In the 1980s, it became popular as a substitute to extraction treatment to resolve crowding even without the presence of posterior crossbite. Advocates of rapid maxillary expansion (RME) claim resolving of borderline crowding of 3-6mm in the mandible in patients with narrow transpalatal

widths. They contend that RME will result in reciprocal mandibular expansion because the mandibular arch form is dictated by the maxillary arch form. McNamara Jr. et al reported that a favourable change in the sagittal occlusal relationships between maxillary and mandibular teeth can be facilitated by RME. Fields cautioned that "to date, there is no credible long-term post retention evidence that early intervention to prepare, develop, balance, or expand arches by any other name has any efficacy in providing a less crowded permanent dentition later". (McNamara Jr JA 2010)<sup>32</sup>

Stability of expansion, particularly in the mandible, has little evidence demonstrating the same. Many authors support the contention that intercanine expansion is unstable. A study by Housley et al in 2003 concluded that in patients who underwent mandibular expansion, intercanine widths were maintained in only 8% of patients, for six years and three months after fixed retention. (Housley et al 2003)<sup>33</sup> Additionally, prospective complications of expansion include the risks of creating a dehiscence (loss of alveolar bone on the facial aspect of a tooth that leaves a characteristic oval, root-exposed defect from the cemento-enamel junction apically) as a result of over-expansion. (Fig. 8). Anterior teeth tend to move labially, when treated by expansion of the arches to alleviate moderate to severe crowding. Extractions on the other hand, allow the teeth to move along the alveolus. (Fields Jr et al 2013)<sup>34</sup>

### Conclusions

Identifying guidelines for the extraction vs non-extraction decision in orthodontic treatment is a complex task. Presently, the controversy is not afflicted by as much beliefs as it was almost 100 years ago and both treatment options are still open. The option to treat with extraction or non-extraction should be made objectively for each case based on strong evidence with equal attention on the soft tissue paradigm.

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# Intersecting Realms : Malocclusion Nexus with Temporomandibular Disorder Pathway

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## Abstract

**AIM:** To assess the relationship between TMDs and malocclusion.  
**Material & Methods:** Temporomandibular dysfunction was assessed in 120 patients using the Helkimo Dysfunction Index (Di) (1974). **RESULT :** The incidence of TMD may not be predicted by age; most women experience mild symptoms, but men rarely do; The majority of severe instances are in females, and Class II malocclusions exhibit severe symptoms.  
**Conclusion:** Our study of 120 patients revealed that mild TMD is the most common category for both genders and that TMD is more common in women. Although there is no clear correlation between Class I malocclusion and TMD, it may play a role in its development.  
**Keywords :** Temporomandibular disorders, Class II, Malocclusion, Helkimo Dysfunction Index (Di).

## Introduction

The temporomandibular joint (TMJ), a hinge joint on each side of the face, allows you to talk and chew without restriction. This joint allows the jaw to move freely when speaking and chewing. The jaw's position and movements are controlled by the muscles surrounding and attached to the joint.<sup>1</sup> Although the precise origin of temporomandibular dysfunction is still unknown, a number of variables are thought to be involved. Malocclusion is often identified as one of these causes, along with parafunctional behaviours and joint hyperlaxity, as the primary cause.<sup>2</sup> Incorrect alignment of the jaw along the sagittal plane can cause malocclusion, which can be impacted by mandibular dysplasia, vertical jaw dysplasia, or a combination of the two.<sup>3</sup> TMJ examination is crucial for malocclusion diagnosis since certain malocclusion features might lead to joint dysfunctions.<sup>3</sup> There aren't many research in the literature about TMD prevalence in those who have malocclusion. Thus, the purpose of this study is to evaluate how malocclusion affects the frequency of bruxism and TMD.

## Methodology

A cohort of 120 people who had visited Nims Dental College and Hospital in Jaipur were the subjects of the current investigation. Using the Helkimo dysfunction index (Di), a screening for temporomandibular dys

function was performed on each participant. Three levels of severity were used to evaluate each domain: 0 for no symptoms, 1 for mild symptoms, and 5 for acute symptoms. A total dysfunction score ranging from 0 to 25 points was obtained by calculating the cumulative scores; higher scores denoted a higher degree of temporomandibular dysfunction.

## Group Categorization

**Group 1:** Patients with Malocclusion and no Temporomandibular dysfunction.  
**Group 2:** Patients with Malocclusion and Temporomandibular dysfunction.

## Clinical Evaluations:

HELKIMO DYSFUNCTIONAL CLINICAL INDEX (1974)		
A. Symptom:	Limiting movement	
Criterion:	No limitation	0
	Moderate limitation	1
	Severe limitation	5
B. Symptom:	Limitation of ATM functionality	
Criterion:	Regular movement without joint noise and detour to open or close <2mm	0
	Joint noises in one or both joints and/or deviation >2mm opening or closing	1
	Locking and/or dislocation of ATM	5
C. Symptom:	Muscle pain	
Criterion:	No palpation pain	0
	Pain in 1-3 sites palpated	1
	Pain in 4 or more palpated sites	5
D. Symptom:	Pain at ATM	
Criterion:	No palpation pain	0
	Pain at side palpation	1
	Pain at the rear palpation	5
E. Symptom:	Pain during jaw movements	
Criterion:	No pain	0
	Pain during a movement	1
	Pain during two or more movements	5

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Fig 1: TMJ assessment.



Fig 3: Masseter Muscle Palpation.



Fig 4 : Temporalis muscle assessment.

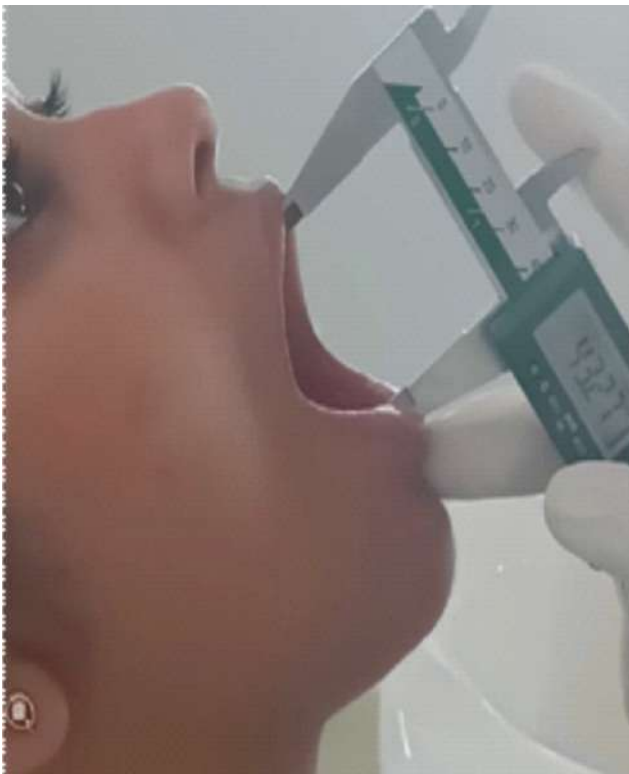


Fig 2: Mouth opening assessment.

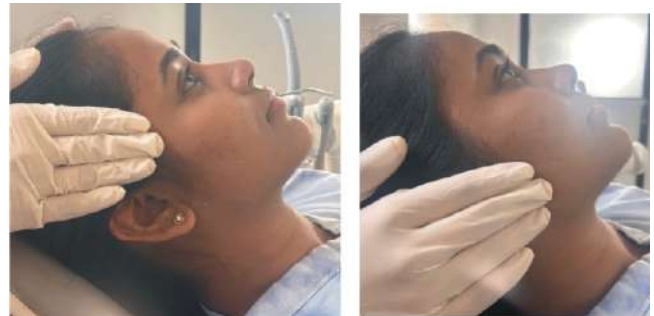


Fig 5 : Muscle palpation in the occipital Region.



Fig 6: Intraoral photographs to assess type of Malocclusion.

### Statistical Analysis

The collected data was coded and entered in a Microsoft Excel spreadsheet. Subsequently, analysis was performed using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) on a Windows software program.

**Normality Assessment**

The variables underwent assessment for normality using the Kolmogorov-Smirnov test to ascertain adherence to a normal distribution.

**Descriptive Statistics**

**Descriptive statistics were computed to provide an overview of the data:** This included the calculation of percentages, means, and standard deviations, offering a summary of the central tendency and dispersion of the variables.

**Significance Level:** A predetermined level of significance was set at a P-value less than or equal to 0.05. This threshold was used to determine statistical significance in the analyses performed. Upon completion of the statistical analyses, the findings provided insights into the distribution, central tendency, and significance of the variables under investigation, allowing for robust conclusions and implications based on the study outcomes.

**Result**

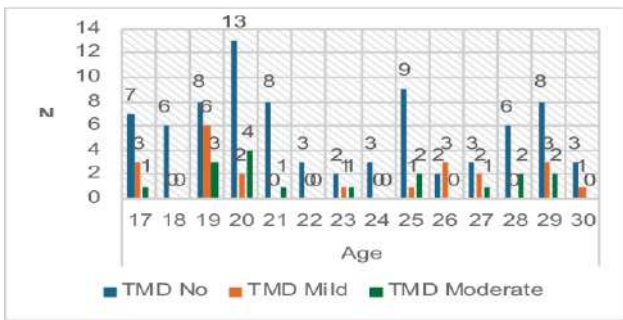


Figure 1 Distribution of TMDs in various age groups TMDs.

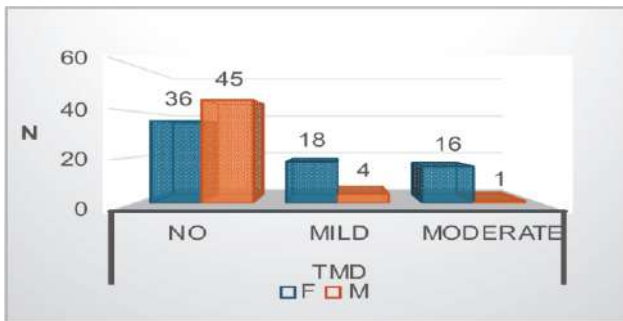


Figure 2 Gender wise distribution of various TMD.

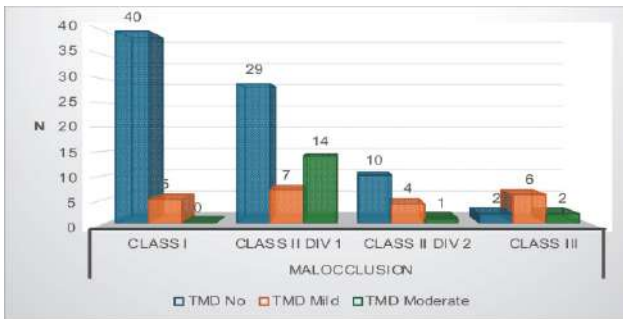


Figure 3 Malocclusion \* TMD.

Figure 1 shows intriguing trends in the prevalence of TMD in various age groups. TMD is most common in people 19 and 20 years old (17.6% and 23.5%, respectively). On the other hand, the lowest occurrence is found among those who are 18 and 22 years old, at 0.0% and 0.0%, respectively. There is a marginal rise in the incidence of TMD among adults 25 years of age or older (11.8%). Nevertheless, no distinct linear pattern is visible for any age group. Given the absence of a distinct linear trend, age may not be a reliable indicator of TMD prevalence in this cohort. This idea is further supported by the non-significant p-value ( $p=0.48$ ), which suggests that age may not be the only factor influencing the observed difference in TMD occurrence.

Significant differences in TMD severity between male and female subjects are shown in Figure 2. Just 18.2% of females had no TMD symptoms (severity level 0), compared to the majority (81.8%) who have mild TMD (severity level 1). On the other hand, fewer men (44.4%) report having no symptoms of TMD, while 55.6% report having mild symptoms. Moreover, 94.1% of severe TMD cases (severity level 2) occur in females, who constitute the majority of cases in this gender group. There is a high correlation between gender and the severity of TMD, as seen by the significant p-value ( $p=0.001$ ).

Figure 3 illustrates the notable differences in TMD severity among various malocclusion types. 49.4% of people with Class I malocclusion have no TMD symptoms (severity level 0), compared to mild (severity level 1) and severe (severity level 2) symptoms in 22.7% and 0.0% of cases, respectively. On the other hand, 82.4% of people with Class II Div 1 malocclusion have severe TMD symptoms, which is a higher frequency of symptoms. In a similar vein, those with Class II Div 2 malocclusion have a high incidence of severe TMD symptoms (82.4%), but a significant fraction of those with Class III malocclusion experience mild (27.3%) and severe (11.8%) TMD symptoms. The significant p-value ( $p=0.001$ ) suggests a considerable correlation between the severity of TMD and the type of malocclusion.

**Discussion**

This study's main goal was to find out how malocclusion affects the frequency of temporomandibular disorders (TMD).

According to our research, the prevalence of TMD symptoms in men was found to be 25.8%, whereas in women it was 38.1%. This is consistent with other research by Hirsch et al., De Oliveria et al., and LeResche, which also found that women had a higher frequency of TMD symptoms. Hormonal differences have been suggested as a possible causative element for gender differences, although the precise cause of these differences is yet unknown.

Based on the Fonseca rating system, which divides TMD symptoms into mild, moderate, and severe categories, the majority of patients (71%), followed by moderate instances (13.7%), had mild TMD. Research by Bagis et al., Dekon et al., Pedroni et al., De Oliveria, and Boniardim et al. is in line with this conclusion.

Various research conducted in the past few decades have offered differing opinions regarding the cause-and-effect

link between TMD and malocclusions. Observing improvements in painful symptoms after adjustments to occlusion, especially in the vertical dimension, Costen (1934) was among the first to propose a link between occlusion and discomfort in the temporomandibular joint (TMJ). Based on MRI investigations, Schellas et al. postulated that ATM pathology may cause malocclusions rather than the other way around. This highlights the significance of assessing TMJ pathology prior to treating malocclusions, which may need orthognathic surgery.

Comparing skeletal Class II (or extreme overjet) malocclusions to other dental abnormalities, several studies have found a higher frequency of TMD in these cases.

On the other hand, Reynders et al. and Seligman and Pullinger came to the conclusion that there was no proof, either scientific or otherwise, linking occlusion to TMD. The contradicting data most likely results from methodological variations in sample qualities, malocclusion recording detail levels, and TMD symptom evaluation amongst research. In light of these results, physicians should take into account certain indicators of malocclusion while performing a clinical examination on patients with TMJ disorders, taking into account the intricate and varied nature of the correlation between malocclusion and TMD symptoms.

### Conclusion

It may be concluded from our current study that women had a significantly higher incidence of temporomandibular joint disorder (TMD) among 120 individuals. The most often seen category, for both male and female participants, was mild TMD. Notably, Class II malocclusion is thought to be a contributing factor to TMD but is not directly linked to the condition.

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# From X-rays to Algorithms Leading to Smart Aligned Smile: AI in Modern Orthodontics

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## Abstract

Artificial intelligence (AI) is revolutionizing the field of orthodontics, which helps to understand diagnosis and treatment plan of the cases with the help of bulk prior data and enhances the clinical outcomes. AI algorithms and machine learning techniques enables precise diagnosis and personalized treatment plans by analyzing large amounts of patient data, including radiographs, photographs, and 3D scans. AI-powered tools assist orthodontists in evaluating whether extraction or non extraction protocol has to be used , helps to predict tooth movement priorly, optimize aligner designs, and monitor treatment progress in real time.

These advancements haslead to reducing chair time and improving patient satisfaction. As AI technology continues to evolve, it holds the promise of further transforming orthodontics through improved accuracy, efficiency, and accessibility, ultimately benefiting both practitioners and patients.

## Introduction

Artificial intelligence (AI), a term first introduced in 1955 by John McCarthy, describes the ability of machines to perform tasks that are classified as intelligent.<sup>1</sup>

It was a 2-month workshop: Dartmouth Summer Research Project on Artificial Intelligence led by John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon and this concept was only on paper. But in 1957- 1975 due to the accessibility and the advances in the computer technology AI field grew faster with different kinds of algorithms for different software.<sup>2</sup>

Artificial intelligence is basically a machine that copies the cognitive functions of human intelligence and helps to take off the manual load of an individual.

Google-developed AI application called AlphaGo in the year 2015 was the breakthrough. With the introduction of Chat GPT in the year 2022 , AI development for different fields bloomed including in the field of medicine and dentistry.<sup>3</sup>

In the field of diagnostic imaging, AI can be categorized into 1) operational AI,

which increases healthcare delivery.

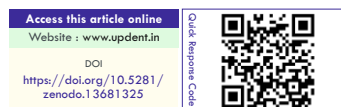
- 2) diagnostic AI, which aids in the interpretation of clinical images;
- 3) predictive AI, which forecasts future outcomes.<sup>4</sup>The main goal of AI in diagnostic imaging is to detect and cut each structure and classify them into pathologies.<sup>5</sup> AI tools can analyse images obtained from various imaging modalities, ranging from X-ray to MRI.

Computer-based diagnostics have gained momentum in the field of health care due to the Convolutional neural network advantage which helps in distinguishing images that detect lesions not seen by the human eye.

CNNs have been successfully used in image-based diagnosis in which the segmentation of the brain tumor and the detection of lung lesions are carried out automatically.<sup>6</sup>

## Types of AI

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- 1) Weak AI - uses a program trained to solve single or specific tasks.
- 2) Strong AI- Strong AI refers to the ability and intelligence of AI equalling that of humans it has its own awareness and behaviour as flexible as human.<sup>7</sup>

There are further categorised in :

- A) Symbolic AI: easily understandable to human<sup>8</sup>
- B) Machine learning AI: Coined by Arthur Samuel in 1952. It relies on models .

Based on the learning strategy and intended result, machine learning techniques can be divided into three categories. Supervised learning is the first kind and is applied to problems involving prediction or classification in which the result is known ahead of time. Here, the algorithm gains knowledge from a labelled dataset and applies it to provide precise predictions about unknown data. Unsupervised learning, the second kind, looks for hidden structures and patterns in data without knowing the outcome in advance. This kind of learning is helpful for tasks like anomaly identification and clustering.

Last but not least, reinforcement learning uses a machine to create an algorithm that optimizes a predetermined reward by using data from earlier iterations of the machine. This kind of education.<sup>9</sup> It Consists of Deep learning , ANN and CNN.

A subset of machine learning called deep learning (DL) includes machines autonomously calculating particular attributes of an input. Artificial neural networks (ANNs), created in the 1990s, provide the foundation for DL.

- A) CNN is a deep learning model mostly utilized for picture production and recognition. Convolution layers in a CNN are utilized to create feature maps from input data by applying convolution kernels.<sup>10</sup>
- B) ANN- It has 3 layers – Input layer , hidden layer and output layer .

#### Why AI is Important?

Healthcare workers can utilize AI to analyze future situations by using its ability to learn from past data and make conclusions from cases.

#### Dental Diagnosis

Orthodontic diagnosis is a challenging task since it requires a thorough simultaneous assessment of different facial components from different perspectives.

Digital dentistry tools enable the collection of patient data on a digital platform, transforming it into a database that can be used for diagnosis and treatment.

The utilization of artificial intelligence and machine learning technologies has resulted in a notable decrease in the assessment workload and the prevention of diagnostic variants.<sup>12</sup>

**A) Radiographs:** Cone-beam computed tomography (CBCT) and orthopantomograms (OPGs) are two radiological techniques that are essential for orthodontic diagnosis, treatment planning, and follow-up.<sup>13</sup> A complete tool is required to assist in the radiological diagnosis procedure. Multimodular AI-based diagnostic systems have arisen in answer to this need.

Using CNNs, Diagnocat Ltd. (San Francisco, CA, USA)

offers accurate and thorough dental diagnoses. The technology allows for volumetric assessment, identification of oral pathology (including periapical lesions and caries), and segmentation and enumeration of teeth.

In an oral CBCT examination, the overall diagnostic performance of two groups one with AI assistance and the other without was evaluated in a recent study by Ezhov et al 2021)<sup>14</sup>. The findings demonstrated that the AI system greatly enhanced dentists' diagnostic abilities, resulting in increased sensitivity.

Rahimi et al<sup>15</sup>, 48 studies were examined to assess the classification models' accuracy in detecting caries. Depending on the imaging modalities, the reported diagnosis accuracy ranged from 68% to 99.2%. According to the study's findings, deep learning models could facilitate clinical processes and show potential for caries diagnosis.

**Cephalometric Analysis:** It is a crucial diagnostic tool that supports assessment of the incisor placement, molar relationship, profile, etc. These days, manual tracing is a rather laborious task, thus for simple evaluation With the introduction of automated cephalometric analysis, only manual landmark identification is required , the x-ray may now be traced and the analysis can be finished by itself.

According to Nishimoto in the year 2019 concluded a study Using cephalogram photos from the internet is a workable method for landmark prediction, despite the wide range of image quality.

Hwang et al. (2020)<sup>17</sup> concluded that automated cephalometric landmark identification can be as reliable as an experienced human reader. Similarly, Kim et al. [65] achieved landmark definition accuracies between 88% and 92% using AI. These authors also found that, compared with manual methods, AI methods demonstrated.

Automated cephalometric landmark detection can be just as dependable as a skilled human reader, according to Hwang et al. (2020)<sup>17</sup>. Similar to this, Kim et al.<sup>18</sup> used AI to attain groundbreaking definition accuracy of 88% to 92%. Additionally, these authors discovered that when compared to manual techniques, AI algorithms showed.

Yu et al.<sup>19</sup> did not find any statistically significant differences between the automated cephalometric analysis findings and the results derived from manually recognized landmarks in their other research.

A study by Serafin et al.<sup>20</sup> published in year 2023 revealed a mean difference of 2.44 mm between manual and three-dimensional (3D) automated land marking.

Blum et al<sup>21</sup> The precision of automatic landmark detection is comparable to that of manual landmark identification, and it takes less time. The achieved accuracy of the system was in range of clinically acceptance.

Ueda et al.<sup>22</sup>The anteroposterior maxillofacial morphology and vertical dimension used by the AI model developed in this study allowed for an appropriate classification of patients into one of the nine combined face classes. This can guarantee accuracy independent of the number of years a practitioner has worked in a clinical setting, improving the standardi-



zation of maxillofacial morphology classification.

All these studies concluded that the greater accuracy in landmark identification has increased due to the introduction of AI which lead to a reduction in the time and human labour required.

**B) Determination of Skeletal Age:** Growth and maturation plays the most important role in orthodontics as all the treatment plan relies over the growth and maturation of the jaws, teeth and cranial base.

Nevertheless, individual differences in development dynamics during adolescence make it inadequate to estimate further growth based only on chronological age.<sup>23</sup>

A better metric for assessing individual growth is skeletal age, which can be determined by wrist X-rays or cervical vertebral maturation (CVM). In conventional diagnostic orthodontic procedures, wrist X-rays are not recommended; however, lateral cephalometric X-rays can be used to evaluate the CVM.<sup>24</sup>

**C) TMJ Evaluation:** Temporomandibular joint osteoarthritis (TMJOA) is a specific type of temporomandibular disorder that can result in significant joint pain, dysfunction, dental malocclusion, and a decreased overall quality of life.<sup>25</sup> The assessment of TMJ function and morphology is essential in orthodontic and dental treatments. Radiographic examination, such as OPG/CBCT, confirms the presence of TMJOA by revealing bony changes, while MRI is the preferred modality for evaluating joint discs.

Marcelo Kreiner<sup>26</sup> did a study in the year 2022 that aimed to develop and test the performance of a novel neural network (multilayer perceptron) with diagnostic capabilities in orofacial pain and TMD, including some types of referred pain. Result- This study showed, for the first time, that an artificial neural network can help medical and general dental clinicians diagnose several types of orofacial pain and dysfunction, including TMD, neuropathic, neurovascular, and a referred cardiac pain. In some cases, the MLP appears to have a life-saving role.

In order to assess the automated diagnosis of disc perforation, internal derangement, TMJ osteoarthritis, and masticatory muscle anomalies, Jha et al.<sup>27</sup> performed a more comprehensive study of 17 publications. According to the meta-analysis, the assessed AI models had excellent diagnostic performance; their specificity and accuracy ranged from 73% to 100% and 84% to 99.9%, respectively.

**D) Extraction Decision Making:** The most demanding issue that an orthodontist faces while making a treatment plan is whether to proceed with the non-extraction protocol or an extraction protocol.

An artificial neural network was used by Kong et al. The results showed that the network could predict extraction and non-extraction with 94% accuracy, extraction patterns with 4.2% accuracy, and anchoring patterns with 92.8% accuracy. The study concludes that less experienced orthodontists can be guided throughout treatment by using the neural network.<sup>29</sup>

To decide whether extraction is required for malocclusion patients between the ages of 11 and 15, Xie developed a de-

cision-making expert system (ES).

According to the study, Jung used the ANN to forecast the precise extraction patterns, correctly determining with an accuracy of 84% whether extraction or non-extraction was required.<sup>29</sup>

Similar results were achieved by Li et al. (2019)<sup>30</sup>, who reported a 94% accuracy for extraction versus nonextraction predictions, 84.2% for extraction patterns, and 92.8% for anchorage patterns. These studies identified several features that are important in predicting treatment efficacy, such as crowding of the upper arch, position of anterior teeth, lower incisor inclination, overjet, overbite, and capability for lip closure.

**E) Orthognathic Surgery Decision Making and Planning:** Whether to plan for a orthognathic surgery in cases of borderline cases or to camouflage is a questionable topic.

Soft tissue profiles were assessed by Jeong et al.<sup>31</sup> using facial picture data. 89% of the assessed CNN's surgical case classifications were accurate.

A model developed by Choi et al.<sup>32</sup> achieved an accuracy range of 88% to 97% in predicting the necessity for surgery and providing an extraction plan for surgical patients.

**F) Treatment Outcome Prediction:** Orthodontists face the challenge of selecting the most appropriate treatment strategy for each patient based on their expectations, socioeconomic conditions, cultural background, and skills. However, procedures such as extractions and orthognathic surgeries are irreversible and can result in permanent patient dissatisfaction. Therefore, accurately predicting treatment outcomes is crucial for both practitioners and patients. Fortunately, a growing body of literature demonstrates the effectiveness of AI in predicting orthodontic and orthognathic treatment outcome.

In terms of six dimensions of tooth movement, Woo et al.<sup>33</sup> compared the accuracy of three different automated digital setup programs with a manual setup.

The outcomes showed that while the automated virtual setup software components were generally effective, more manual changes would still be necessary in clinical practice.

Using modified C-palatal plates, Park et al.<sup>34</sup> utilized a CNN model to predict the cephalometric changes of Class II patients, and they got an overall accuracy of  $1.79 \pm 1.77$  mm.

In order to anticipate the 3D changes in facial morphology following orthodontic (including the extraction of four premolars) or orthognathic surgical treatment, Tanikawa et al.<sup>35</sup> integrated geometric morphometric approaches with deep learning. In the surgical and orthodontic groups, the average inaccuracy of the suggested system was  $0.94 \pm 0.43$  mm and  $0.69 \pm 0.28$  mm, respectively.

To predict patients' experiences with Invisalign treatment, Xu et al.<sup>36</sup> used an ANN model using training data consisting of 17 clinical characteristics.

High prediction accuracy of 87.7% for pain, 93.4% for anxiety, and 92.4% for quality of life was attained by the suggested model.

**G) Modeling:** The AI model demonstrated a modest degree of accuracy in predicting results, which is consistent with other

studies that have demonstrated the usefulness of AI in medical prediction tasks. With a success rate of almost 73%, it is possible that a sizable percentage of patients had treatment outcomes that aligned with the AI model's predictions.<sup>37</sup>

#### H) Treatment Optimization:

**A) Aligner Therapy:** Thurzo et al.<sup>38</sup> The goal is to assess the effects of using computerized tailored decision algorithms as an upgrade to an already-existing clinical orthodontic application (app) in response to observed and predicted patient behavior. They concluded that by implementing application updates that incorporate computerized decision processes, current healthcare applications can perform much better clinically and increase patient compliance. A secondary finding is that, by telemedicine concepts, dental monitoring is a helpful tool for assessing clinical situations.

**B) Bracket Placement:** Features of SureSmile technology includes:

1. OraScanner
2. Wire bending robot
3. Digital bracket placement<sup>39</sup>

An innovative use that improves the accuracy and effectiveness of orthodontic treatments is AI-driven bracket placement. Here's how bracket placement is being revolutionized by AI:

- i) Imaging and Scanning Digitally 3D Imaging produces a comprehensive digital model which has high precision.
- ii) Planning and Analysis Optimal Positioning: To ascertain the best location for every bracket, artificial intelligence algorithms examine the digital model. This entails determining the ideal migration route for the tooth as well as its current and intended final positions.  
Customization: Taking into account individual variances in tooth alignment and shape, the system adjusts the bracket placement for every tooth.
- iii) Virtual Setup Simulation: AI models the teeth virtually, simulating the full course of treatment from beginning to end.
- iv) Guided Placement: The orthodontist is assisted in precisely positioning the brackets on the teeth by the AI-generated bespoke placement jigs or templates.  
Decreased Errors: By guaranteeing that brackets are positioned precisely in accordance with the digital plan, these guides lower human mistake and enhance the effectiveness of therapy.
- v) Real-Time Modifications Instant Feedback: During the bracket insertion process, artificial intelligence (AI) technologies offer real-time feedback, assisting orthodontists in making quick adjustments as needed.  
Enhanced Accuracy: By utilizing a feedback loop, any deviations from the ideal positioning are promptly detected and fixed.
- vi) Predictive Result Predictive analytics: AI makes predictions about how teeth will move throughout treatment using predictive analytics. This aids in foreseeing possible problems and making proactive corrections.  
Better Outcomes: AI helps produce more predictable and

gratifying outcomes for patients by forecasting outcomes.<sup>39</sup>

#### Conclusion

The field of orthodontics is changing because to artificial intelligence (AI), which is providing patient care with previously unheard-of levels of precision, efficiency, and personalization. The accuracy of orthodontic procedures has increased thanks to AI's skills in diagnosis, treatment planning, and monitoring. This has reduced treatment times and improved results. Artificial Intelligence (AI) enhances patient treatments by optimizing procedures like bracket insertion and aligner design through the use of sophisticated imaging, predictive modeling, and real-time feedback.

AI also makes teleorthodontics and remote consultations easier, increasing accessibility to high-quality orthodontic treatment. The application of AI technology in orthodontics promises even more breakthroughs as it develops, including improved patient happiness, increased treatment accuracy, and more accessibility to care. In the end, artificial intelligence (AI) will play a major role in the development of orthodontics and usher in a new era of creativity and quality in dental care.

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# Stabilizing Smiles: The Gunning Splint's Role in Mandibular Fracture Management

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## Abstract

Treating partially dentate or edentulous patients for fixation of fractured maxilla / mandible poses a challenge for the operator in case of elderly patients. The 'Gunning splint' initially was presented by Thomas Brain Gunning (1813–1889). Possibility of complications in elderly patients are more when compared to younger patients. Gunning splints provide closed reduction and better stabilization.

**Keywords:** Edentulous mandible, Gunning splint, Mandibular Fracture

## Introduction

Road Traffic accidents are most common etiology for facial fracture. Treating partially dentate or edentulous patients for fixation of fractured maxilla/ mandible poses a challenge for the operator in case of elderly patients<sup>1</sup>. For edentulous patients, treatment planning poses greater difficulties during reduction and fixation of fractured atrophic mandible. Due to edentulism, guidelines provided by occluding teeth for reduction and fixation of fracture, are absent. Open Reduction Internal Fixation is also not possible in case of immunocompromised elderly patients. The 'Gunning splint' initially was presented by Thomas Brain Gunning (1813–1889) for the immobilization of edentulous or partially edentulous jaw segments after reduction<sup>1</sup>. A Gunning splint for the edentulous mandible consists of a type of mono block resembling two bite blocks joined together. These splints take form of modified dentures with bite block placed in posterior region and a space in incisal area to facilitate feeding. Intermaxillary splinting can be done by connecting two splints with wire loops or elastic bands<sup>2</sup>.

## Case Report

A 59 year old male patient reported to the NIMS Dental college with a complaint of swelling of the face resulting from a road traffic accident. The patient was examined by oral and maxillofacial surgery team in the Department of Oral and Maxillofacial Surgery. The examination revealed swelling

over the right and left side of the face extending from angle of mouth to angle of mandible bilaterally (fig 1). Laceration was present on the lingual surface of lower lip. There was no periorbital or sub-conjunctival ecchymosis. Intraoral examination revealed limited mouth opening. Hematoma was present on the floor of the mouth (Fig 2). Patient had been advised for NCCT Face which reveals right parasymphysis and left angle of mandible fracture. Fracture line was extending till the base of the mandible in vertically favourable manner. (Fig 3)

Then patient has been planned for closed reduction of the fractured mandible with Gunning splint instead of open reduction and internal fixation. The patient was moderately built and conscious. After initial first aid and cleaning of the wounds the patient was referred to the Department of Prosthodontics for the fabrication of gunning splint for the purpose of stabilizing the fractured segment. The initial impressions with alginate (irreversible hydrocolloid) impression material (Dentsply Zelgan Plus) was taken for both mandibular and maxillary arch (Fig 4). Impressions were immediately poured in dental stone to obtain casts and a heat cure splint was fabricated. (Fig 5).

Mandibular splint was designed with stoppers which would occlude with the maxillary splint and helps to keep that splint in

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place. The splints were checked in patient's mouth for extension and frenum relief.

Then finishing and polishing of splints was carried out and they were disinfected in glutaraldehyde solution. First the maxillary splint was fixed with per-alveolar wiring. Close reduction of mandibular segments were carried out with hand manipulation of fracture segments to their approximate position. The tissue side of mandibular splint was relined with low fusing impression compound. This was done to compensate for any discrepancy between the splint and the mandible and also to provide firm immobilization of mandibular segments. Mandibular splint was fixed by circum-mandibular wiring (Fig 6). After securing the splints to the underlying bone, intermaxillary fixation was done with arch wires to provide firm immobilization. This was kept for 6 weeks after which it was replaced with elastics.

### Discussion

As age progress, significant changes occurs in the functional vascular supply of mandible<sup>3</sup>. Healing will be delayed thus open reduction and internal fixation method is not preferred<sup>4</sup>. A careful history, oral and facial examination and complete radiographic survey are imperative whenever any fracture is suspected. The treatment options should be evaluated according to the patient's need and appropriate case selection with the dental team by careful treatment planning and interdisciplinary cooperation. Immobilization is carried out by attaching the upper splint to maxilla by para-alveolar wiring and lower splint to the mandibular body by circumferential wires. Intermaxillary splinting can be done by connecting two splints with wire loops or elastic bands. Close reduction with Gunning splint is advantageous because, not only it preserves the periosteal blood supply, but also provides firm mandibular fixation and immobilization.

### Conclusion

In almost all the cases with edentulous mandibular fracture, a satisfactory union of fracture is obtained with Gunning splints than Open reduction internal fixation. Fabrication of gunning splints is easy, Cost effective and comfort to the patients. Thus Gunning splints are preferred over open reduction internal fixation for edentulous mandible fracture.

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Figure 1: Photograph showing extra oral swelling



Figure 2: Photograph showing intraorally



Figure 3: Photograph showing NCCT Face



Figure 4 : Photograph showing Alginate impressions



Figure 5 : Photograph showing fracture line marked on cast

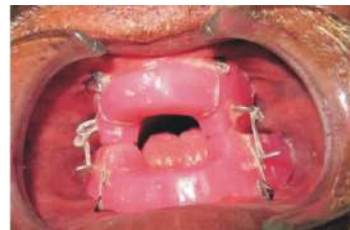


Figure 6 : Photograph showing Gunning Splint

# Decoding Orthodontic Retreatments: A Study of Motivations and Outcomes

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## Abstract

Orthodontic retreatment is necessitated by a variety of factors that compromise the stability and effectiveness of initial treatment outcomes. Key reasons for retreatment include:

- 1) **Relapse:** Movement of teeth back to their original positions due to factors such as inadequate retention, patient non-compliance, or underlying periodontal issues.
- 2) **Incomplete Correction:** Insufficient correction of malocclusions or alignment issues during initial treatment, often due to mis-diagnosis or treatment limitations.
- 3) **New Dental Issues:** Emergence of new dental problems, such as spacing or crowding due to dental extractions, erupting teeth, or changes in the dental arch.
- 4) **Changes in Patient Needs:** Shifts in patient's functional or aesthetic goals, necessitating adjustments to align with evolving personal preferences or clinical needs.
- 5) **Technical Failures:** Problems related to appliance failures, such as bracket debonding or wire breakage, which can hinder treatment progress. Understanding these factors is crucial for optimizing orthodontic treatment planning and ensuring long-term success.

## Introduction

Over the past thirty years, there has been a consistent increase in adult orthodontics. In the United States, the proportion of adult orthodontic cases rose from 15.4% in 1981 to 21.0% by 2017<sup>1</sup>. Additionally, a 2018 survey conducted by the British Orthodontic Society indicated that its members were treating 5% more adult patients in private practice compared to 2016<sup>2</sup>. A significant number of these adult patients likely underwent orthodontic treatment during their adolescence and are often categorized as retreatment patients.

Orthodontists involved in retreatments may encounter patients with heightened expectations regarding both the quality and duration of their treatment. To achieve successful outcomes in these cases, orthodontists need a comprehensive understanding of the potential challenges that could lead to treatment failure. Additionally, implementing an objective system to guide the quality of retreatment completion could improve clinical management and enhance the likelihood of successful results<sup>3</sup>.

In the context of this increased interest in aesthetics, the need for treatment does not

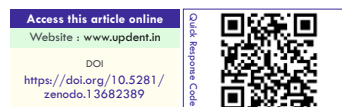
depend solely on clinical symptoms and signs; attention must be paid to the appearance of the teeth. Among the patients seeking orthodontic treatment is a subgroup who have received treatment previously and decide to seek retreatment. In general, such patients are more concerned with personal appearance and have higher socioeconomic status, independent of the objective need for treatment.

The aim and objective of the current study was to explore the experiences, perceptions, and treatment requirements of patients seeking orthodontic retreatment.

## Materials and Methods

An online questionnaire survey of adults seeking first-time orthodontic treatment (control) and retreatment (study) was conducted. The responses from the patient questionnaire, along with records from before the initial treatment and pre-retreatment, including photographs, radiographs, and study models, were reviewed. This was done in conjunction with

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identifying the causes of the original orthodontic failure by a senior and experienced orthodontist.

A structured questionnaire encompassing demographic data and closed ended question was administered to assess the reasons behind orthodontic retreatment and patient awareness. Participants aged between 12-45 years, provided information on age, gender, socio-demographics, Retention history, Reasons for initial treatment and retreatment.

**Results**

A total of 460 patients were invited to take part in the study, with 200 in the retreatment group and 262 in the first-time treatment group. The response rate for the retreatment group was approximately 50% (99 participants), while the first-time treatment group had a response rate of 40% (100 participants). Incomplete responses were not included in the analysis.

The retreatment group consisted of 20 males and 79 females. The control group had 32 males and 68 females. There were significantly more females than males in both groups (Table 1) with a majority age group of 21-25 years.

Characteristics	Initial Treatment	Retreatment
Gender		
Male	32	20
Female	68	79
Age Groups		
18-28	16	27
29-39	29	28
40-50	27	30
>59	28	14

Table 1: Gender and Age Groups

Out of the 99 retreatment patients, 60 reported receiving a retainer, 29 did not receive one, and 10 were uncertain about whether they had received a retainer. Among those who did receive a retainer, 38 reported following the retainer regimen as prescribed, 20 were non-compliant, and 2 were unsure about their compliance (Table 2).

	Yes	No	Not Sure
Retainers Issued	60	29	10
Reported Compliance	38	20	2

Table 2: Retention History

Respondents could provide multiple answers, so the data was reported as frequency counts rather than the number of individual patients. The primary reasons for seeking orthodontic treatment across all groups were aesthetic concerns, such as crowded teeth, smile enhancing, improving facial profile, spacing between teeth and Malocclusion. Individuals seeking retreatment were often motivated by the relapse of their orig-

inal treatment or its failure to achieve desired results. Fewer people were motivated by issues related to jaw positions, the desire to improve chewing ability, airway concerns, or problems with the jaw joints (Table 3).

Reason	Frequency of Response	
	Initial Treatment	Retreatment
Smile Enhancement	43	37
Improvement of facial profile	27	18
Crowded teeth	48	42
Spacing	19	13

Table 3: Motivation factors

**Increase in Retreatment Cases:** Class 1 and Class 2 Dental malocclusions show a higher number of retreatment cases, with a significant increase, especially among females. **Decrease in Certain Classes:** Class 2 Skeletal and Class 3 Dental show a decrease in retreatment cases, with Class 3 Dental having a notably lower number in retreatment. **Gender Trends:** Females generally constitute a higher proportion in the retreatment phases compared to the initial treatment (Table 4).

Malocclusion	Initial treatment			Retreatment		
	Male	Female	Total	Male	Female	Total
Class 1	3	11	14	7	28	35
Class 2 Dental	3	17	20	6	21	27
Class 2 Skeletal	6	10	16	1	8	9
Class 3 Dental	6	11	17	1	3	4
Class 3 Skeletal	8	7	15	4	9	13
Bimaxillary Protrusion	6	12	18	11	0	11

Table 4: Malocclusion

**Discussion**

One major debate in adult orthodontics revolves around the difficulties related to long-term post-treatment stability. Despite evidence showing that orthodontists can achieve excellent occlusion, relapse remains a significant issue. This study utilized an online survey to systematically assess responses from a large group of individuals: 99 adults seeking retreatment and 100 first-time treatment seekers.

The study also provided insights into the reasons behind the failure of the original treatment<sup>5</sup>. The situation worsens if iatrogenic issues occur and the orthodontist fails to pay attention to proper canine and lateral guidance, as well as correct alignment and intercuspation during the finishing phase of orthodontic treatment<sup>6</sup>.

In this study, retreatment group consisted of 20 males and 79 females. The control group had 32 males and 68 females. There were significantly more females than males in

both groups with a majority age group of 21-25 years. This finding was in contrast with that of Breece and Nieberg<sup>7</sup>, who reported two-thirds of patients were aged 18-27 years from a sample of 180 first-time adult patients. So this is not in accordance with the study.

In 2011, Pabari et al.<sup>10</sup> found from a study of 172 adult patients at teaching hospitals in the United Kingdom that the reasons adults pursue orthodontic treatment are diverse and multifaceted<sup>8</sup>. Our study examined adult motivations for orthodontic treatment from three angles: (1) the source of motivation, (2) the factors driving motivation, and (3) the level of motivation.

The findings indicated that the majority of participants in both the retreatment (71.1%) and control (68.7%) groups were primarily motivated by their own desires rather than being influenced by their spouse or marital status. Our levels of self-motivation were higher than the 27.1% reported by Oliveira et al.<sup>9</sup>. So this is in accordance with this study.

Our work showed that the main motivation factors or reasons for seeking original treatment, retreatment, and first-time seekers to be aesthetic, namely crooked or crowded teeth.

Typically, one would anticipate that patients seek retreatment due to relapse from inadequate retention compliance. Our expert evaluations and questionnaire data corroborate this expectation. The findings revealed that relapse was often due to poor patient adherence to retainer use, and notably, a significant number of patients had not been provided with any type of retainer at all.

Despite individuals' self-reported concerns and complaints about their dental issues, their readiness to undergo orthodontic treatment again can lead to feelings of insecurity and uncertainty. High anxiety levels among those about to start orthodontic treatment may adversely affect their health related quality of life.

## Conclusion

The increasing demand for orthodontic treatment is highly significant and intriguing for orthodontists. However, it's crucial to understand patients' needs and ensure our ability to deliver treatments that meet their expectations effectively. Attentively listening to patients and determining the optimal timing for intervention are essential for the success of orthodontic treatment, thereby reducing the likelihood of requiring future interventions.

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# Orthodontic Elastics

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## Abstract

Elastics have been a useful addition to any orthodontic treatment for a number of decades. Artificial Elastomers get around some of the drawbacks of natural rubber. The force extension values provided by the manufacturer for various elastic sizes are used to estimate the use of elastics in clinical practice. This review aims to assess the existing data on the various types of elastics employed in orthodontics.

Keywords: Rubber, Synthetic, Elastic Bands, Elastic Chains, Elastic Module, Elastic Separators, Force Degradation, Latex Allergy, Staining.

## Introduction

Orthodontic elastics play a vital role in both intraoral and extraoral treatments. They are commonly categorized based on the direction of force they exert, such as class II or class III elastics, and can vary in length. These elastics are sourced from either natural rubber or synthetic polyurethane derived from the petrochemical industry. Both natural and synthetic rubbers share the characteristic of quickly returning to their original shape after being stretched, known as resiliency. This quality enables them to provide a continuous force for moving individual teeth or groups of teeth effectively to produce light, continuous stresses for the rotational correction, extraction space closure, diastema closure, arch consolidation, and selective midline shift.<sup>1,2</sup>

## History

The introduction of vulcanization by Charles Goodyear in 1839 revolutionized the utility of natural rubber, leading to a considerable expansion in its applications. Early proponents of employing natural latex rubber in orthodontics included Baker, Case, and Angle.<sup>3-6</sup>

Natural rubber In 1770, English chemist Joseph Priestley made the pivotal discovery that the substance from rubber tree known as "cahuchu", could effectively erase pencil marks, leading to its designation as "rubber". However, it was Henry A. Baker who in 1893 is credited with introducing intermaxillary elastics using rubber bands, later dubbed "Baker Anchorage." Dr. Angle

further elaborated on this technique at the New York Institute of Stomatology in 1902.

Synthetic rubber Polymers that originated from petrochemicals in the 1920s. In orthodontic applications, the majority of elastic materials currently in use are composed of polyurethane, these demonstrate resistance to heat and can endure significant stresses and pressures. In comparison to natural rubber, polyurethane rubbers boast excellent strength and resistance to abrasion.

## Classification

Elastics can be classified in many ways. According to their availability, the material, there uses, force.<sup>7-11</sup>

According to the Materials

1. Latex elastics
2. Synthetic elastics

## According to the Availability Elastic Bands

1. According to lumen size
  - $2/16'' = 1/8'' = 3.18\text{mm}$
  - $3/16'' = 3/16'' = 4.76\text{mm}$
  - $4/16'' = 1/4'' = 6.35\text{mm}$
  - $5/16'' = 5/16'' = 7.94\text{mm}$
  - $6/16 = 3/8'' = 9.5\text{mm}$
  - $8/16'' = 1/2'' = 12.7\text{mm}$
  - $10/16'' = 5/8'' = 15.8\text{mm}$
  - $12/16'' = 3/4'' = 19.1\text{mm}$
2. According to the Force
  - High pull: It gives 71 gm force (2½ oz)

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- Medium pull: It gives 128 gm or 4½ oz force
- Heavy pull: It gives 184 gm or 6½ oz force.
- 3. According to colour- Manufacturer based.
- 4. According to use-
- Intraoral Elastics : Intramaxillary Elastics- Class I elastics , also known as horizontal elastics, are positioned in the same side of the arch anteroposterior.  
Intermaxillary Elastics- Intraoral elastics placed in both arches, classified into Class II, III, Crossbite and Openbite elastics and others like Midline (Alexander) elastics.
- Extraoral Elastics

#### Elastics Chains

Also called power chains. These filaments come in three different configurations based on the length of the filament: closed, short, and long.

#### Elastic Ligatures

Also known as modules/ 'O' rings. Modules are small ring elastics used to secure the arch wires to the orthodontic bracket.

#### Elastic Thread and Elastic Sleeves

Round thread composed of silk or nylon with a non-porous, smooth surface is available. It uses a gentle, constant, persistent, and predictable force.

Similar to thread, elastic tubing has a hollow core, used to cover arch wires in areas where teeth are absent or unerupted thus preventing irritation to soft tissues.

#### Elastic Separators

These are ring-shaped elastics that are placed in between two teeth, no more than two weeks, in order to create space between the teeth for the placement of molar bands.

#### Force Degradation

Following a thorough analysis of the elastomeric chain literature, it can be concluded that the majority of commercially available elastomeric chains typically lose between 50% and 70% of their initial force on the first day of load application. After three weeks, only 30-40% of original force was retained. In an in-vivo study, fifty percent of force degradation occurred in the first 4 to 5 hours of latex elastics, followed by continuous and gradual force degradation for the remaining time intervals.<sup>12-17</sup>

#### Disadvantages of Elastics

- Absorbs water from saliva.
- Cytotoxicity.
- Discoloration and staining.
- Latex allergy.<sup>18,19</sup>

#### Conclusion

Elastics rank among the most adaptable materials at an orthodontist's disposal, serving as an invaluable tool in their arsenal. Failing to fully utilize these materials means not fulfilling the patient's needs adequately. In fact, it's difficult to envision practicing this branch of dentistry effectively without incorporating this essential material.

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# Surgical Removal of Lingually Placed Supernumerary Tooth : Case Report

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## Abstract

Teeth that erupt in addition to the normal number of teeth are known as supernumerary teeth. Supernumerary teeth are the most prevalent type of dental abnormality. The maxillary anterior area is where extra teeth are typically found. They can appear in any arch at any position and can be single or numerous, unilateral or bilateral. These teeth may be found in either the permanent or primary dentition. Many clinical issues could arise from their existence. As a result, they require the proper diagnosis and care. A comprehensive clinical examination and radiographic examination are used to diagnose extra teeth. This paper includes a case study of a patient with unilateral impacted supernumerary teeth along with a synopsis of the causes and treatments of these teeth.

**Keywords** – Supernumerary tooth, surgical extraction, lingual flap

## Introduction

A supernumerary tooth is one that is not part of the usual set of teeth.<sup>1</sup> With a frequency of more than 3%, reports of these teeth are more prevalent among the mongoloid racial group.<sup>2,3</sup> In comparison to primary dentition, the prevalence of extra teeth is higher in permanent dentition. Supernumerary teeth are found in 1–3% of permanent dentition and 0.3-0.6% of primary dentition, according to Koch et al.<sup>4</sup> According to Rajab and Hamden,<sup>5</sup> the prevalence of these teeth is 0.3-0.8% in the primary dentition and 0.1-3.8% in the permanent dentition. Because of the voids in the primary dentition that permit the emergence of these teeth in a normal alignment, supernumerary teeth may go unnoticed at this stage of development.<sup>6</sup> The morphology and position of extraneous teeth determine their classification.

In primary dentition, supernumerary teeth often have normal or conical morphologies. The morphology of these teeth varies in the permanent dentition.

Conical teeth, tuberculate supernumerary teeth (barrel-shaped teeth with multiple tubercles in the crown and incomplete or absent root), supplemental teeth (supernumerary teeth with shape resembling normal teeth), and odontome (multiple small tooth like structures or a single irregular mass) are some examples of these variations. Supernumerary teeth are classified as mesiodens, which are extra teeth between the maxillary central incisors; paramolars, which are extra teeth next to molars; distomolars, which are extra teeth farthest from the last molar; and parapremolars, which are extra teeth in the premolar region. One or two supernumerary teeth found commonly in anterior maxilla followed by mandibular premolar area. Multiple supernumerary teeth seen commonly in premolar area.<sup>7,8</sup>

Many theories have been proposed

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to explain aetiology of supernumerary teeth. These include atavism, dichotomy of tooth bud, and localized hyperactivity of dental lamina resulting in formation of additional tooth germ, genetic factors and syndromes.

**Atavism:** The re-emergence of an ancestral condition is known as atavism, which is a form of long-distance heredity or phylogenetic reversion. There have been suggestions that it is a throwback to evolution. Man's teeth have become smaller and fewer in number as a result of phylogenetic evolution, and extra premolars could be an atavistic feature of the premolar region. According to this theory, human dentition may have reverted to that of an ancestor who had more teeth.<sup>9,10</sup>

**Dichotomy:** Dichotomy is division of tooth bud into two teeth of equal size or one normal and one dysmorphic tooth with two equal or different sized parts. Division in the developing tooth bud can give rise to supernumerary tooth and a normal tooth.<sup>11</sup>

**Hyperactivity of dental lamina:** Because of their size, the epithelial remains can stimulate and regulate the growth of the dental papilla. An additional tooth bud forms and additional odontogenic structure develops if the epithelial remnants are exposed to induction stimuli.<sup>10</sup> The most widely recognised explanation for the production of supernumerary teeth is the localised and autonomous hyperactivity of the dental lamina.<sup>12</sup> A eumorphic tooth develops from the lingual extension of an extra tooth bud, whereas a primitive tooth is created by the proliferation of dental lamina epithelial remains.<sup>13</sup>

**Genetics:** The growth of extra teeth is also influenced by environmental and genetic factors. Recurrence of extra teeth in monozygotic twins and members of the same family also showed a hereditary component. 14 Siblings, twins, and other family members have been documented to have extra teeth in a number of case reports.<sup>15</sup>

**Associated syndromes:** Various hereditary syndromes found to be associated with hyperdontia. These syndromes are Crouzon syndrome, Cleidocranial dysplasia, Ehlers-Danlos syndrome, Gardner's syndrome,<sup>16</sup> Goldenhar syndrome<sup>17</sup>, Hallermann-Streiff syndrome,<sup>18</sup> Orofaciodigital syndrome type I<sup>19</sup>, Incontinentia pigmenti,<sup>20</sup> Marfan syndrome, Nance-Horan syndrome, and cleft lip and palate.<sup>21</sup>

#### Case report

A patient aged 21 years came to the department of Orthodontics and Dentofacial Orthopaedics at Babu Banarasi Das College of Dental Sciences with chief complaint of forwardly placed upper front teeth. Intraoral examination showed permanent teeth till third molar present in each quadrant of mandibular arch and in

maxillary arch all permanent teeth erupted. Patient had class II molar relation with increased overjet and crowding in maxillary and Mandibular anterior region. It was observed that mandibular right second molar is grossly carious and the left maxillary 3<sup>rd</sup> molar is absent. Lateral cephalogram and orthopantomogram were taken for orthodontic analysis and treatment planning.

On analyzing orthopantomogram, it was observed that one tooth is impacted in right canine-premolar region in mandibular arch.(fig.1) Crown shape of tooth was similar to premolar and roots are shorter than normal. Surgical extraction was planned as a treatment for this case for which the patient was referred to department of oral & maxillofacial surgery.

Intra oral periapical radiographs (IOPA) were taken with SLOB technique to see exact position of the tooth whether it is located buccally or lingually. It was confirmed from these radiographs that the tooth is located on lingual side. Extra-oral examination presented convex facial profile with incompetent lips. Patient had no medical history regarding any type of diseases or medication.

Routine blood investigation was done for complete blood count, bleeding time, clotting time, random blood sugar the values for which were under normal limits. Viral markers like HIV, HbsAg and HCV was done and was non reactive. The surgical removal of the supernumerary tooth was done by giving a crevicular incision on lingual side from right molar to left premolars without giving releasing incision. Lingual flap was reflected and the location of the supernumerary tooth on the lingual cortex was exposed.(fig 2) Straight surgical hand piece was used with round bur and 701 straight bur to remove the bone on the bulge of lingual cortex to expose the supernumerary tooth in a controlled manner in order to prevent injury to inferior alveolar nerve. Extraction of supernumerary tooth was done in toto (fig 3& 4) followed by extraction of 44 and 14. The extraction socket of the supernumerary teeth was placed with PRF which was prepared by drawing 10 ml blood from the patient in a sterilized syringe and transferred to test tube to make platelet rich fibrin in a centrifuge machine at 3000 rpm (800g) for 10 minutes. PRF was made and placed in the extraction socket of supernumerary tooth to enhanced healing. Closure was done using 3-0 mersilk and sling suture technique pressure pack was given and antibiotics and analgesics was prescribed for 5 days along with post extraction instructions.

#### Discussion

In permanent dentition, supernumerary teeth are most prevalent. Extra teeth may occasionally remain



Fig 1. Orthopantomogram



Fig 2. Reflection of lingual flap

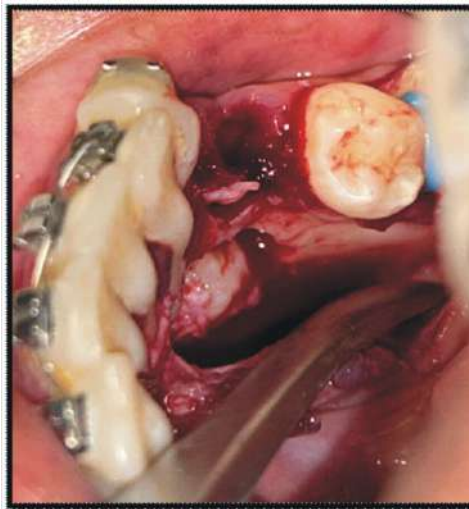


Fig 3. Exposure of supernumerary tooth



Fig 4. Extracted supernumerary tooth

impacted or may occasionally emerge in the oral cavity. A tooth that remains in position and does not erupt is called an impacted tooth. In permanent dentition, eruption failure is a common dental abnormality. Teeth impaction can lead to a number of issues, including altered tooth mobility, functional ramifications, and aesthetic issues. The complex, genetically based process of permanent tooth emergence involves the eruptive movement

of dental germs along predefined pathways to reach the occlusal level at a given time. The intricacy of the eruption process can lead to several difficulties, including delayed and unsuccessful eruption of teeth.<sup>22</sup>

The aetiology of tooth impaction involves both systemic and local causes. crowding, ectopically positioned tooth germs, supernumerary teeth, dense mucosa or overlying bone, and the early loss or protracted retention

of deciduous teeth are examples of local variables. Impaction can be caused by systemic causes like as rickets, congenital syphilis, progeria, achondroplasia, and endocrine disorders.<sup>23</sup>

Supernumerary teeth were shown to be prevalent in primary dentitions (0.8%), whereas in permanent dentitions (2.1%), according to Brook.<sup>24</sup> They could be in one or both jaws, single or many, unilateral or bilateral, erupted or impacted. Multiple extra teeth are uncommon in persons without any additional comorbidities or disorders.<sup>25</sup> There is a correlation between some illnesses such as cleidocranial dysplasia, Gardner syndrome, and cleft lip and palate and the higher frequency of extra teeth. In patients with unilateral cleft lip or palate, or both, the incidence of extra permanent teeth in the cleft region was observed to be 22.2%.<sup>26</sup> In individuals with cleidocranial dysplasia, the incidence of extra teeth varied from 22% in the maxillary incisor region to 5% in the molar region.<sup>27</sup> Males are affected about twice as much as females in the permanent dentition, while there is no discernible difference in primary supernumerary teeth between the sexes.<sup>28</sup>

As in this case study, extra teeth might occasionally remain impacted. For effective orthodontic treatment planning, such teeth must undergo a thorough radiographic evaluation. Diagnostic tools like tube shift radiography and cone beam computed tomography can be used to pinpoint the precise location of an impacted supernumerary tooth and how it relates to adjacent hard and soft tissue components. In order to attain the right occlusion and aesthetics, treatment options may include orthodontic alignment and the extraction of excess teeth.<sup>29</sup>

Extraction of supernumerary teeth is advised in conditions such as: Delayed eruption of adjacent tooth, altered eruption and displacement of adjacent tooth, any pathology associated to supernumerary tooth, for orthodontic treatment, when such tooth is present in bony area designated for implant insertion, or when bone grafting in cleft patients is compromised due to presence of supernumerary tooth.<sup>30</sup>

Indications for monitoring of supernumerary teeth without extraction includes satisfactory eruption of adjacent tooth, no orthodontic treatment is needed for patient and no pathology linked to supernumerary tooth.<sup>30</sup>

The presence of impacted, unnoticed supernumerary tooth may interfere with orthodontic alignment and space closure. Extraction of such teeth is advised for orthodontic treatment. In present case report the impacted supernumerary tooth present close to roots of permanent canine and premolars in right mandibular arch. Extraction of these was planned for orthodontic treatment pro-

gress.

## Conclusion

Supernumerary teeth are extra teeth beyond the normal complement that are present in both dentitions. Men are particularly affected by these teeth, which are common in permanent dentition. Supernumerary teeth can arise unilaterally or bilaterally, in one or both dental arches, in one or more teeth, erupted or impacted. Mesiodens are the most prevalent type of extra teeth, and then extra premolars. It is essential to properly diagnose and treat these teeth in order to minimise any potential issues that may arise from having too many teeth. These complications include crowding, displacement, dilations, and cyst formation, among others, and they may interfere with orthodontic tooth movement. If the extra tooth is asymptomatic, there is no need to treat it; however, routine clinical and radiological surveillance is necessary to guard against any unfavourable consequences it may cause.

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# Understanding Dental Implants: Key Findings From a Questionnaire Study

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## Abstract

**Background:** Dental implants have become a popular treatment option for replacing mis-sing teeth. The purpose of this study was to evaluate the knowledge, awareness, and attitudes of the Pondicherry population regarding dental implants as a treatment option for replacing missing teeth.

**Materials and methods:** This study included 2,570 participants aged 18 and above who visited the outpatient department of a tertiary dental hospital in Pondicherry. The participants received a self-explanatory questionnaire containing fifteen questions, which was distributed using Google Forms software and sent via email.

**Results:** A total of 1,230 participants completed the questionnaire. Of these, 44.5% preferred dental implants for replacing missing teeth and acknowledged the crucial role of dentists in educating the public about implant therapy. Approximately 39.5% cited the relatively high cost of implants as a barrier to acceptance. Additionally, 57.3% of the participants viewed fixed replacements as advantageous, primarily for their aesthetics and improved functionality.

**Conclusion:** Our study findings indicate that patients possessed knowledge about dental implant therapy and expressed willingness to consider them for replacing their missing teeth in the future. However, the relatively high cost emerged as a significant barrier to accepting implants. Ultimately, this study underscores the critical role of dentists in educating the public about the effectiveness of dental implants in treating tooth loss.

**Keywords:** dental implant, general knowledge, awareness, attitude, web-based surveys, and questionnaire.

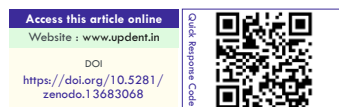
## Introduction

Tooth loss can lead to challenges in mastication, occlusion, temporomandibular joint disorders, and an esthetically displeasing appearance, all of which can have adverse effects on the overall physical well-being and social satisfaction of an individual.<sup>(1,2)</sup> Tooth loss can also have adverse effects on oral health, potentially leading to drifting of adjacent teeth, supra eruption of opposing teeth, increased risk of further tooth loss, and the development of temporomandibular disorders (TMDs). The World Health Organization (WHO) categorizes individuals without teeth as physically weakened, emphasizing the loss of a crucial body part.<sup>(3)</sup> Taking all these factors into account, it is essential to address edentulism through appropriate treatment.<sup>(4)</sup> Treatment of edentulism, including fixed or removable partial dentures, as well as implant-supported prostheses, have tradition-ally

been utilized for restoring missing teeth. However, dental implants have been emerged as the preferred choice in recent times due to their ability to offer long-term benefits with fewer complications.<sup>(5,6)</sup>

The perspectives and attitudes of the population toward dental implants remain largely unclear. Therefore, it is crucial to conduct a survey aimed at assessing knowledge about dental implant as a treatment option for replacing missing teeth, their acceptance levels through feedback analysis.<sup>(7)</sup> Ho K et al showed that patients generally have positive experiences with dental implants. However, there appears to be a deficiency in patient education regarding dental implants and their associated procedures.<sup>(8)</sup> A Al-Haj

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Husain et al uncovered a positive attitude and a satisfactory level of awareness and understanding regarding the utilization of dental implants in treating edentulism.<sup>(9)</sup>

Nowadays, web-based surveys are becoming increasingly prevalent, especially in fields like evaluation research, in contrast to traditional paper based surveys. They facilitate the collection of large volumes of data through self administered electronic questionnaires distributed over the internet. This method eliminates the need for interviews, paper materials, or postage fees, and streamlines data processing by integrating data entry directly.<sup>(7)</sup>In previous studies, the Indian population was found to have a significant knowledge gap regarding dental implants, whereas higher levels of awareness have been reported in other studies.<sup>(10)</sup>Hence, the aim of the present study was to assess the general knowledge about dental implants in patients reporting to a tertiary dental hospital in Pondicherry using online questionnaire (Google forms software).

**Materials & Methods**

The present study was conducted to assess the general knowledge regarding dental implants in a total of 2,570 participants through online questionnaire (prepared using Google forms software) composing of 15 questions and assessed using percentage. The questionnaire was sent to the participants through their individual email IDs. All participants were informed about the aim and objectives of the study. Out of 2,570 participants contacted, only 1,230 chose to take part in the study.

The inclusion criteria consisted of individuals aged 18 years or older, reporting the outpatient department of a tertiary dental hospital in Pondicherry. Participants who did not express interest in the study were excluded. This web survey included self-explanatory questions consistent with prior study conducted by Hosadurga et al.<sup>(10)</sup>

**Questionnaire**

1. Do you have any missing teeth?
  - a) Yes
  - b) No
2. What would you like to have your teeth replaced with?
  - a) Removable prosthesis/appliances
  - b) Fixed prosthesis/appliances
  - c) Implants
  - d) Not replaced at all
3. Do you know about dental implants as a treatment option to replace missing teeth?
  - a) Yes
  - b) No
4. From where have you heard about dental implants?
  - a) Dentist
  - b) Family & friends
  - c) Medical doctor
  - d) Media
5. Do you think replacement of missing teeth is important?
  - a) Very important
  - b) Somewhat important
  - c) Neither important nor unimportant
  - d) Not at all

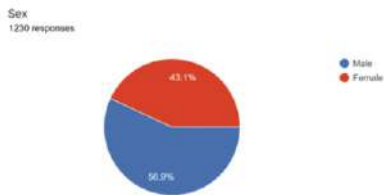
6. Where do you think dental implant is placed?
  - a) In the bone
  - b) In the gums
7. How long do you think a dental implant lasts?
  - a) Lifetime
  - b) More than 10 years
  - c) Less than 5-10 years
  - d) Not sure
8. How much do you think a patient have to pay for an implant in India?
  - a) Rs 10,000
  - b) Rs 10,000 to Rs 20,000
  - c) Rs 20,000 to Rs 30,000
  - d) More than Rs 30,000
9. Who in your opinion should opt dental implants for replacing their missing teeth?
  - a) Single tooth loss
  - b) Multiple tooth loss
  - c) Complete tooth loss
  - d) All the above
10. Do you think implants are effective in replacing missing teeth?
  - a) Yes
  - b) No
11. If yes, what are they?
  - a) Fixed replacement is better
  - b) Better esthetics
  - c) Better function
  - d) No grinding of teeth
12. What are the barriers to dental implant as a treatment modality?
  - a) Did not see the need for surgery
  - b) High cost
  - c) Fear of surgery
  - d) Not clear about the treatment procedure
13. Have you come across anybody with a dental implant?
  - a) Yes
  - b) No
14. If yes, how satisfied is he/she with the implant(s)?
  - a)Very satisfied
  - b)Satisfied
  - c)Not so satisfied
  - d)Unsatisfied
15. Are you willing to consider dental implant as a treatment modality in future?
  - a) Yes
  - b) No

**Results**

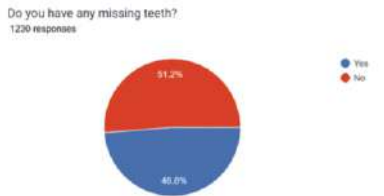
Demographic data of the participants



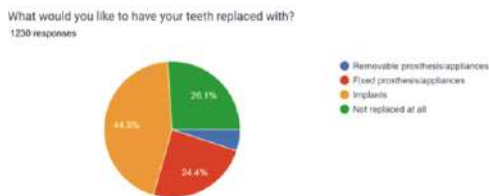
Figure 1: Age of the study participants



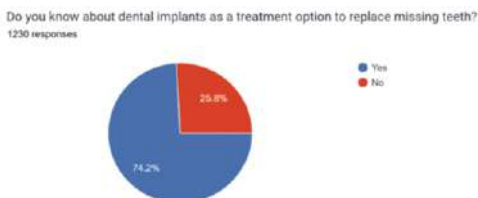
**Figure 2: Sex of the study participants**  
Questionnaire for assessing the general knowledge about dental implants in the study participants



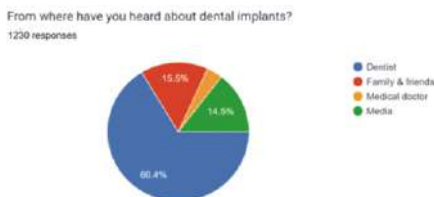
**Figure 3: Assessing the percentage of edentulism among study participants**



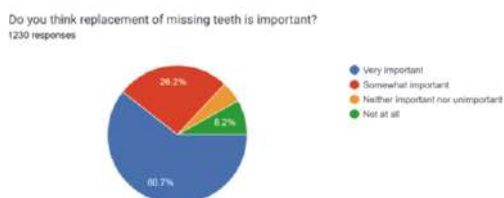
**Figure 4: Choice of preference for replacing missing teeth among study participants**



**Figure 5: Knowledge about dental implants for replacing missing teeth among study participants**



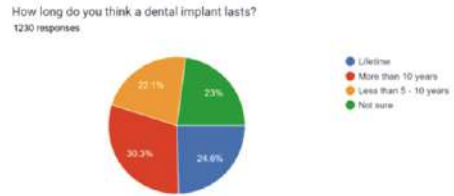
**Figure 6: Source of information about dental implants among study participants**



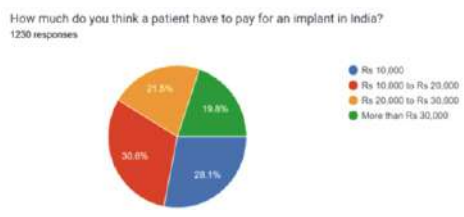
**Figure 7: Assessment of importance regarding replacement of missing**



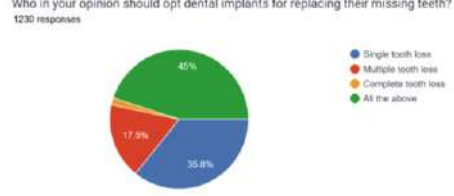
**Figure 8: Knowledge about dental implant placement among study participants**



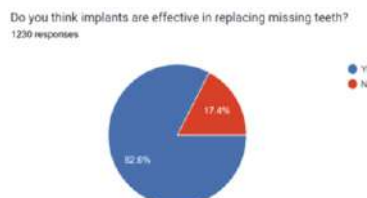
**Figure 9: Perspective of implant survival among study participants**



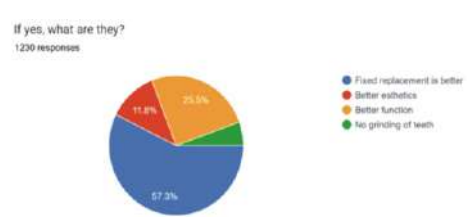
**Figure 10: Perspective of implant cost charges among study participants**



**Figure 11: Opinion on opting dental implants among study participants**



**Figure 12: Assessing the effectiveness of replacing missing teeth in the study participants**



**Figure 13: Benefits of dental implants among study participants**

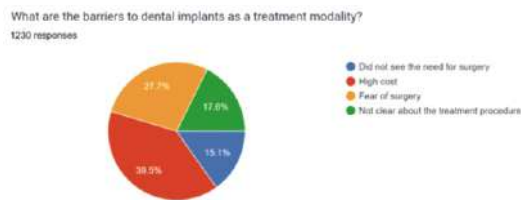


Figure 14: Barriers for dental implant therapy among study participants

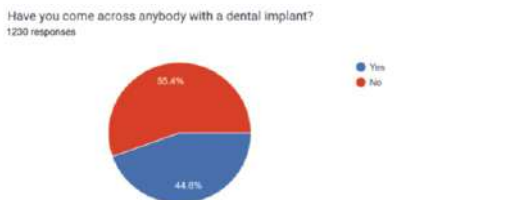


Figure 15: Participant's knowledge on patients who had previously undergone dental implant therapy

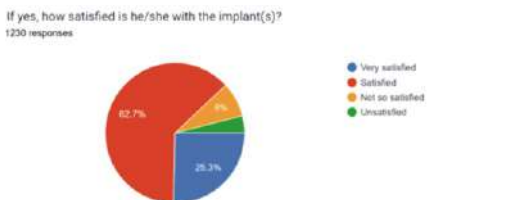


Figure 16: Satisfaction levels of patients who had previously undergone dental implant therapy

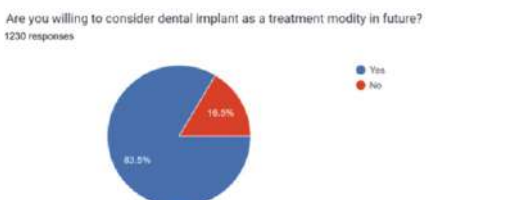


Figure 17: Acceptance rate of dental implants among study participants

## Discussion

In the present study, when asked if the study participants would replace their missing teeth, approximately 44.5% of participants preferred dental implants, followed by fixed prostheses at 24.4%. In a previous study done by Mously HA et al, majority of the study participants chose dental implants for replacing missing teeth.<sup>(18)</sup> Furthermore, when asked if they would restore their missing teeth with dental implants, 74.2% of the participants were aware of dental implants as a treatment option. Although, contrast findings were observed in an earlier study done by Ravi Kumar C et al, where the most preferred treatment for replacing missing teeth was fixed partial dentures (FPD).<sup>(14)</sup> Additionally, 60.7% of participants considered replacing missing teeth to be very important, whereas only 8.2% did not feel the need to address edentulism. In the present study, 66.9% of the participants believed that implants were placed directly in the bone.

In the present study, it was also evident that dentists (64.4%) were the primary source of information on dental

implants, followed by family and friends (15.5%), media (14.5%), and medical doctors (5.6%). Hosadurga et al, in his study has also acknowledged the significant role dentists play in disseminating knowledge about dental implants.<sup>(10)</sup> On the contrary, Berge TI et al. in his study have found out that media plays as a main source of information to the public about dental implants.<sup>(15)</sup>

Regarding the longevity of implants in the oral cavity, approximately 24.6% of the study participants reported that implants would last a lifetime, 30.3% believed they would last more than ten years, 22.1% said they would last between five and ten years, and 23% were unsure about the survival chances of dental implants. In another study, it was found that approximately 70% of the participants were uncertain about the possibility of implant survival.<sup>(18)</sup> Another important factor influencing the decision to opt for implant therapy is the cost. Specifically, 28.1% chose Rs.10,000; 30.6% chose Rs.10,000 to Rs.20,000; 21.5% chose Rs.20,000 to Rs.30,000; and 19.8% chose more than Rs.30,000.

Nearly 45% of the participants opted dental implants for treating single tooth loss, multiple tooth loss, and complete tooth loss. However, these findings were not consistent with a previous study conducted by HA Mously et al., where most participants believed that implants were primarily indicated for replacing multiple missing teeth, followed by single missing teeth. More than two-thirds (82.6%) of the participants, who knew about dental implant answered that they were effective in replacing missing teeth.<sup>(18)</sup> This probably indicates that participants, once familiar with implant-based treatments, would choose these options to replace their missing teeth and would generally be satisfied with the results.<sup>(7)</sup> Also in the present study, participants chose dental implants for the following advantages namely; fixed replacement as a better option (57.3%), better esthetics (11.8%), better function (25.5%) and to prevent grinding of the adjacent tooth structures (5.4%). However, contrary reports were seen in a previous study where most of the participants opted for missing tooth replacement due to esthetics followed by difficulty in mastication.<sup>(18)</sup>

In the present study, when asked about the barriers preventing them from preferring dental implant therapy, 39.5% of participants cited the high cost, 27.7% mentioned fear of surgery, 17.6% were unclear about the treatment procedure, and 15.1% did not see the need for surgery. Similar findings in earlier studies also identified high treatment costs as a major disadvantage of implant therapy. When asked regarding satisfaction levels with implant therapy in our study, majority of the population (62.7%) reported being satisfied, while only 3.9% were unsatisfied. At the end of the questionnaire, more than two-thirds of the participants (83.5%) expressed a willingness to consider dental implants as a future treatment option for replacing missing teeth. Consequently, in the present study, constraints such as limited sample size and lower response rate may have impacted the validity of our findings.

## Conclusion

Nearly half of participants were found to have knowledge about dental implants for replacing missing teeth. This study uncovered the significant role of dentists in educating the public about dental implants as an effective replacement for missing teeth. Additionally, the study highlighted that the relatively high cost of implants and fear of surgery were the primary hindrance for participants considering implant therapy. Furthermore, the importance of addressing edentulism was widely acknowledged among the study participants. Also, these web-based surveys seem to be more advantageous in terms of data collection and storage for future use. Further studies should focus on conducting thorough assessments of participants within a large and diverse population, while also exploring innovative methods to consistently spread knowledge about dental implant therapy.

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# A Review on the Lateral Pedicle Flap as a Treatment Modality For The Coverage of Millers Class 2 Gingival Recession

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## Abstract

During 100 A.D. back, the only treatment modality that was most of the times carried out in the field of dentistry whether it was for a problem of carious tooth, mobile tooth (even for grade 1 or grade 2 mobility), receding gums, was extraction of the involved teeth. Often the extraction was a much traumatic one, and proper healing never took place. However now a days, dentistry has evolved so much that apart from extraction as a treatment modality, many other treatment are available. One of such treatment for receding gums is the lateral pedicle flap in which the adjacent teeth is used as a donor teeth to cover the receding teeth by the flap of the donor teeth.

**Key Words:** Extraction, recession, millers, root coverage, lateral pedicle flap.

## Introduction

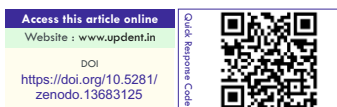
Long time ago, almost 100 A.D. back, dental field had a very limited treatment modality. In this treatment modality, the only treatment that was much of a prior concern was extraction of the diseased tooth; whether this diseased tooth has a pit, and fissure caries, class 1 caries, class 2 caries, grade 1 or grade 2 mobility, Millers class 1, or class 2 recession.<sup>1</sup> However over these past few years, dentistry had come so far beyond extraction that extraction can be considered a much last treatment modality.<sup>2</sup> Over these few years, people have become aware of their dental problems, and the point which is of prior concern in terms of patient point of view is esthetics and to save the diseased tooth.<sup>3</sup> Considering esthetics as a prior concern as per patient point of view, which is one of the reason that dentistry had evolved so much beyond extraction. Now a days beyond extraction, smile designing, composites, veneers, other restorations, depigmentation, pedicle flaps, free gingival grafts are available, which tend to save the tooth instead of extracting them.<sup>4</sup>

## Gingival Recession

In the field of Periodontology, four structures, are of important concern; gingiva (whose main function is the protection of the underlying structures), and the alveolar bone, cementum, and periodontal ligament (whose main function is to act as a supporting tissues for the teeth).<sup>5</sup> Talking in terms of gin-

giva, so gingiva is the part of oral cavity, that covers the alveolar process of jaws, and surrounds the neck of tooth in a collar like fashion.<sup>6</sup> Different characteristic features of gingiva are there, that gives the gingiva, its sole identity. One of the characteristic feature, that is position of the gingiva. The normal position of gingiva is at the level of cemento enamel junction, or 1mm coronal to the cemento enamel junction.<sup>7</sup> However this position of gingiva is not stationary as compared to cemento enamel junction, which remains stationary throughout the life of an individual. This change of position can vary at the time of gingivitis or periodontitis and also after the different phases of treatment plan.<sup>8</sup> However the treatment plan is considered to be successful as if all the signs and symptoms of gingivitis are eliminated and the gingiva returns to its normal colour, contour, consistency, surface texture, and position.<sup>9</sup> Taking consideration into the position of gingiva, this gingival position can shift either more than 1mm coronal to the cemento enamel junction, a condition called as gingival enlargement, or there can be an apical shift in the position of gingiva, a condition called as gingival recession.<sup>10</sup> However long back ago, gingival recession terminology, had been

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replaced by the term marginal soft tissue recession, which is defined as the displacement of soft tissue margin, apical to the cemento enamel junction with oral exposure of the root surface. Marginal soft tissue recession is the more appropriate term to be used than the gingival recession, as it involves the recession of either alveolar mucosa or gingiva. In terms of communication with the patient, the term root coverage is much more appropriate.<sup>11</sup>

### Causes of Gingival Recession

Gingival recession can be caused due to various reasons such as<sup>11</sup>

**1. Morphology:** Morphology refers to the biotype of the Periodontium. This biotype is reflected in the gingiva as thin and scalloped, or thick and flat. The thin gingival biotype is identified by the prominence and visibility of roots beneath the gingiva and in case of thick gingival biotype, the roots are not so prominent and visible beneath the gingiva. This thin bio-type of gingiva shows that the bone beneath the gingiva is thin, and such type of bone had a higher chance of fenestration, dehiscence. This thin gingiva also has the tendency to tear during flap reflection. And henceforth concluding all these terms, this thin gingival biotype has a greater chance of recession.

The thick gingival biotype shows that the bone beneath the gingiva is thick and hence such type of bone resist the recession. But this type of bone has a greater chances of exostoses and tori. And henceforth considering all these things, the thick gingival biotype has a lesser chance for recession and in case if the recession occurs, then the prognosis is good to fair.

**2. Trauma:** Traumatic practice to the soft tissue can result in inflammation which often leads to the destruction of soft tissue, alveolar bone, cementum, and periodontal ligament. Following are some of traumatic things that can result in gingival recession.

**A. Toothbrush:** One of such traumatic injury the aggressive use of toothbrush. These type of individuals have a picture in their mind, that brushing vigorously can lead to a thorough cleaning of the teeth, often unaware that such type of tooth brushing is damaging their soft tissue, and leading to gingival recession. In such cases, its very necessary to identify the cause of gingival recession, because if these type of recession, treated by surgical intervention without a proper etiology for the recession can lead to a greater amount of recession after surgery. Often these aggressive toothbrush induced gingival recession is treated non-surgically.

**B. Dental Floss:** Often patients with a shallow probing depth and good periodontal health are conscious about keeping their teeth clean. And in the consciousness of keeping the teeth clean, these patients along with the toothbrush often use dental floss but this dental floss is often used in such a manner such that facial, papillar, and lingual gingival recession occur, because of a habit of keeping the dental floss in between teeth pushing hard

into the gingiva such that the gingival recession occurs.

**C. Foreign Objects:** It includes a habit of keeping the blunt end of a pen, pencil, fingernail on the gingiva and rubbing against gingiva leading to gingival recession. Another cause can be sports injury of the mouth leading to gingival recession.

**D. Dental Procedures:** Placement of rubberdam, gingival retraction cords, violation of biologic width by placement of subgingival margins of restoration can result in gingival recession.

**3. Inflammatory Periodontal Disease:** It results due to accumulation of plaque and calculus as an important etiological factors. Often there is loss of interdental bone and papillary height in the anterior region of dentition followed by lateral food impaction in the posterior region of dentition.

### Millers Classification of Gingival Recession.<sup>12</sup>

Miller in the year, given the classification of gingival recession based upon the interdental bone loss, soft tissue loss, and the important landmark in millers classification was the muco-gingival junction.<sup>4</sup>

**Class 1:** Marginal tissue recession, that does not extend to the mucogingival junction. There is no soft tissue loss and the interdental bone loss.

**Class 2:** Marginal tissue recession that extends to or beyond the mucogingival junction. There is no soft tissue loss and the interdental bone loss.

**Class 3:** Marginal tissue recession that extends to or beyond the mucogingival junction. Loss of interdental bone or soft tissue is apical to the cemento enamel junction but coronal to the apical extent of the marginal tissue recession.

**Class 4:** Marginal tissue recession that extends beyond the mucogingival junction. Loss of interdental bone extends to the level apical to the extent of marginal tissue recession.

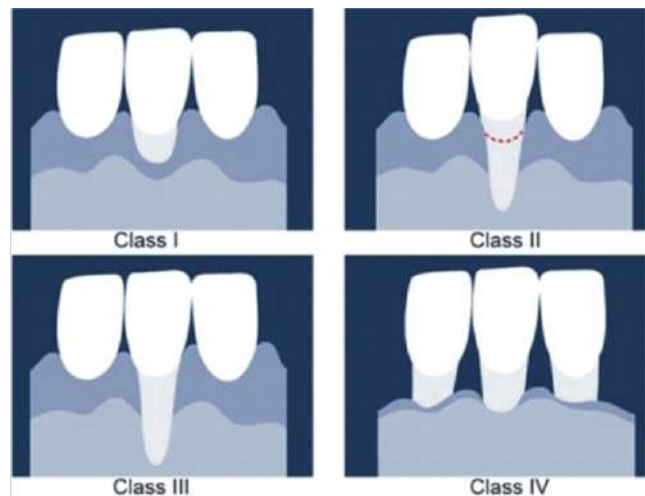


Fig. 1: Millers Classification of Gingival Recession.

### Clinical Significance of Root Coverage/Gingival Recession Coverage

Since, gingival recession is characterized by the exposure of roots either partially or completely, this exposed root/roots holds the clinical significance that if these exposed root/roots are not covered by any type of root coverage procedures, then this exposure can lead to sensitivity / hypersensitivity, root caries, esthetically displeasing, and in some cases particularly in case of class 3 or class 4 gingival recession, decreased width of attached gingiva.<sup>13</sup>

### Lateral Pedicle Flap

Surgical flaps used in the treatment of recession coverage are of two types:<sup>14</sup>

1. **Pedicle Soft Tissue Graft Procedures:** These are the type of flaps, which maintain their connection with the donor site. Examples include: Coronal repositioning flap, lateral pedicle flap, semilunar flap.
2. **Free Soft Tissue Graft Procedures:** These are the type of flaps, in which donor site in most of the cases is not the adjacent one, but a site such as palate from which graft is taken. Examples include: free gingival graft, connective tissue graft.

Term lateral pedicle flap was firstly introduced by Grupe and Warren in 1957. This technique uses the donor gingiva of a healthy adjacent tooth to cover the recessed tooth. It involves moving a full thickness flap to the mucogingival junction, after which a partial thickness flap is raised.<sup>15</sup>

### Indications

1. A good indication for the use of lateral pedicle flap is an isolated area of recession, with no interproximal bone loss. Henceforth the use of lateral pedicle flaps achieve its good results in Millers class 1 or class 2 recession cases with 100 percent root coverage as compared to millers class 3 or class 4 cases where the chances of root coverage is 25 to 50%. The only condition to implement the lateral pedicle flap is that the adjacent donor tissue must have the sufficient width, and thickness of gingiva and vestibular depth with good bone thickness and no dehiscence or fenestration.<sup>15</sup>
2. The ideal indication is in a crowded teeth, where a donor tooth placed lingually has a sufficient thickness and width of gingiva, and the sufficient height and the thickness of bone and the adjacent tooth ( Recipient tooth) is more facial and had little or no gingiva with root exposure.<sup>15</sup>

### Contraindications

1. Significant loss of interproximal bone height<sup>15</sup>
2. Extensive root prominences<sup>15</sup>
3. Presence of extensive erosion or abrasion<sup>15</sup>
4. Presence of deep interproximal pockets.<sup>15</sup>

### Advantages

1. Good vascularity of the pedicle flap as the pedicle flap get its blood supply from the base of flap.<sup>15</sup>
2. One surgical site hence one surgical wound which reduces the chances of bleeding and postoperative pain.<sup>15</sup>
3. A good technique to cover the isolated root recession.<sup>15</sup>

### Disadvantages

1. Possibility of recession at the donor site.<sup>15</sup>
2. Possibility of occurrence of dehiscence and fenestration at the donor site.<sup>15</sup>
3. Not much applicable in case of multiple recession cases.<sup>15</sup>
4. Technique is limited by the sufficient amount of keratinized gingiva at the donor site.<sup>15</sup>

### Procedure of Lateral Pedicle Flap

1. The first step is to determine the bone level at the facial aspect of the donor site after profound local anaesthesia. This distance of bone level from cemento enamel junction should not exceed more than 1-2 mm.<sup>15</sup>
2. Proper smoothing of recipient root should be carried out in order to eradicate any roughness ,and irregularities on the root surface as these irregularities and roughness will interfere with the proper adaptation of the flap, as well hampers the blood supply to the flap.<sup>15</sup>
3. The first incision is an oblique incision which is made at a distal end of a donor teeth beyond the mucogingival junction.<sup>15</sup>
4. This incision is continued as a sulcular incision from a donor teeth to a recipient teeth.
5. The third incision is a horizontal incision into the papilla between the recipient teeth and a non donor teeth and is terminated by a oblique incision beyond the mucogingival junction.<sup>15</sup>
6. Later on a full thickness flap is raised by a blunt dissection by a periosteal elevator and a partial thickness flap is reflected by a sharp dissection.<sup>15</sup>
7. The elevated flap is rotated from the donor teeth to a recipient teeth and is adapted by means of sutures.<sup>15</sup>



Fig. 1: Preoperative



Fig. 2: Incisions of View of Millers Lateral Pedicle flap Class 2 gingival recession.



Fig. 3: Flap stabilized by Means of Sutures.



Fig. 4. 6 Weeks Post Operative

#### View of 100% Root Coverage Common Reasons for The Failure of Lateral Pedicle Flap

1. Flap is not adequately stabilized because of tension present in the flap.<sup>15</sup>
2. Design of the pedicle flap is too narrow.<sup>15</sup>
3. Bone exposure because of poor flap adaptation or stabilization, resulting in occurrence of fenestration or dehiscence.<sup>15</sup>
4. Poor stabilization resulting in excessive movement of flap.<sup>15</sup>

#### Discussion

The field of Periodontology mainly revolve around two conditions; gingivitis and Periodontitis. The differentiating feature between gingivitis and Periodontitis is the loss of attachment as in case of gingivitis there is an inflammation of the gingiva but without the loss of clinical attachment. Once there is an extension of inflammation from gingiva into the bone, there is a clinical attachment loss and this condition is termed as Periodontitis.<sup>5</sup> Apart from clinical attachment loss as a one of the characteristic clinical feature of periodontitis, a periodontitis is also characterized by other features such as in the sulcus depth which is termed as periodontal pocket, mobility, furcation involvement, bone loss, and recession.<sup>6</sup> So here this review is on the recession also known as root coverage in terms of patients language and the lateral pedicle flap as a procedure to cover the recession. In the normal individual, there is a position at which the gingival level remains in health within the oral cavity, once this position gets altered by any means such as by aggressive tooth brushing, flossing, rubbing blunt end of pen, pencil against the gingiva, the retention of etiological factors plaque and calculus on the gingiva can all lead to the

inflammation and shift in a position of the gingiva to a more apical level which in a clinical term is known as gingival recession or a more appropriate term marginal soft tissue recession as this later term includes the loss of both the soft tissue and the bone.<sup>11</sup> Various treatment modalities to cover up this recession or the exposed roots are there, out of which the one which we have written our review is on the lateral pedicle flap or lateral repositioning of the flap. This lateral pedicle flap is best suited for the teeth with isolated recession as in case of multiple recession defects it is quite difficult to move the flap laterally. Lateral pedicle flap has the donor site and the recipient sites adjacent to each other. These adjacent areas has the advantage of being less traumatic to the patient, less bleeding postoperatively and a good blood supply from the base of the flap. However the limitation of lateral pedicle flap is that the tooth which act as a donor for a recessed tooth should have a sufficient width, thickness, adequate height of the interproximal bone and there should not be any bone loss, because if we choose such a donor tooth with insufficient thickness and width of gingiva, as well bone loss facially and interproximally can lead to recession of the donor tooth, without the proper root coverage of the recipient tooth because of the hindrance with the blood supply from the base of the flap.<sup>15</sup> Thus keeping these conditions in the mind, lateral pedicle flap is best suitable for Millers class 1 or class 2 recession cases where the chances for root coverage is 100% in most of the class 1 or class 2 recession cases and is less suitable for millers class 3 or class 4 recession cases, where due to the loss of bone both interproximally and facially and insufficient gingival width and thickness, the chances of root coverage reduces from 100% to 25-50%.<sup>15</sup>

#### Summary and Conclusion

Recession or the root exposure is one of the pathology that needs to be of a thorough concern to the patient. Patient must be made aware about their exposure of roots, the consequences of it and various treatment modalities available to cover those exposed roots. The cause of recession must be identified and treated accordingly. It is the duty of the clinician to diagnose and emphasized the importance of root coverage to the patient so that in order to achieve a 100 percent chances of root coverage.

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# Twin Occlusion Prosthesis: A Case Report

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## Abstract

Hemimandibulectomy patient presents with many debilitating problems because of deviation of mandible on affected side. This incapacitation depends upon the amount of hard and soft tissue resected, remaining dentition and tongue mobility for mastication and other oral functions. It is essential to restore the oral function like mastication in such patients to ensure for an ability to have healthy diet and overall general health. The treatment options for such patients are surgical restoration of resected part, physiotherapy or prosthodontic intervention. Prosthodontic options are to either provide guiding flange prosthesis or twin occlusion prosthesis. Appropriate treatment option is to be chosen depending upon the degree of loss of structure and function. This article presents a technique of restoring oral function for a hemimandibulectomy patient by twin occlusion prosthesis.

**Key Words:** Twin Occlusion Prosthesis, Hemimandibulectomy.

## Introduction

Mandibular deviation is multifactorial defect and its severity is based on the extent of osseous and soft tissue involvement, degree of tongue impaired, the loss of sensory and motor innervations, the type of wound closure, the presence of remaining natural teeth and finally the first initiation of prosthetic treatment<sup>1</sup>.

Oral diseases are widespread all over the world and negatively affect people's quality of life. It greatly affects various anatomic regions of the oral cavity, making the functions like chewing, swallowing, speech, and oral competence difficult<sup>2</sup>.

These include ameloblastoma, osteoradionecrosis of jaws, salivary gland tumors, oropharyngeal carcinomas, trauma, and so on. However, the most frequent carcinomas in the head and neck area are squamous cell carcinomas of the oral cavity<sup>3</sup>.

Squamous cell carcinoma of the oral cavity is a malignant neoplasm that makes individuals suffer both physiologically and psychologically. Surgical resection of the tumor and the structures involved with it, along with radiotherapy or chemotherapy, is the treatment protocol for oral squamous cell carcinoma (OSCC)<sup>4</sup>.

One of the most difficult and demanding essays is the prosthodontic rehabilitation

of such individuals, especially for the mandible, because the segmental loss of mandibular integrity leads to its deviation towards the resected area with lack of occlusion. In addition, segmental loss of mandible results in limited mouth opening, scar formation, abnormal jaw relationships, and compromised health of oral mucosa which further worsens the mandibular deviation to reestablish an acceptable occlusal relationship for the residual dentition which helps to achieve mastication is the mainstay treatment modality for hemimandibulectomy cases<sup>5,6,7</sup>.

This study will help the viewers in dealing with the treatment plan of the patients undergoing hemi-mandibulectomy, and it will lend a helping hand to postgraduate trainees in constructing a maxillary partial denture with a double occlusal table. The goal of this article is to present a prosthesis that is simple, lightweight yet strong enough to withstand the masticatory forces, and cost-effective as patients with oral carcinomas are mostly from a low socioeconomic background, due to the consumption of chewing and smoking carcinogens.

## Case Report

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A 58 year old Female patient reported to the Department of Prosthodontics with a chief complaint of difficulty in mastication since 6 months. Her medical history revealed that she was diagnosed for squamous cell carcinoma on the left side of the mandible, for which she had undergone extensive resection of the entire mandible on left half of the mandible 3 years back. An extra oral examination showed asymmetrical face, and a convex profile. There was deviation of the mandible to the left side that is towards the resected side.



Pre Operative

**Clinical Procedure**

Preliminary impressions were made with irreversible hydrocolloid material using stock trays and casts were poured with type III dental stone. On the maxillary cast a custom tray was fabricated with self-cure acrylic resin (RR, Dentsply, India). Impressions were poured with type III dental stone to obtain a final cast. Denture base was fabricated and wax occlusal bit was made. Maxillary master cast was articulated using a Mean value articulator. Maxillomandibular relations were recorded with Modell-ing wax to get interocclusal records.



Twin Occlusion On Cast

The patient was advised to move his mandible as far as possible to the untreated side and then gently close his mandibular jaw into position to record a functional maxillomandibular relationship. After articulation, one set of anatomic teeth were selected



Twin Occlusion In Mouth-post Insertion



Post Insertion Twin Occlusion

**Discussion**

Olson ML et al<sup>8</sup> in 1978 and Curtis DA et al<sup>9</sup> in 1997 recommended that immediate reconstruction of resected part of mandible should be done to recover both facial symmetry and masticatory function.

Classes	Description
Class 1	Mandibular resection involving alveolar defect with preservation of mandibular continuity.
Class 2	Resection defects involve loss of mandibular continuity distal to the canine area.
Class 3	Resection defect involves loss up to the mandibular midline region.
Class 4	Resection defect involves the lateral aspect of the mandible, but are augmented to maintain pseudo articulation of bone and soft tissues in the region of the ascending ramus.
Class 5	Resection defect involves the symphysis and parasymphysis region only, augmented to preserve bilateral temporomandibular articulations.
Class 6	Similar to class V, except that the mandibular continuity is not restored.

Table: 01 Cantor and Curtis classification for Hemi mandibulectomy

It is reported that even the recent developments in reconstructive surgery and prosthodontic rehabilitation have not been able to restore impaired masticatory function in 50% of head and neck cancer patients. Osseointegrated dental implants provide a treatment modality that may adequately rehabilitate oral functions of these patients so that they can lead a healthy life. However this is an expensive modality which may be not be acceptable to all strata of patients. In this case the guidance prosthesis was not planned because a time period of 3 years had elapsed and scar tissue

formation had occurred.<sup>10,11,12</sup> Twin occlusion was provided because the patient could not occlude on the natural teeth. The palatal row of teeth occluded with the remaining natural mandibular teeth and the buccal row of natural teeth supported the cheeks. This technique enables the patient to masticate appropriately, to lead a healthy, good quality of life. It helps patient to deal with the physical and psychological disabilities.

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# Comparative Evaluation of Three Different Mechanical Properties of Four Orthodontic Wires By Instrumented Indentation Technique (IIT)-an In Vitro Study.

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## Abstract

**Background-** Brackets, molar tubes, and orthodontic wires work together to exert stresses on the teeth as therapy progresses. Because they are so intrinsic to the efficacy of orthodontic treatment, the mechanical properties of orthodontic wires are very important.

**AIM-** The researchers set out to compare the mechanical qualities of conventional round orthodontic wires (i.e. NiTi, TMA, HANT & Gummetal, that are used in the treatment during the initial stage of levelling and aligning.

**Method-** The study was conducted in the Nanoindenter Facility in the Department of Metallurgical Engineering & Material Science of Indian Institute of Technology, Bombay. The machinery used to perform the indentation and scratch test to determine the characteristics of the arch wire was Hysitron TI Premier Nano indenter, BrukerTM

**Result-** Post Hoc test was done for individual comparison for hardness and significant difference at  $p \leq 0.05$  between the four wires i.e. HANT, NiTi, TMA, Gummetal. The mean values of the Vickers hardness(HVIT) ,modulus of elasticity(Es) and coefficient of friction of the HANT, NiTi, TMA, and Gummetal were compared using a one-way ANOVA test , the results were found to be significant at  $p \leq 0.05$ , which meant that there was a significant difference

**Conclusion-** The average coefficient of friction for Gummetal is lower than TMA while it is significantly much higher than HANT and NiTi.

**Keywords-** Efficacy, Orthodontic Treatment, Nickel Titanium, Heat Activated Nickel Titanium, Titanium Molybdenum Alloy, Gummetal

## Introduction

Orthodontic therapy relies on arch wires. Through the use of molar tubes and brackets, they produce the necessary stresses to shift the teeth into place. Different archwires are available with different cross-sections. As the orthodontic wires, brackets, and molar tubes work together, they exert stresses on the teeth. The characteristics of a perfect archwire are defined by the following criteria:

- (1) High formability
- (2) low stiffness
- (3) high range, and
- (4) high strength

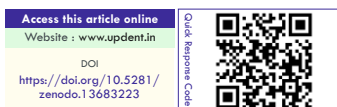
The material must also have the capacity to be weldable and solderable. Not only that, but the material also needs to be affordable. No orthodontic archwire material has been able to meet all of these criteria. To get the greatest results, use a different archwire for each function.<sup>1</sup>

Arch wires are utilized in fixed ortho-

dontic appliance therapy to provide force to the teeth. The effectiveness of the multistage treatment process depends on the careful selection of arch wires. No fixed appliance treatment phase is best served by a single archwire. Typically used to address crowding and small tooth rotations, the initial archwire is the first archwire put into the permanent appliance at the start of therapy. People generally agree that optimal forces light, continuous forces are the best way to move teeth in a controlled and predictable way while causing little damage to the teeth and their supporting tissues<sup>2</sup>

The mechanical qualities of the wires are crucial to the effectiveness of orthodontic therapy. The modulus of elasticity, yield strength, fracture strength, and other basic mechanical parameters are often evaluated

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by means of tensile, bending, and torsion tests.<sup>3</sup>

The International Organization for Standardization (ISO) has acknowledged instrumented indentation testing (IIT) as a new alternative method for assessing several mechanical properties, including as hardness, modulus of elasticity, creep, relaxation, and more.<sup>4,5</sup>

Indentation testing with a precisely shaped and force-controlled probe is a common method for studying the mechanical characteristics, including elastic stiffness and hardness, of solid-state materials. As the indenter is inserted and removed from the surface material, the device's high-resolution capacitive gauges and actuators allow it to continuously adjust and monitor the load and displacement.<sup>6</sup>

For the purposes of this experiment, the following definition of the properties of the archwires that will be determined is mentioned below.<sup>7</sup>

1. The ratio of stress to strain inside the elastic limit is known as the elastic modulus (E) and is measured in pounds/inches. This is another name for Young's Modulus.
2. Difficulty with localized plastic deformation caused by mechanical indentation or abrasion is measured by hardness (H).
3. term is the coefficient of friction, which is the ratio of the normal force acting on two surfaces to the frictional force that is opposing their motion.

**Method**

The Nano indenter Facility at the Indian Institute of Technology, Bombay's Department of Metallurgical Engineering & Material Science was the site of the research.

The types of arch wires used as the samples for this study are mentioned in (table.1) with their product/code, manufacturer, cross-section, and composition in weight percentage, diameter and length.

Product/Code	Manufacturer	Cross-section	Type	Composition	Diameter	Length
SE NiTi Trueform™	G&H orthodontics	Round	Conventional super elastic NiTi	Ni% 54.52 Ti% 45.48	0.016inch	20mm
CNA Beta 3 Global	Liberal Traders Pvt.Ltd.	Round	TMA	Ti% 79 Mo% 11 Zr% 6 Sn% 4	0.016inch	20mm
Gummetal®	J.Morita Europe GMBH	Round	TiNb	Ti% 23 Nb% 0.7 Ta% 2 Zr% 1.20	0.016inch	20mm
Niti Thermal Trueform	Liberal Traders Pvt.Ltd.	Round	HANT	Ni% 55 Ti% 45	0.016inch	20mm

**Table:1 commercial name, product/code, manufacturer, cross-section, Type, composition in weight percentage, diameter and length of as received pre-formed orthodontic archwires used in this study**

For precision sectioning of the archwire we used a low-speed oil-cooled diamond saw machine by(IsoMet, Buehler, Lake Bluff,Il). The machinery used to perform the indentation and scratch test to determine the characteristics of the archwire was Hysitron TI Premier Nano indenter, BrukerTM.

**Specimen preparation:** Table :”1 lists all of the orthodontic archwires that were part of this study, together

with their manufacturer codes, cross-sections, commercial names, and weight percentages, diameters, and lengths. A 10-millimeter-long portion was meticulously cut out of each wire sample using a cutting tool (IsoMet, Buehler, Lake Bluff, Il.). The next step was to mount the samples longitudinally in epoxy resin and polish them using normal metallographic methods. After that, they were vibratory polished for 12 hours in a solution of 0.5 µm colloidal silica. The goal was to make sure the surface wasn't too rough.”

**Nanoindentation and Nano scratch measurements:** “A material's "mechanical fingerprint" in response to contact deformation can be obtained by analyzing nanoindentation load-displacement curves. Using a pointed trigonal (Berkovich) indenter, one may obtain both the Young's modulus and the indentation hardness number. To understand the relationship between the indenter displacement, δ, and the applied load, P, the equation  $P = Km\delta^2$  may be utilized for several materials. The Km of a material may be predicted from its hardness (H) and Young's modulus (E). As a result, if we know E, we can use the experimental loading curve to find H. In cases when analyzing unloading curves is not feasible, this approach provides a feasible alternative to finite element modelling as an easily applied methodology. Nano scratch and nano indentation experiments were conducted using the Hysitron TI Premier Nano indenter, which is produced by BrukerTM. We used a load-controlled setting to do the indentation tests. The durations of loading (10 seconds), holding (5 seconds), and emptying (8 mN), in that order, were recorded. A diamond Berkovich probe with a tip radius of 200 nm was used for the studies. Ten indentations were made on each specimen, and the parameters were averaged. It We recorded all force-indentation depth curves according to the ISO 14577-1 standard, and then we calculated the indentation hardness (HIT), indentation modulus (EIT), and percentage of the elastic component of indentation work (ηIT), which is also called the elastic index.”

To assess the wear resistance of the wire Nanoscratch measurements were performed to determine the dynamic friction co-efficient of the material which is a measure of its wear resistance. 5 constant load scratches at 8mN load, each 5 µm in length were performed on each specimen. The diamond Berkovich probe used in these experiments scratches the surface of the specimens at 8mN load for a lateral distance of 5 µm, and quantities like normal load and displacement, lateral load, and displacement are recorded. The co-efficient of friction is found as the ratio between lateral force and normal force. Data from the scratch segments were extracted and analysed. The coefficient of friction for all the scratch segments of each specimen were averaged to determine its coefficient of friction value.

**Result**

Based on the nanoindentation and nano scratch test performed by Hysitron TI Premier Nano indenter, BrukerTM results were derived by implementing the formulas by Oliver-Pharr as stated in the methodology the Vickers Hardness and modulus of elasticity were derived. The mean value of Vickers

Hardness (HVIT) of the sample wires i.e. HANT, NiTi, TMA, Gummetal

- HANT- “the mean hardness(HVIT) = 3.00Gpa with standard deviation  $\pm 0.12$ Gpa”
- NiTi-“the mean hardness(HVIT) =2.64Gpa with standard deviation 0.08Gpa”
- TMA-“the mean hardness(HVIT) =2.81Gpa with standard deviation of 0.09Gpa”
- Gummetal-“the mean hardness(HVIT) =0.08Gpa with standard deviation of 0.18Gpa”

The mean hardness(HVIT) was noted to be highest for HANT at mean value of 3.00Gpa with a standard deviation of  $\pm 0.12$ Gpa. and lowest hardness(HVIT) for Gummetal with the mean reading of 0.84Gpa and standard deviation of  $\pm 0.18$ Gpa (table-2). The mean value of modulus of elasticity (Es) the sample wires i.e. HANT, NiTi, TMA, Gummetal

- HANT- the mean modulus of elasticity (Es)=36.27Gpa with standard deviation of 1.14Gpa
- NiTi-the mean - the mean modulus of elasticity (Es)=38.47Gpa with standard deviation of 2.66Gpa
- TMA-the mean modulus of elasticity (Es)=67.82Gpa with standard deviation of 1.59Gpa.
- Gummetal-the mean modulus of elasticity (Es)=21.43Gpa with standard deviation of 2.21Gpa

The mean modulus of elasticity(Es) was noted to be highest for TMA at the mean value of 67.82Gpa with a standard deviation of  $\pm 1.59$ Gpa and the lowest mean modulus of elasticity was for Gummetal with a mean reading of 21.43Gpa and standard deviation of  $\pm 2.21$ Gpa. For the nano scratch results of HANT, Ni-Ti, TMA and Gum metal, there is variation in co-efficient of friction as a function of the lateral displacement for all the specimens. While Gum metal and TMA showed large variation in co-efficient of friction, where as Ni-Ti and HANT, have nominally constant values.

- HANT-the mean coefficient of friction =0.24 with a standard deviation of 0.12
- NiTi-the mean coefficient of friction=0.29 with a standard deviation of 0.13
- TMA-the mean coefficient of friction =0.42 with a standard deviation of 0.19
- Gummetal- the mean coefficient of friction =0.40 with a standard deviation of 0.19. HANT shows the lowest average coefficient of friction ( $0.24 \pm 0.12$ ), while TMA shows the highest ( $0.42 \pm 0.19$ ).

Gum metal also shows a coefficient of friction of ( $0.40 \pm 0.19$ ). The test readings were statistically analyzed to determine the hardness, modulus of elasticity, and coefficient of friction by ANOVA and Post Hoc Tests

The mean values of the vickers hardness(HVIT) ,modulus of elasticity(Es) and coefficient of friction were compared using a one-way ANOVA test , the results were found to be significant at  $p \leq 0.05$ .Post Hoc test was done for individual comparison for hardness and significant difference at  $p \leq 0.05$  between the four wires

Post Hoc Test				
Dependent Variable			Mean Difference	Sig.
HVIT	HANT	NiTi	0.36	0.000
		TMA	0.19	0.004
		Gummetal	2.17	0.000
	NiTi	HANT	-0.36	0.000
		TMA	-0.17	0.017
		Gummetal	1.80	0.000
	TMA	HANT	-0.19	0.004
		NiTi	0.17	0.017
		Gummetal	1.97	0.000
	Gummetal	HANT	-2.17	0.000
		NiTi	-1.80	0.000
		TMA	-1.97	0.000

Table:2

Post Hoc Test				
Dependent Variable			Mean Difference	Sig.
Es(elastic modulus)	HANT	NiTi	-2.20	0.052
		TMA	-31.55	0.000
		Gummetal	14.83	0.000
	NiTi	HANT	2.20	0.052
		TMA	-29.35	0.000
		Gummetal	17.03	0.000
	TMA	HANT	31.55	0.000
		NiTi	29.35	0.000
		Gummetal	46.38	0.000
	Gummetal	HANT	-14.83	0.000
		NiTi	-17.03	0.000
		TMA	-46.38	0.000

Table 3

Post Hoc test was done for individual comparison for elastic modulus and significant difference at  $p \leq 0.05$  between the four wires i.e. HANT, NiTi, TMA, Gummetal .

Post Hoc Test				
Dependent Variable			Mean Difference	Sig.
Co-Efficient of Friction	HANT	NiTi	-0.05	0.000
		TMA	-0.19	0.000
		Gummetal	-0.16	0.000
	NiTi	HANT	0.05	0.000
		TMA	-0.14	0.000
		Gummetal	-0.11	0.000
	TMA	HANT	0.19	0.000
		NiTi	0.14	0.000
		Gummetal	0.02	0.000
	Gummetal	HANT	0.16	0.000
		NiTi	0.11	0.000
		TMA	-0.02	0.000

Table 4

**Discussion**

Orthodontic therapy begins with the archwire. With the use of brackets and molar tubes, archwires may shift teeth and provide mandatory forces. Numerous cross-sections of archwires are available. Forces are applied by the interaction of wires with orthodontic brackets and molar tubes.

Orthodontists get three-dimensional control over tooth movement during the active phase of treatment by using archwires in multibracket appliances. Because the elastic orthodontic wire applies the required force, teeth may be moved with braces. Its Young Modulus and comparable strength made it the preferred material, soon replacing the more expensive gold-nickel wire. Orthodontia has long made use of wires made of stainless steel (SS) or cobalt chrome (CoCr).

The next phase of orthodontics was inaugurated with nickel-titanium (NiTi) wire in the 1970s. Orthodontic treatment's early phase was made simpler by the material's superelasticity and shape memory. The middle and end stages of orthodontic treatment should not use it since it is nearly hard to bend. Moreover, the 50% nickel content of NiTi alloy may cause an allergic reaction by prompting the body to generate antibodies. Orthodontic wires should not contain any heavy metals, as intended.

For high-stress medical applications like orthodontic and

orthopaedic implants and orthodontic wires, the most important and subsequent category of nickel- and chromium-free alloys is beta-titanium (-Ti) alloys. Orthodontists now have access to titanium-molybdenum (TiMo) wires that are bendable and exhibit properties comparable to CoCr and NiTi alloys. -Ti wires can be used in place of CoCr and SS wires, however they aren't quite as adaptable for uses that call for NiTi alloys.

Finding the perfect orthodontic wire will take more time. For metals and alloys to be suitable for use in biomedicine, they must meet certain criteria, including being biocompatible, non-toxic, and corrosion resistant. In addition to having a high tensile strength, an ideal orthodontic archwire would also be visually beautiful, very elastic, pliable, and easy to bend. For optimal tooth movement, it's also important that the orthodontic force be easily adjustable and that the coefficient of friction be low.

In 2001, Toyota Central RandD, Inc. in Japan created Gummetal, a novel  $\beta$ -Ti alloy with many functionalities. The Metallurgical Research Department. Oxygen, zirconium, tantalum, niobium, and titanium make it up. According to the theory of atomic valence, gum metal's chemical formula is Ti-23Nb-0.7Ta-2Zr-1.2O. To achieve its primary characteristics, this alloy is subjected to extensive cold working. so is quite unusual for an alloy to possess both high strength and very high malleability simultaneously, yet this non-toxic alloy manages to do so with a very low value of Young's modulus, according to the manufacturers. The special quality of this new alloy, according to the producers, is the perfect control over plastic deformation, also known as crystal displacement.<sup>10</sup>

Hasegawa65 claims that gummetal is practically perfect for use as an orthodontic archwire. Initially, this should cause the obstruction to be processed with a little continuous force. Gummetal can decrease orthodontic force even with big tooth movements since it does not follow Hooke's Law.

This study aimed to evaluate the hardness, modulus of elasticity, and surface roughness (i.e. coefficient of friction) of a novel  $\gamma$ -Ti archwire (gummetal) by conducting nanoindentation and nano scratch tests, and then comparing the results with those of NiTi, HANT, and TMA that were of comparable size and cross-section.

The Bruker™ Hysitron TI Premier Nano indenter was used to perform the nanoscratch and nanoindentation experiments. By pressing an indenter into a material's surface and then photographing the resulting imprint, the indentation technique may be utilized to evaluate the material's mechanical characteristics. Initially, the hardness could be ascertained by means of the indentation test. The examined material is pressed into form using a hard, precisely sized device called an indenter, and then released. The connection between total indentation load and displacement or area allows one to calculate the hardness of the tested material.

We conducted the indentation testing in a loadcontrolled environment. A loading duration of 10 seconds, a holding time of 5 seconds, and an unloading time of 10 seconds were utilized, with a maximum load of 8 mN. The investigations



were conducted using a 200 nm tip radius diamond Berkovich probe. We averaged the parameters measured from 10 indents on each specimen, which included SE NiTi Trueform<sup>TM</sup>, CNA Beta 3 Global, Gummetal<sup>R</sup>, and Niti Thermal Trueform. Oliver-Pharr determined the hardness and elastic modulus using the following formulas.

Coefficient of friction, hardness (HVIT), and elastic modulus (Es) were calculated using the given formulae.

Examining the nanoindentation-based elastic moduli (Es) of each wire.

The findings demonstrated that TMA had the greatest mean elastic modulus at 67.82 Gpa with a standard deviation (SD) of 1.59 Gpa, compared to gummetal's lowest value of 21.43 Gpa and SD of 2.21 Gpa. Results from a comparable study by Laino et al. (2012) and Murakami et al. (2015) using a 3-point bending test showed that gummetal had the lowest elastic modulus and TMA had the highest. Our findings corroborated their findings.

Evaluation of All Wires' Hardness (HVIT) via Nanoindentation

With a mean hardness of 0.84Gpa and a standard deviation of 0.018Gpa, gummetal produced the softest material compared to HANT, NiTi, and TMA. Similar studies were conducted by Zinelis.S et.al.<sup>58</sup> Murakami et al., and Suzuki et al.<sup>14,15</sup> where they evaluated the bending strength of Gummetal, TMA & Niti they concluded in their study that gummetal showed the lowest stiffness, followed by NiTi, and TMA wire showed to be the hardest as compared to the other two wires, the present study shows similar outcome, though the method of testing done by Murakami et al., and Suzuki et al.<sup>14,15</sup> was different from that of nanoindentation test the outcome of the results was same but with different values, while Zinelis.S et.al.<sup>9</sup> used similar indentation method in their study using TMA and NiTi wires, the results of this study were in agreement with the results of their study stating hardness of TMA being more than NiTi.

Comparison of the coefficient of friction of all the wires in this study.

HANT showed the lowest coefficient of friction with mean 0.24 and a standard deviation (SD) of 0.12, followed by NiTi with mean of 0.29 and SD of 0.13, with Gummetal showing a higher coefficient of friction when compared to NiTi and HANT with mean 0.40 and SD of 0.19 while TMA showed the highest amongst all with mean 0.42 and SD of 0.19. the coefficient of friction of given wires in this study was determined between the diamond Berkovich probe used in Hysitron TI Premier Nano indenter, Bruker<sup>TM</sup> while most of the studies for the coefficient of friction carried out by others were between the orthodontic archwires and several orthodontic bracket systems. A study done by Megumi Tagada et.al.<sup>8</sup> in 2018 determined frictional force (FF) NiTi, TMA & Gummetal(TiNb) and found that the FF of TMA was the highest in relation to the stainless steel bracket system.

Abdullah Albawardi et.al.<sup>16</sup> in 2022 compared the coefficient of friction of Gummetal, TMA, SS, and rhodium-plated aesthetic Gummetal(E-GM) they observed that TMA

archwire produced the highest coefficient of friction when compared with other wires.

Schmeidl K et.al.<sup>62</sup> in the year 2021 evaluated the frictional properties of Gummetal (TiNb), nickel-titanium NiTi, and Titanium-molybdenum (TiMo) they found that TiMo showed the highest friction force but Gummetal showed similar frictional resistance as NiTi. The results obtained by present study, the friction force of TMA was greater than Gummetal, is in accordance with the results obtained by previous researchers Megumi Tagada et.al.<sup>8</sup>, Abdullah Albawardi et.al.<sup>16</sup>

### Conclusion

On the basis of the data derived from this study, it was found that the average coefficient of friction for Gummetal is lower than TMA while it is significantly much higher than HANT and NiTi.

Such an ability of the material makes it a good candidate for orthodontic wires during leveling and aligning stage i.e. the initial phase of the fixed orthodontic treatment only in scenarios where the patient is allergic to nickel and conventional NiTi or HANT wires can't be used and can be a good replacement of TMA since the coefficient of friction of the gummetal is much lower than that of TMA.

However further research needs to be done on this particular property of the wire, friction is orthodontic remains for open debate. The current methodology employed in the study for friction is inadequate and does not simulate the oral environment. So only improved methodology and further study can shed more light on the topic

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# Guidelines For Surgical Procedures Conducive To Bone Grafting

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The mechanism of periodontal regeneration is still a mysterious and intricate occurrence. In the modern era of dentistry, bone grafting has become an invaluable clinical treatment for a range of reconstructive uses. Various regeneration treatment approaches have been utilized and implemented in clinical settings throughout the past ten years. It is commonly known that the results of periodontal regeneration operations are improved by bone transplants and bone substitutes. Periodontists currently prefer using bone as a grafting material since it has demonstrated clinical efficacy, functional periodontal repair, filling of visible bone defects, and pocket reduction to acceptable levels. Particulate grafts have primarily been applied to treat small bone defects like fenestrations and dehiscence. Particulate grafting has a success rate ranging from 85.7% to 100% and very few problems. When autografts were paired with xenografts, HA, or homologous bone, a higher success rate was noted.

According to Brunel et al. and Pieri et al.,<sup>1,2</sup> grafts are not used in the following cases:

- ✓ Patients who smoke more than ten cigarettes a day;
- ✓ Patients with severe liver or kidney disease;
- ✓ Patients who have previously received head and neck radiation therapy;
- ✓ Patients who are uncontrolled diabetics;
- ✓ Patients who have active periodontal disease in the residual dentition;
- ✓ Patients who have autoimmune or inflammatory disorders of the oral mucosa;
- ✓ Noncompliant patients; and any other medical condition that contraindicates oral surgery when the anatomic factors are unfavourable.

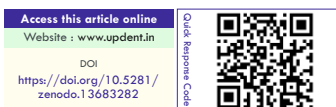
Indications of Bone Grafts:<sup>3,4</sup>

1. Bone Defects;
  - Two-walled and three-walled deep intraosseous defects,
  - Retention of teeth that may need more bony support,
  - Augmentation of bone support for abutment teeth,
  - Bone abnormalities linked to juvenile periodontitis
  - Defects in furcation: Grade II, III
  - Ridge enhancement Regrowing bone surrounding the implants
  - Bone deficiency at the donor site.

Many attempts have been made to regenerate periodontal defects, including intrabony and furcation defects. Many clinicians support the use of DFDBA owing to its faster release of growth factors which promotes better periodontal regeneration. DFDBA may also be combined with other additional regenerative materials like enamel Matrix derivatives or PRF. DFDBA may also be combined with FDBA in a ratio of 70/ 30 to provide some additional stability of the graft while maintaining the core protein release potential from the DFDBA.

2. Sinus Augmentation: Sinus is one of the most challenging areas to regenerate. To overcome this many clinicians have advocated using PRF in combination with graft procedure. Clinicians have recommended using a combination of FDBA and a non resorbable xenograft for sinus augmentation procedure, typically done in a ratio of 1:1 .  
Clinical Goals of Bone Grafting for Periodontal Regeneration:  
Patients with periodontitis should aim for the following results from bone

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grafting procedures:

1. Bone fill of the osseous defect
2. Gain in clinical attachment
3. Probing depth reduction
4. New bone, cementum, and periodontal ligament regeneration

What Are the Perfect Features of a Bone Graft?

- ✓ Nontoxic to the human body
- ✓ Should not provoke an inflammatory response
- ✓ Should be able to withstand infection
- ✓ Should not lead to Ankylosis or root resorption
- ✓ Should be strong and resilient
- ✓ Should be Easily mouldable
- ✓ Easily and sufficiently available
- ✓ Should require a minimal surgical technique.
- ✓ Encourages the formation of new attachment

Requirements for a Successful Graft: When doing bone grafts for periodontal regeneration, the following surgical factors are crucial:

**Patient Selection**

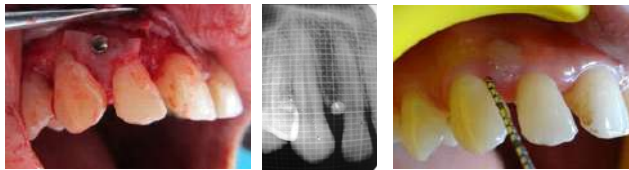
When it comes to the application and outcome of regenerative medicine, especially bone grafting, careful consideration of the patient is very crucial. The patient needs to show that they are highly motivated and capable of doing daily plaque removal. To maintain their periodontal health, patients must also demonstrate a dedication to keeping the frequently drawn-out and demanding sessions. During these, the patient's progress is assessed using a plaque index assessment and baseline records. The patient's emotional state, habits (especially smoking), and capacity for long dental visits are other issues that need to be taken into account.

**Selection of Materials**

Matching a defect's outlines to the right treatment is crucial for any augmentation or regenerative procedure. For example, a graft's chance of success increases with the number of bone walls present in the defect site. Choosing a treatment for a defect that won't respond well to the surgery is a major cause of failures. Generally speaking, the greater the defect, the more crucial it is to use autogenous bone since it offers the highest possible levels of cellularity and structure for the formation of new bone. For a variety of reasons, cancellous bone is preferred over cortical bone when using autografts or allografts. Revascularization occurs more quickly with cancellous grafts, which increases the likelihood of preserving more osteogenic cell



**Bone grafting in a furcation defect**



**Bone Grafting with tacks:**

1. Postoperative Care: Provide detailed postoperative instructions to the patient, including oral hygiene measures, dietary restrictions, and medication use (e.g., analgesics, antimicrobials). Schedule follow-up appointments to monitor healing progress and assess the need for any additional interventions.
2. Complications Management: Educate the patient about potential complications such as infection, graft failure, or excessive postoperative pain. Monitor the patient closely for any signs of complications and intervene promptly if necessary.



3. Long-term Maintenance: Emphasize the importance of long-term periodontal maintenance to preserve the results of bone grafting surgery. Regular monitoring and professional cleanings are essential to prevent disease recurrence and maintain periodontal health.
  4. Patient Education: Educate the patient about the rationale behind bone grafting surgery, expected outcomes, and realistic expectations regarding the treatment outcome and timeline for healing.
  5. Collaboration with Specialists: In complex cases, collaborate with other dental specialists such as oral surgeons or prosthodontists to optimize treatment outcomes and provide comprehensive care for the patient.
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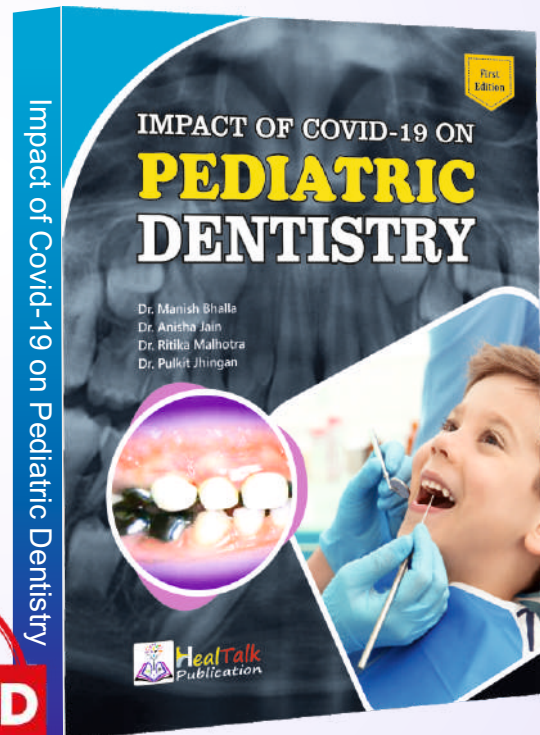
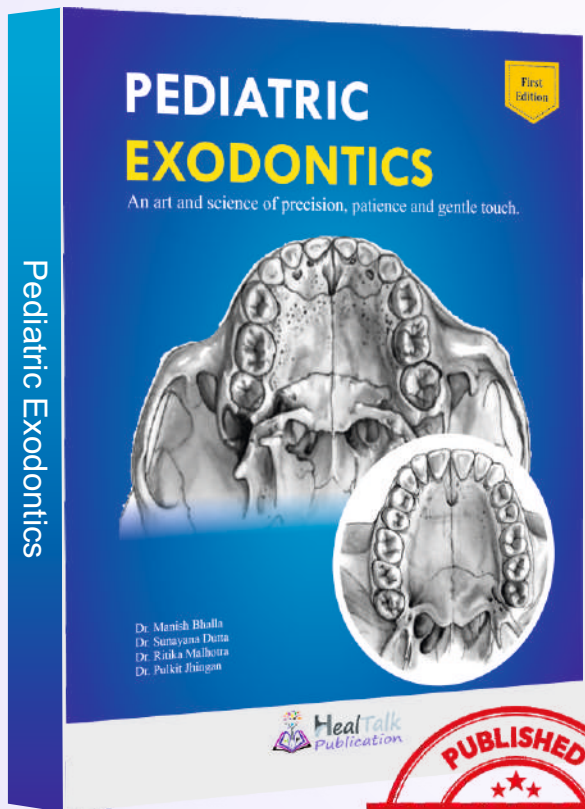


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