ISSN 2395-6844

National Research Denticon

An Official Publication of
Rajasthan University of Health Scieces, Jaipur

Issue: Vol. 13, No.2 Apr to Jun 2024

INDEX

Optimizing Single Tooth Replacement: A Clinical and Radiological Evaluation of Basal Bi-cortical Screws Implants

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Abstract

Objective: To evaluate the clinical and radiological outcomes of single tooth replacement using basal bicortical screws implants, focusing on primary stability, postoperative comfort, and patient satisfaction.

Methods: Twenty-five patients received BBS implants, with outcomes measured by insertion torque, periapical radiolucency, infection rates, implant mobility, and patient satisfaction using a Visual Analogue Scale and satisfaction surveys.

Results: A high rate of primary stability was observed with 64% of implants, low postoperative pain scores, and zero incidences of radiolucency, infection, or implant mobility. Variable patient satisfaction rates emphasized the importance of individualized care.

Conclusion: BBS implants are effective for single tooth replacement with excellent primary stability and minimal discomfort. However, patient satisfaction is varied, indicating a need for tailored patient care.

Categories: Dentistry
Keywords: Basal bicortical screws, post-extraction implant placement**,** Immediate functional loading**,** initial stability, clinical and radiological assessment

INTRODUCTION

Basal implantology has become a cornerstone in modern dental medicine, offering innovative solutions for patients with limited dental restoration options. This field has seen a significant shift, with a growing body of research dedicated to evaluating its effectiveness and longevity. The aim is to amalgamate these scholarly contributions to present an exhaustive overview of the progress and current status of basal implantology.

Contemporary dentistry strives to reinstate oral health to its natural state, addressing not just the functional and structural aspects but also considering aesthetic, phonetic, and psychosocial factors. The quest for knowledge, alongside advancements in diagnostic tools, implant designs, biomaterials, and surgical techniques, has greatly improved our capacity to manage intricate dental conditions[1].

The maxillary bone, especially in the dentate area, poses distinct challenges due to its varying density, which impacts implant-bone contact and the distribution of occlusal forces. Studies over the past twenty years have shown that factors such as implant length, bone quality, and individual patient factors like smoking and radiation exposure significantly influence implant survival rates. Choosing the right system is crucial for the biomechanical optimization of dental implants. Root form and basal implants, both essential to endosseous dental rehabilitation, differ in their insertion protocols, biomechanical load distribution, and clinical indications based on available bone anatomy. Root form implants are typically used when there is sufficient vertical bone height, while basal implants are beneficial in cases with compromised bone quality due to their engagement with the denser cortical bone.

Basal implantology is a distinct branch of implant dentistry, known for its wide-ranging indications and minimal constraints. The 'dual-integration' concept—initial and primary load transmission to the cortical bone followed by progressive osseointegration—highlights the body's incredible ability to adapt and heal[2].

In the pursuit of dental restoration, achieving a stable and retentive smile is crucial for edentulous patients. The introduction of endosseous implants has transformed prosthodontic therapy, with both crestal and basal implants playing key roles in providing osseointegrated support for dentures. The differences between these implant types extend beyond their surgical insertion and biomechanical functions, affecting prosthodontic planning, execution, and postoperative care[3].

The inherent strength and stability of the basal bone make it an excellent foundation for implant retention, offering a lasting solution for dental restoration. The evolution of basal implant systems, from the early work of Dr. Jean-Marc Julliet to the innovations by Dr. Gerard Scortecci, has led to the development of BCS implants. These implants are sophisticated, minimally invasive, and designed for immediate interaction with the cortical bone, representing a significant advancement in the field[4].

MATERIALS AND METHODS

Basal Bicortical Screw Implants: Revolutionizing Single Tooth Replacement

In the landscape of dental medicine, the advent of basal bicortical screw implants has marked a significant milestone, particularly in the realm of single tooth replacement. These implants stand out as a reliable and consistent option, offering a beacon of hope for patients who previously faced limited choices due to inadequate bone quality or quantity. The importance of meticulous clinical and radiological evaluation cannot be overstated, as it ensures that patients receive a treatment that is not only durable but also harmonizes with the intricate anatomy of the oral cavity. 25 BBSI system of basal implants were placed and evaluated clinical and radiologically for better outcome.

Clinical and Radiological Evaluation: A Pillar of Success

The evaluation process serves multiple critical functions. Firstly, it ascertains the suitability of basal bicortical screw implants, ensuring that the treatment outcome is effective and long-lasting. Secondly, it allows for the preservation of the

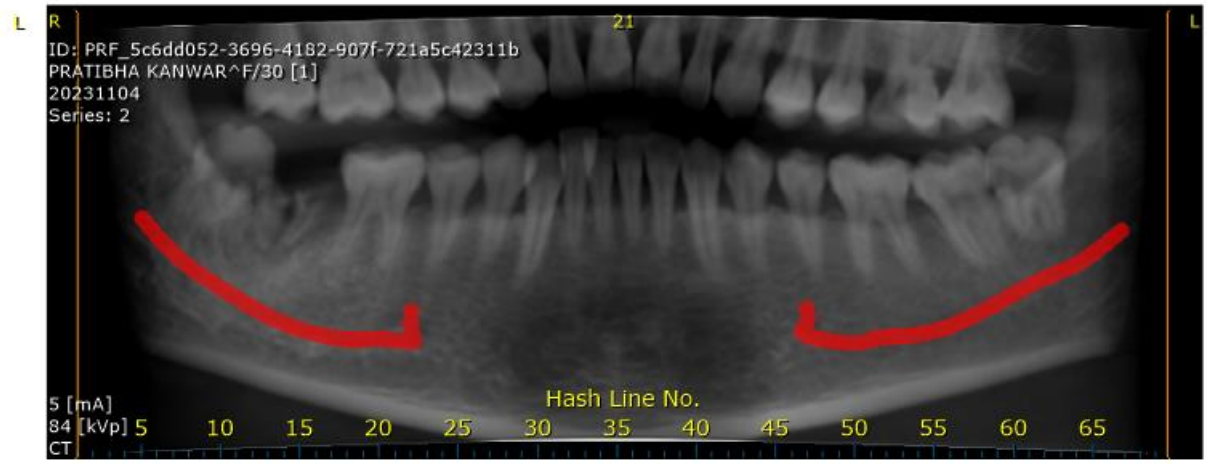
integrity of neighbouring teeth by negating the need for bridge supports. Thirdly, the health of the jawbone is of paramount importance; these implants leverage the jaw's basal cortical bone for stability and optimal load distribution. Radiological assessment is instrumental in confirming that the implants are positioned in the appropriate bone areas, fostering long-term bone preservation. Lastly, the aesthetic dimension is not overlooked; the evaluation aids in planning the position, alignment, and colour-matching of the implant, striving for an optimal aesthetic result that aligns with patient satisfaction.

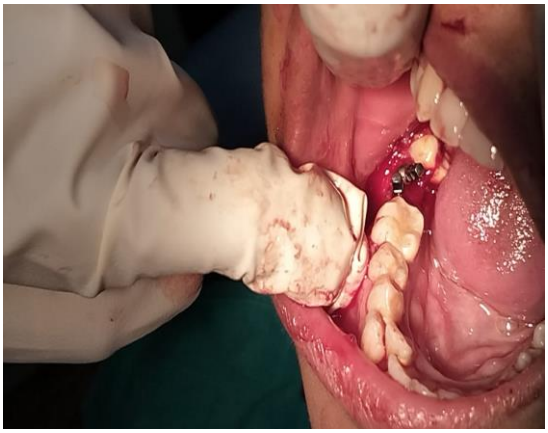
Study Design: A Methodical Approach

The study's design was meticulously crafted to encompass a comprehensive evaluation of the patients requiring single tooth replacement. Detailed medical histories were collected, and informed consent was obtained, ensuring that participants were fully aware of the study's purpose, risks, and benefits. The maxillofacial region was thoroughly assessed, focusing on bone quality, soft tissue health, and occlusion. Radiographic analysis, including pre- and post-operative imaging (CBCT, OPG, IOPA), provided a three-dimensional understanding of the implant sites and facilitated the evaluation of outcomes. Clinical photography documented the edentulous area and surrounding tissues, capturing standardized images from various angles.

Surgical Protocol: Precision and Care

The surgical intervention followed a protocol that emphasized precision and patient care. Pre-surgical planning was informed by the radiographic findings, and the surgery was conducted under strict sterilization standards. Post-operative analysis was integral to the study, monitoring implant stability and healing over time through follow-up radiographs and examinations. (fig)





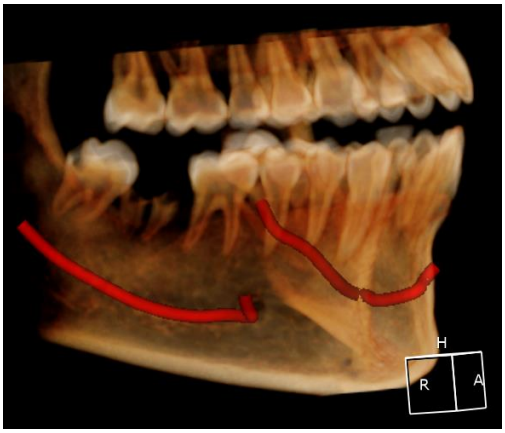


Figure: single tooth replacement with BBSI wrt 37.

Variables: Measuring Success

Several variables were considered to measure the success of the implant placement. The duration of the surgery, the patient's pain experience, the torque values for primary stability, the presence or absence of infection, and the evaluation of post-operative mobility were all meticulously recorded. Patient satisfaction levels were also gauged, providing a holistic view of the treatment's efficacy.

Assessment Methods: The data obtained was subjected to statistical analysis. The data recorded were transferred and tabulated to the computer - Windows Microsoft Excel (2007) - for the purpose of the data analysis. Statistical Package of Social Science (SPSS Version 20; IBM Chicago Inc., USA) was used for statistical analysis. The total data was subdivided and distributed meaningfully and presented as individual tables along with graphs. The significance level was fixed to be $p \leq 0.05$ for the analysis.

Depending upon the nature of the data, the statistical tests were chosen. Categorical data expressed in terms of frequency were analyzed for statistical significance using Chi square test. All continuous data were subjected to Kolmogorov Smirnov test for normality. It was found that the data was normally distributed ($p > 0.05$) and hence parametric tests of significance were used. ANOVA was used to analyze the difference in the means of continuous variables. For all comparisons, p value of < 0.05 was considered to be statistically significant.

Results: The data obtained was subjected to statistical analysis. The data recorded were transferred and tabulated to the computer - Windows Microsoft Excel (2007) - for the purpose of the data analysis. Statistical Package of Social Science (SPSS Version 20; IBM Chicago Inc., USA) was used for statistical analysis. The total data was subdivided and distributed meaningfully and presented as individual tables along with graphs. The significance level was fixed to be $p \leq 0.05$ for the analysis.Depending upon the nature of the data, the statistical tests were chosen. Categorical data expressed in terms of frequency were analyzed for statistical significance using Chi square test. All continuous data were subjected to Kolmogorov Smirnov test for normality. It was found that the data was normally distributed ($p > 0.05$) and hence parametric tests of significance were used.

Table 7 : Comparative evaluation of the Insertion Torque

Based on the Insertion Torque						
Tooth Replaced	Counts	Low insertion torque/moderate primary stability (Less than 40)	High insertion torque/sufficient primary stability (40-50)	Very high insertion torque/excellent primary stability (Greater than 50)	Chi Square	p Value
11	3	1(50.0%)	1(6.2%)	1(14.3%)	21.168	0.733
12	3	1(50.0%)	2(12.5%)	0(.0%)		
17	1	0(.0%)	1(6.2%)	0(.0%)		
21	1	0(.0%)	1(6.2%)	0(.0%)		
22	2	0(.0%)	2(12.5%)	0(.0%)		
23	1	0(.0%)	0(.0%)	1(14.3%)		
31	4	0(.0%)	4(25.0%)	0(.0%)		
32	1	0(.0%)	1(6.2%)	0(.0%)		
33	2	0(.0%)	1(6.2%)	1(14.3%)		
41	1	0(.0%)	0(.0%)	1(14.3%)		
42	2	0(.0%)	1(6.2%)	1(14.3%)		
43	2	0(.0%)	1(6.2%)	1(14.3%)		
45	1	0(.0%)	0(.0%)	1(14.3%)		
47	1	0(.0%)	1(6.2%)	0(.0%)		

% Based on the Categorized Insertion Torque

Table 8: Comparative evaluation of the means of periapical radiolucency/infection and mobility and patient satisfaction

Based on the Periapical Radiolucency/ Infection and Mobility					
Tooth Replaced	Counts	Periapical Radiolucency/ Infection	Mobility	Chi Square	p Value
11	3	3(12.0%)	3(12.0%)	NA	NA
12	3	3(12.0%)	3(12.0%)		
17	1	1(4.0%)	1(4.0%)		
21	1	1(4.0%)	1(4.0%)		
22	2	2(8.0%)	2(8.0%)		
23	1	1(4.0%)	1(4.0%)		
31	4	4(16.0%)	4(16.0%)		
32	1	1(4.0%)	1(4.0%)		
33	2	2(8.0%)	2(8.0%)		
41	1	1(4.0%)	1(4.0%)		
42	2	2(8.0%)	2(8.0%)		
43	2	2(8.0%)	2(8.0%)		
45	1	1(4.0%)	1(4.0%)		
47	1	1(4.0%)	1(4.0%)		

%

Based on the Categorized Periapical Radiolucency / Infection and Mobility ; NA - Not Applicable

Based on the Patient Satisfaction						
Tooth Replaced	Counts	Very dissatisfied	Dissatisfied	Satisfied	Chi Square	p Value
11	3	0(.0%)	3(23.1%)	0(.0%)	29.879	.273
12	3	1(33.3%)	1(7.7%)	1(11.1%)		
17	1	1(33.3%)	0(.0%)	0(.0%)		
21	1	0(.0%)	0(.0%)	1(11.1%)		
22	2	1(33.3%)	0(.0%)	1(11.1%)		
23	1	0(.0%)	1(7.7%)	0(.0%)		
31	4	0(.0%)	3(23.1%)	1(11.1%)		
32	1	0(.0%)	1(7.7%)	0(.0%)		
33	2	0(.0%)	0(.0%)	2(22.2%)		
41	1	0(.0%)	1(7.7%)	0(.0%)		
42	2	0(.0%)	1(7.7%)	1(11.1%)		
43	2	0(.0%)	2(15.4%)	0(.0%)		
45	1	0(.0%)	0(.0%)	1(11.1%)		
47	1	0(.0%)	0(.0%)	1(11.1%)		

% Based on the Categorized Patient Satisfaction

Table 9 : Comparative evaluation of the means of the Duration Of surgery & Insertion Torque

Based on the Duration Of surgery (mins)										
Parameters	Tooth Replaced	Counts	Mean	Std. Deviation	Std. Error of Mean	Minimum	Maximum	Median	Range	ANOVA (p Value)
Duration Of surgery	11	3	45	13.22876	7.637626	30	55	50	25	.379
	12	3	46.66667	11.54701	6.666667	40	60	40	20	
	17	1	55	.	.	55	55	55	0	
	21	1	50	.	.	50	50	50	0	
	22	2	35	7.071068	5	30	40	35	10	
	23	1	50	.	.	50	50	50	0	
	31	4	41.25	4.787136	2.393568	35	45	42.5	10	
	32	1	45	.	.	45	45	45	0	
	33	2	37.5	10.6066	7.5	30	45	37.5	15	
	41	1	35	.	.	35	35	35	0	
	42	2	32.5	3.535534	2.5	30	35	32.5	5	
	43	2	40	0	0	40	40	40	0	
	45	1	55	.	.	55	55	55	0	
	47	1	60	.	.	60	60	60	0	

Based on the Insertion Torque wrench values (Ncm)										
Parameters	Tooth Replaced	Counts	Mean	Std. Deviation	Std. Error of Mean	Minimum	Maximum	Median	Range	ANOVA (p Value)
Insertion Torque	11	3	45	15	8.660254	30	60	45	30	.988
	12	3	45	8.660254	5	35	50	50	15	
	17	1	40	.	.	40	40	40	0	
	21	1	45	.	.	45	45	45	0	
	22	2	45	7.071068	5	40	50	45	10	
	23	1	55	.	.	55	55	55	0	
	31	4	48.75	4.787136	2.393568	45	55	47.5	10	
	32	1	50	.	.	50	50	50	0	
	33	2	47.5	10.6066	7.5	40	55	47.5	15	
	41	1	55	.	.	55	55	55	0	
	42	2	50	14.14214	10	40	60	50	20	
	43	2	52.5	10.6066	7.5	45	60	52.5	15	
	45	1	60	.	.	60	60	60	0	
	47	1	45	.	.	45	45	45	0	

Insertion Torque Stability

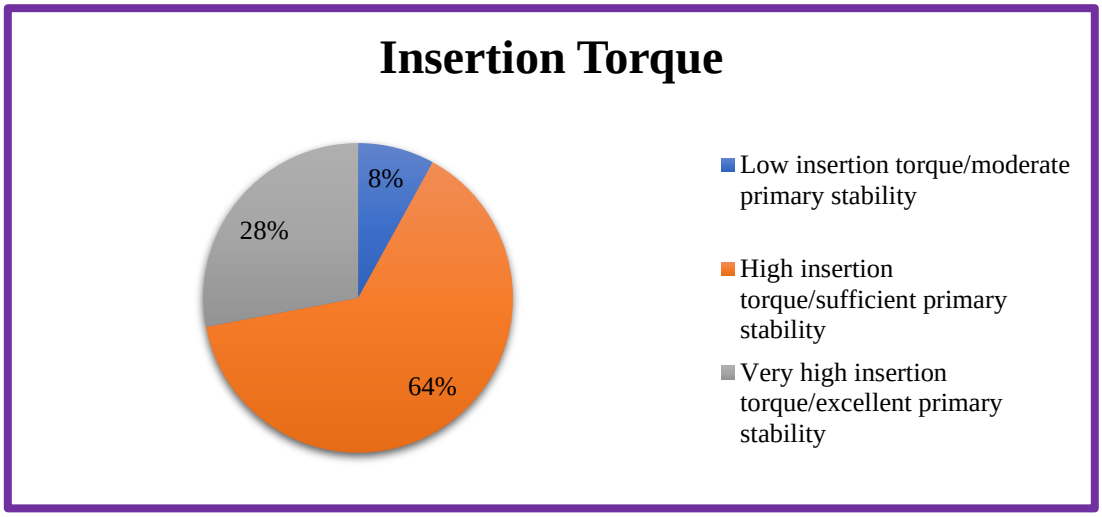
The success of a dental implant is often predicted by its primary stability, which is measured by the insertion torque. In our study, we found that a majority of the implants (64%) achieved high insertion torque values between 40-50 Ncm. This suggests that these implants had sufficient primary stability, which is a positive indicator for successful osseointegration. Furthermore, 28% of the implants demonstrated very high insertion torque values over 50 Ncm, indicative of excellent primary stability. Only a small fraction of implants (8%) were associated with lower insertion torque values under 40 Ncm, signaling moderate primary stability. This distribution indicates that most implants placed achieved a level of torque considered conducive to successful osseointegration.

Pain Assessment

Postoperative pain was measured using the Visual Analogue Scale (VAS). The results were quite promising, with the vast majority of patients (88%) experiencing only mild pain (VAS score 1-3). A smaller subset of patients (12%) reported no pain post-surgery. These findings suggest that the implant placement procedure associated with basal bicortical screws is generally well tolerated by patients, contributing to a more positive overall experience.

Periapical Radiolucency/Infection and Implant Mobility

Critical indicators of implant success include the absence of signs of infection and implant mobility. Our study showed an encouraging outcome in this regard, with none of the patients exhibiting periapical radiolucency or signs of infection in follow-up radiographs done at period of 1st and 3rd month. Additionally, there was no reported postoperative mobility in any of the implants. This suggests a high level of stability and successful integration of the implants within the oral environment, which is crucial for long-term success and patient comfort.



Patient Satisfaction

Patient satisfaction is a multifaceted metric that reflects the success of dental treatments. In our assessment, while 36% of patients expressed satisfaction with their implants, a significant number (64%) expressed some level of dissatisfaction. This emphasizes the importance of setting realistic expectations and the need for tailored treatment plans to improve patient satisfaction rates in dental implantology. It's a reminder that while clinical success is important, the patient's perception of success is equally vital.

Surgical Duration and Efficiency

The time efficiency of the surgery was evaluated, and the mean duration of the dental implant surgeries was 43.2 minutes. Surgery times showed some variability, with a standard deviation of 9.34 minutes. The minimum and maximum durations of surgery were 30 minutes and 60 minutes, respectively. This data provides valuable insights into the efficiency of the surgical procedure and can be used to further optimize the process for better patient experience and outcomes.

This study provides valuable insights into the clinical and radiological outcomes of single tooth replacement with basal bicortical screws implants. The findings underscore the importance of several factors in the success of dental implants, including insertion torque stability, pain management, infection control, implant mobility, patient satisfaction, and surgical efficiency. our study demonstrated that the surgical procedure for single tooth replacement using basal bicortical screws is relatively consistent in terms of surgical duration and insertion torque, regardless of the tooth replaced. Additionally, most patients experience only mild pain postoperatively, suggesting effective pain management protocols. The clinical implications of these results indicate that surgeons can expect predictable surgical times and torque values when placing basal bicortical screws for single tooth implants, contributing to efficient surgical planning and positive patient outcomes. Future research should aim to build on these findings to further improve outcomes and patient satisfaction in dental implantology.

DISCUSSION

Implants are frequently used as a treatment choice for partially or fully toothless patients. **Branemark**[1] was the first to describe the use of dental implants for prosthetic rehabilitation, reporting an 81% survival rate for maxillary arches and 100% for mandibular arches. The success of implants is closely tied to the osseointegration process, which has seen improvements in recent years due to enhanced implant design and surface topography. **Dr. Jean-Marc Julliet** developed the initial single-piece implant, later improved by **Dr. Gerard Scortecci**[9] Furthermore, **Dr. Stefan Ihde** adapted lateral basal implants into screwable bi-cortical ones.

Yadav et al.[4] defined basal implantology—also referred to as bi-cortical implantology—as a contemporary system that utilizes cortical bone areas following orthopaedic surgery principles, leading to what can be termed "orthopaedic implants." According to **Nair C Bharathi S**[5], two types of basal screws—basal osseointegrated [BOI]

and Basal Cortical Screw [BCS], designed specifically for utilizing cortical bone—provide good primary stability. A special type involves using 12mm thread diameter screwable implants placed into freshly extracted tooth sockets. Dental implants are often used to replace missing teeth in order to preserve the alveolar bone. Endosteal implants according to **Zarb G Schmitt A, (1996**)[30] can help maintain bone width and height as long as they remain healthy.

Basal bone, which forms the dental skeletal structure, is resistant to resorption and serves as a stress-bearing portion of the jaws due to its muscle attachments.

The design of basal bicortical screw implants allows them to anchor in the 2nd cortical bone, providing excellent primary stability along the vertical surface without requiring corticalization. Studies by **Dos Santos, (2011)[21]** and **Seeman and Delmas (2006)[32]** have shown that implant stability is influenced by factors such as bone quality at the site, implant geometry, drilling sequence, and bone density - which primarily determines strength and stability. A retrospective study by **Narang et al, (2016)[22]** on immediately loaded single-piece implants demonstrated a high cumulative survival rate of 95.7% over an average observation period of 18.93±8·41 months. This success highlights how anchoring basal implants in the 2nd cortical bone through Osseo fixation allows for functional loading in edentulous jaws compared to traditional crestal implants.

Visual Analogue Scales have been used widely and effectively in psychological medicine as clinical and research tools. Although they have been used largely to measure subjective experiences, they have also been used for behavioural measurement. Most VAS described in the literature are designed for self-assessment; however, several studies have also used them for observer rating, and have reported significant levels of inter-rater reliability when used in this way, **Heather M. Mccormack, (1988)[54].**

A retrospective literature review study by **Greenstein G(2017) et al[55].** on the effects of minimum and maximum forces that can be used to successfully place implants. The minimum torque that can be employed to attain primary stability is undefined. Forces ≥30 Ncm are routinely used to place implants into healed ridges and fresh extraction sockets prior to immediate loading of implants. Increased insertion torque (≥50 Ncm) reduces micromotion and does not appear to damage bone. In general, the healing process after implant insertion provides a degree of biologic stability that is similar whether implants are placed with high or low initial insertion torque. Primary stability is desirable when placing implants, but the absence of micromotion is what facilitates predictable implant osseointegration. Increased insertion torque helps achieve primary stability by reducing implant micromotion.

After reviewing several studies **Anita Gala Doshi (2023)[44] et al.** concluded Basal implants allow for immediate loading and osseofixation. The immediate loading of basal implants reduces the treatment time and cost for patients and allows for immediate function. The immediate loading also reduces the risk of implant failure and bone loss. Immediate loading has several advantages over delayed loading, which is the traditional approach where a crown or bridge is placed on the implant several months after placement to allow for osseointegration. One of the main advantages of immediate loading is that it reduces the treatment time for the patient. Patients can receive their new teeth on the same day as implant placement, which is a significant improvement over traditional implants that require several months of healing before the final restoration can be placed.

A recent study by **H. Gosai et al. (2021)[42]** has provided evidence supporting the efficacy of these implants. The research indicates that after the placement of basal bicortical screw implants, there was an absence of peri-implant radiolucency and mobility seen during the time of final prosthesis delivery and upon follow up period, which are key indicators of implant stability and osseointegration.

Single tooth replacement with basal bicortical screw implants, patient satisfaction is particularly important. A study by **Fadia Awadalkreem et al(2020)[56]** found that patients' general satisfaction with basal implants was very high. The satisfaction covered various aspects such as comfort, mastication, speech, and aesthetics, all of which significantly improved with the new basal implants. Even in cases where patients had

complaints, they still expressed high satisfaction and would choose the same treatment modality again.

In our present study of placement of 25 BCS implants immediately in freshly extracted teeth socket and with immediate loading within 72 hours of implant placement shows a synthesis of the clinical and radiological data acquired through meticulous research. The statistical analysis, leveraging the robust capabilities of SPSS Version 20, has provided a comprehensive understanding of the efficacy and outcomes associated with basal bicortical screws implants. According study done by **H. Gosai et al. (2021)[42]** it is stated that there is a limited role for variously treated implant surfaces for immediate loading protocol , as in 72 h, the bone neither heals nor integrates with the implant devices. The basal implants and internal fixation devices of traumatology are considered "osseofixated" in stable cortical bone with almost no metabolism. Secondary osseointegration would occur later into the endosseous parts of the implants contacting cancellous bone.

Primary Stability and Insertion Torque: Our study delved into the critical aspect of primary stability of dental implants, a cornerstone for successful osseointegration. We measured the insertion torque to assess this stability. A promising 64% of the implants showcased high insertion torque values, a clear indication of adequate primary stability. This is a strong testament to the precision and dependability of the surgical techniques we employed. Moreover, 28% of the implants displayed very high insertion torque, signifying exceptional primary stability and hinting at a positive prognosis for enduring success. A small fraction (8%) fell into the moderate primary stability category, which is still within the clinically acceptable limits.

When we compared the insertion torque values across various teeth replacements, we found a uniform distribution of these values. Interestingly, there was no significant difference in the mean values (ANOVA p-value: .968). The range of these values, from 0 to 30 Ncm, mirrors the individual variability in the surgical procedure and patient anatomy. The standard deviation and standard error values suggest that while there is some variability in insertion torque, it falls within an acceptable range for clinical practice. These findings underscore the consistency in achieving the desired torque values, a critical factor for the immediate stability and long-term success of dental implants. The data supports the conclusion that the type of tooth replaced does not significantly impact the ability to achieve optimal insertion torque during implant surgery.

Pain Perception and Patient Experience: We also evaluated the postoperative experience using the Visual Analogue Scale (VAS). The results were encouraging, with the majority of patients (88%) reporting only mild pain. This underscores the effectiveness of our pain management protocols and aligns with our overarching goal of patient-centred care, where minimizing discomfort is paramount. The mean score of 1.72 is indicative of successful pain management strategies. The low standard deviation and error of the mean suggest that the experience of pain is consistently managed across the patient population. Our comparative evaluation of pain levels using the VAS scale indicates that most patients experience low to moderate pain following dental implant surgery, with mean scores ranging from 0 to 3. The lack of significant variation in pain scores across different teeth (ANOVA p-value: .084) suggests that the type of tooth replaced does not significantly affect the patient's postoperative pain experience. However, the p-value is close to the threshold for significance, indicating that further research with a larger sample size might be necessary to conclusively determine if there are differences in pain perception based on the tooth replaced.

Patient Satisfaction: Patient satisfaction is a complex measure influenced by aesthetic results, functional recovery, and overall patient experience. Our study found that while 52% of patients were satisfied, a significant 36% showed some degree of dissatisfaction, and 12% were highly dissatisfied. These numbers emphasize the need for ongoing enhancements in patient communication, managing realistic expectations, and personalized care plans. Our research investigated patient satisfaction across different dental implants, uncovering a range of satisfaction levels. Despite these variations, a Chi Square statistical analysis did not show significant differences among the replaced teeth ($p = .273$). This indicates that factors not covered in this study might affect patient perceptions. Future studies should take

into account individual patient characteristics, surgical methods, and post-operative care to fully comprehend the factors influencing satisfaction. In conclusion, our results highlight the intricacy of patient satisfaction and the necessity for tailored strategies in dental implantology. This underscores the importance of a holistic approach to patient care, where every aspect of the patient's journey is considered and addressed.

Infection Control and Implant Mobility: In 2016**, S. Ihde and A** Ihde[9] proposed the concept of "supporting polygon" to determine the position of occlusal contacts within or outside of polygon drawn up by the load transmitting part of the implants in the second or third corticals. The aim of the treatment for work on strategic basal implants should be: • A bilateral equal and symmetrical occlusion • A bilateral equal and symmetrical mastication, with contact on first, second premolar, and the mesial half of first molar • A symmetrical function of the muscles, especially tongue Identical angle functional masticatory de planus (AFMP) angles on both the sides. In a case report, **Stefan Ihde and Antonina Ihde**[21] evaluated the bone reaction to the polished surface and sandblasted surface in a case and evaluated it over a period of 20 years. They stated that polished vertical implant surfaces on lateral basal implants and a thin diameter at the point of mucosal penetration provide a sustainable environment for a stable (unaltered) bone level even after 20 years. Our study found that there were no instances of infection or mobility post-operation in all the cases we analyzed during the time of placement and at the time of follow up at 1st and 3rd month using OPG scans . This is a positive sign for the effectiveness of both the design of the implants and the surgical techniques used. These favourable outcomes underscore the biocompatibility of the materials used in the implants. They also suggest a high level of skill in their placement, reinforcing the reliability of these implants for single tooth replacement.

Surgical Efficiency: We analyzed the duration of dental implant surgeries across various types of teeth in this study. The results show that the average time taken is relatively consistent, with no significant differences observed (ANOVA p-value: .379). The range of surgery times, from 0 to 25 minutes, reflects the complexities and challenges of individual cases. The standard deviation and standard error values indicate a moderate dispersion around the mean. This suggests that while some surgeries may take longer or shorter than the average, most fall within a predictable timeframe. This consistency in surgical duration is crucial for efficient scheduling and managing patient expectations. It highlights the standardized nature of these procedures in oral and maxillofacial surgery. Our findings suggest that the duration of surgery is not significantly affected by the type of tooth being replaced. This indicates that other factors may play a more critical role in determining the length of the procedure.

Statistical Significance: The study adhered to a significance threshold of $p \leq 0.05$, ensuring a robust analysis of the data. While most comparisons yielded a non-significant p-value, indicating no substantial differences in primary stability and patient-related outcomes, attention should be directed toward the borderline significances that could warrant further exploration.

Oleg et al.[68] and Lazarov[69] also showed BECES® implants being the maximally used basal implant type in their studies 89.6% and 87.1%, respectively. Basal bicortical screws implants have emerged as a reliable and effective option for single tooth replacement. The clinical and radiological evaluations conducted in the thesis have substantiated their role in achieving satisfactory primary stability and patient outcomes. As the field of dental implantology continues to evolve, the findings of this study will serve as a valuable reference point for both current practitioners and future research endeavours. This underscores the importance of continuous learning and adaptation in the field of dental implantology. It also highlights the potential of basal bicortical screws implants in improving patient outcomes and satisfaction. Drawing from the knowledge gained in this study, it becomes clear that subsequent research needs to dig deeper into the elements that lead to patient dissatisfaction. It's crucial to comprehend the fundamental sources of discomfort, whether they're rooted in physical or mental aspects. This understanding will play a pivotal role in improving patient outcomes.

Moreover, the exploration of progress in the field of implant design and surgical methodologies could provide avenues to further reduce pain and enhance the reliability of successful implant procedures. Every patient's journey is unique, and their comfort and satisfaction are paramount. Therefore, understanding their experiences, fears, and expectations can help us tailor treatments that not only address their clinical needs but also their holistic well-being.

CONCLUSION

The primary stability of dental implants is a crucial aspect that can significantly impact the long-term success of the restoration. The research conducted on basal bicortical screws implants has shed light on their ability to provide high insertion torque values, indicating robust primary stability[57].

This characteristic is attributed to the design of these implants, which anchor into the basal cortical bones known for their reduced susceptibility to resorption and infection. The unique ability of basal bicortical screws implants to offer strong primary stability is particularly advantageous in cases where the surrounding bone may not be able to adequately support traditional implants[62].

Efficient pain management and a well-tolerated surgical technique are critical components of a successful dental implant procedure. The study provides significant insights into the effectiveness of pain management during the insertion of basal bicortical screws implants. The majority of patients reported minimal discomfort, signifying that the associated surgical technique is well-tolerated[58].

This aspect is not only essential for patient comfort but also for the overall success and acceptance of the implant procedure. The absence of post-surgical complications such as infection or implant mobility indicates the stability and integrity provided by basal bicortical screws implants within the oral environment. However, the variability in patient satisfaction underlines the importance of implementing a personalized care approach, acknowledging that individual experiences and preferences play a significant role in shaping the overall perception of the implant treatment[59].

Consistent operative times reflect a standard and efficient surgical method, which can streamline clinical workflow and improve patient convenience. This efficiency is a valuable aspect of basal bicortical screws implants, contributing to a positive overall experience for both patients and dental practitioners[60].

SUMMARY

While acknowledging the limitations of a small and homogeneous sample size, the study also emphasizes the potential for future research to expand the findings to diverse patient populations and compare them with other implant systems[61]. The pursuit of further research is essential in establishing the broader applicability and efficacy of basal bicortical screws implants as a reliable alternative for single tooth replacement. Summarising the findings of this study provide substantial support for considering basal bicortical screws implants as a viable option for single tooth replacement, especially in scenarios where traditional implants may not be suitable due to limitations in bone quality or quantity[63].

However, comprehensive research endeavours are required to validate their long-term efficacy and comparative benefits and to solidify their position among the spectrum of available implant systems. As the field of implant dentistry continues to evolve, a deeper understanding of basal bicortical screws implants and their clinical outcomes will contribute to expanding treatment options for diverse patient populations. Consistent operation times reflect standard and efficient surgical methods that enhance workflow efficiency. Techniques specific to Basal Bicotrical Screws contribute to a positive overall experience for both practitioners and recipients alike. While acknowledging the limitations of a small, homogenous sample size, it is essential to emphasize potential future expansion into diverse patient populations when comparing them with other systems in order to fully understand their efficacy as viable alternatives for single tooth replacement.

Funding

No funding, grants or other support was received.

Data availability

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy regulation.

Conflict of interest

The authors declare no conflict of interest.

Institutional review board statement

Ethical approval was waived by local ethical committee of Nims University Rajasthan. In view of nature of the study and all procedures being performed were part of routine care.

Informed consent statement

Patient consent was taken.

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Comparative Study Evaluating the Clinical Efficacy of 2mm Three Dimensional (3d) Miniplates Versus 2mm Locking Miniplates in the Management of Mandibular Anterior Fractures - A Retrospective Clinical Study

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Abstract

Objectives: To compare the effect of three dimensional (3D) miniplates in the management of anterior mandibular fracture by occlusion stability, neurosensory deficit, duration of surgery, postoperative occlusion, segmental mobility and post op neurosensory deficit, other complications (infection, wound dehiscence and fracture of plate) were compared with that of locking miniplate.

Material and Method: A total of 30 patients were included in this study and divided randomly into 2 groups having 15 patients each. Two plates has been used for fixation of fractures of anterior mandibular region. Patients under Group 1, 2mm locking plate/screw system has been used and in Group 2, 2mm 3 Dimensional Miniplate has been used postoperatively all the patients were evaluated for Postoperative occlusion, segmental mobility, postoperative neurosensory deficit and other complications.

Results: There was no statistically significant difference noted in the treatment outcome between both the groups.

Conclusion: The operative experience gained with the use of Locking miniplates suggests that it is an easy and effective treatment modality in cases of moderately displaced anterior mandibular fractures. 2.0mm locking miniplates provide more rigid fixation compared to 2.0mm 3 dimensional miniplates in fracture of mandible often avoiding /decreasing the need for IMF.

Keywords: Locking miniplates, 3 Dimensional miniplates, Mandible fractures, IMF

INTRODUCTION

Fractures of Mandible occurs more frequently than that of any other Facial skeleton. It is one of the serious facial injury that the average practicing dental surgeon may expect to encounter, albeit on rare occasions, at is surgery. Trauma to the facial skeleton commonly results in injuries to the soft tissues, teeth and major skeleton component of the face including the mandible, maxilla, zygoma, naso-orbitoethmoid complex and supraorbital structures[1]. The management and rehabilitation of the patient with facial trauma demands a thorough understanding of facial fractures. Mandible, due to its anatomical position in the facial skeleton is very vulnerable to trauma[2]. Most cases of maxillofacial trauma present with a blow to the chin making the condyle and the parasymphysis area the most common site of fracture (Malmstrom;1969).

The aim of mandibular fracture treatment is restoration of anatomical form and function for which the fractured bone fragments need to be held in stable close apposition to promote uneventful healing[3]. These objectives of fracture management can be achieved by closed reduction and intermaxillary fixation (IMF) but, unfavorable and displaced fractures require open reduction and internal fixation (ORIF) and also, conditions wherein IMF is contraindicated or undesirable ORIF is preferred[4].

AIM

The purpose of this study is to evaluate the clinical efficacy of three dimensional (3D) plates and locking plates in the management of anterior mandibular fractures.

MATERIALS AND METHODS:

The study was approved by the institutional ethics board (Approval Id: NIMSUR/IEC/2021/160)

The present study is to evaluate "The clinical efficacy of Three dimensional (3D) plates and locking plates in the management of anterior mandibular fractures" in the Department of Oral and Maxillofacial Surgery of NIMS Dental College and Hospital, Jaipur. Patients were selected irrespective of gender, caste and socioeconomic status. Informed consent for the procedure was obtained from all the patients enrolled for the study.

Criteria for selection of patients

Inclusion criteria

1. All Dentate patients with mandibular fracture from 18 to 60 years of age.
2. Symphysis and para symphysis fractures.
3. All patients with non-comminuted fractures of mandible.
4. Patient willing to give written consent for the surgical procedure.

Exclusion criteria

1. Edentulous patients
2. Patients having Primary and Mixed dentition.
3. ASA classification type IV and V.
4. Patients who are unfit for GA

METHODOLOGY

This study was carried out between Jan 2022 to Apr 2023. A standard proforma was used to collect necessary information regarding each case after inclusion. Preoperatively, all patients were informed about the surgical procedure, postoperative instructions, possible complications and written consent was taken.

In the present study, 30 patients were randomly divided into two groups and were treated for anterior mandibular fracture using Locking miniplate (Group 1) and 3D miniplate (Group 2). Post operative evaluation was done by the same observers under the following criteria: occlusion stability, neurosensory deficit, duration of surgery, postoperative occlusion, segmental mobility and post op neurosensory deficit, other complications (infection, wound dehiscence and fracture of plate).

PROCEDURE

After intubation, eye ointment was applied to both the eyes and sterile gauze pads were placed over the eyes, a throat pack was placed in all patients. Patients were painted with 10% povidone iodine and draped as per standard protocol. Irrigation of the oral cavity was done with Normal saline and povidone iodine solution. Surgical approach for the fractures was through the intra oral and extra oral incisions and through pre-existing laceration. Surgical Site infiltrated with 2% Lignocaine Hydrochloride with 1:80,000 adrenaline.

The lip is then retracted, and a curvilinear incision is made perpendicular to mucosal surface. The incision is carried out into the lip so as to leave at least 1cm of attached gingiva. This incision extended anteriorly into the lower lip, leaving 10 to 15 mm of mucosa attached to the gingiva. The dissection is then carried subperiosteally to identify the mental neurovascular bundle and identify the line of lesion within the mandible at the site of fracture. After exposing the fracture site, fracture segments were reduced either using intermaxillary fixation (IMF) with upper and lower Erich's arch bars/ eyelet wiring or by manual approximation of the visible fracture segments by holding the dentition into occlusion.

Internal fixation was done in group A patients using a 2.0mm SS Locking plates, whereas in group B the fractures were fixed using a 2.0mm SS 3-D miniplate. According to the Champy's principle , firstly a 2.0mm SS Locking plate was adapted to the lower border of the mandible with the help of the

bending pliers. It was then fixed using 2.0 mm locking screws of 8mm length. Then a second plate was similarly adapted in the subapical region and fixed using 2.0 mm screw of 8 mm length.

The 3-D SS miniplate was firstly adapted to the mandibular contour taking care of the neurovascular canal with the help of bending pliers. It was fixed with 2.0 mm locking screws of 8mm length. The screw holes were drilled using a slow speed drill after attaching guiding sleeve to each hole of the plate and copious irrigation to prevent any thermal bone injury. The drill holes were secured with monocortical screws with a self-holding screw driver.

After reduction and fixation of the fracture, the area was irrigated with povidone iodine and normal saline. Intra- operative stability of fracture segments after fixation was checked by clinical manipulation in three directions. The maxillomandibular fixation released in all the patients. After achieving adequate hemostasis, the wound was closed in two layers using 3-0 vicryl for deeper layers and 4-0 silk /(Ethilon) for skin and mucosa. Adhesive bandage was applied to chin to support the mentalis muscle and prevent its drooping. Extubation done ,throat pack removed. Recovery was uneventful. Patient shifted to ICU.

POST OPERATIVE CARE

All patients were kept post-operatively on the following regimen.

1. Injection Cefotaxime 1 gm / B.D / Intravenous for 3 days.
2. Injection Metronidazole 500mg /T.I.D / Intravenous for 3 days.
3. Injection Pantoprazole /O.D/Intravenous for3 days.
4. Injection Diclofenac sodium 75mg /B.D /infusion with 100ml NS .
5. Injection Dexamethasone 8mg / T.I.D / Intravenous tapering dose.
6. Injection Ondansetron 4mg / Intravenous / S.O.S
7. 0.2% Chlorhexidine gluconate mouthwash for 30 days.

FOLLOW UP DESIGN

All the patients were followed for a period of 3 months at the intervals of 1st week, 2nd week, 6th week and 12th week and evaluated for:

1. Postoperative occlusal
2. Segmental mobility
3. Post operative neurosensory deficit
4. Other complications such as infection, wound dehiscence and fracture of plate.

POSTOPERATIVE ASSESSMENT

Postoperative assessment was carried out both clinically on 1st week, 1 Month and 3 Months.

OBSERVATION AND RESULTS

In the present study, 30 patients were randomly divided into two groups and were treated for anterior mandibular fracture using Locking miniplate (Group 1) and 3D miniplate (Group 2). There were 7 females and 23 males included in the study. The age ranged from 18 to 60 years. The present study was conducted in 30 patients to compare the locking miniplate and 3-D miniplates in management of symphysis and parasymphysis fracture of mandible. The patients were evaluated preoperatively, postoperatively for different parameters.

Following parameters were assessed:

Preoperatively

- Age
- Gender of patient
- Fracture site
- Type of fracture
- Mode of injury

Postoperatively

- Postoperative Occlusion
- Segmental mobility
- Postoperative neurosensory deficit
- Postoperative infection

Postoperatively these parameters are evaluated at regular intervals at 1st week, 2nd week, 6th week, and 12th week.

DISCUSSION

An ideal plate-screw system must be strong and rigid enough to withstand functional loads and enable undisturbed fracture healing[5]. In fixation of mandibular fractures, the results are influenced by both; the mechanics at the fracture site and the mechanical properties of implant. The load across fracture is carried partially by fragments and partially by implant. The forces and moments acting on every single fragment have to be zero. If sum of moments is not zero, fragments tend to rotate.

From a biomechanical point of view, the mechanical properties of implant such as strength and stiffness also play an important role in stabilizing the load across fracture site[6]. It should contain these forces but should not be so rigid that stress shielding occurs and delays treatment[7]. Champy et al studied the moments of flexion and torsion produced in mandible during jaw function. Anteriorly, it is complicated due to a combination of sharp curvature of bone and the muscle attachments, each pulling in different directions. Posterior to canine, mylohyoid muscle pulls medially, whereas anteriorly, genial muscles and digastric tend to pull posteriorly, resulting in additional rotational forces.

Such displacing forces need to be well controlled if a small plating system is to work. Taking into account the anatomy of mandible, with the location of dental apices and the thickness of the cortical layer Champy et al determined an ideal line of

osteosynthesis that corresponds to the course of a line of tension at the base of alveolar process which is biomechanically the most favorable site for placement of monocortical plates to neutralize tension forces causing distraction[7].

Based on the biomechanical studies of Champy et al, torsion moments were thought to be the most important load across fracture in symphysis region. But, Tams et al in a three-dimensional study of load across fracture for different sites of mandible found that torsion moments are not of utmost importance. They indeed are high but the maximum torsion moments are 1.5 times smaller than the maximum negative moments for symphysis, canine and anterior body fractures.

In their study, Tams et al divided mandibular fractures roughly into two groups. One group formed by angle and posterior body fracture, having high positive bending moments. Another group formed by symphysis, canine and anterior body fractures, having high negative bending and high torsion moments. Considering this unique biomechanical behavior of anterior mandibular fractures, a single miniplate would not provide adequate fixation and two plates are required to overcome these displacing forces. First plate is placed along the inferior border of mandible along ideal line of osteosynthesis. Two screws are placed on each side of fracture site.

The second plate is placed approximately 4-5mm above the first plate (below root apices) with two screws on each side of the fracture site[8]. In 1913, Lambotte recommended aluminum geometrically closed quadrangular plate secured with bone screws at the lower border of mandible for treatment of mandibular fracture via an extra oral approach. However, this method did not gain further popularity because of the lower biocompatibility of the material and because treatment methods using closed reductions were preferred at that time. The first biomechanical study of 3- D miniplates was conducted by Farmand in 1992.

Wittenberg et al (1997) in an in-vitro biomechanical study found that a Leibinger 8-hole 3-D plate which was formed by joining two four-hole miniplates with interconnecting cross bars provided adequate torsional resistance and plate deformation occurred at load levels >230N[9]. Based on these studies, authors have established that Locking plates have improved biomechanical stability compared with 3D miniplates. However, majority of the studies on 3-D plates were in-vitro biomechanical studies.

The clinical application of these plates in the treatment of fractures is relatively new. Guimond et al (2005) in their retrospective evaluation of angle fracture cases treated with strut plates stated that the geometry of 3-D strut plate conceptually allows for an increased number of screws, stability in three dimensions and resistance against torque forces while maintaining a low profile and malleability. In 3-D plate, because the screws are placed in a box configuration on both sides of fracture rather than on a single line, broad platforms are created that may increase resistance to torsional forces along the axis of plate[10].

In osteosynthesis, the requirement of minimum implant material with maximum stability should always be considered[11]. The structure of bone itself gives an insight into the ideal design of osteosynthesis device to heal bone fractures. Wolff stated that living bones will change, grow and resorb according to changing stress and strain to which they are subjected. Roux gave the principle of maximum-minimum design which holds that maximum strength in bone is achieved with minimum quantity of material. Accepting the optimal design theory of structure of bone, it would seem appropriate for any foreign device to, at minimum, not impede the natural internal evolution of living tissues.

The main goal of osteosynthesis plate design should be to provide adequate stability in the bone fracture region with a minimal amount of implanted material[12]. The Locking miniplates seem to fulfill this requirement ideally than 3D miniplates. Minimum amount of surgical exposure is necessary for placement of plates and screws. Periosteal stripping is minimal, when compared to other conventional miniplate osteosynthesis technique.

The mandible is in the most esthetically sensitive part of the body, where scars and deformities are less tolerated and it is also involved in activities such as mastication and speech. In treating mandibular fractures, there is need to restore a normal (pretrauma) occlusion, maintenance of facial symmetry and balance, and complex movements of the temporomandibular joint. Alterations of mandible secondary to trauma or trauma management are readily apparent, measurable and less forgiving.

Even a slight malocclusion is readily apparent to the patient, as is a numb lip and chin or inability to open mouth adequately. Malocclusion resulting from fractures outside the condylar region, which are fractures related to tooth bearing areas of mandible, usually result from failure to gain or maintain reduction of fracture. Ideally, anatomic reduction of bone should result in an anatomic relationship of dental arches[13].In the present study, 30 patients were randomly divided into two groups and were treated for anterior mandibular fracture using Locking miniplate (Group 1) and 3D miniplate (Group 2).

The incidence of fracture was 76.7% in males (23patients). In our study, the age group most commonly affected was in the range of 20-40 year

with a mean age of 33-34 year. Also, it was observed that majority of the symphysis/parasymphysis fractures (60%) had a concomitant condylar or angle fracture. The studies have shown that modes of displacement at symphyseal fracture site would be similar with or without a concomitant fracture.

The principal cause of fracture was road traffic accident (RTA) with a frequency of 43.3% followed by self-fall, accounting for 40% of the cases. It was found that majority of cases of self-fall were under the influence of alcohol. Studies do recognize importance of alcohol consumption, not only because of its etiologic implications but also because it contributes to certain complications such as delay in post-surgical healing or infection.

In this study, the mean duration of surgery for Group 1 cases was 10.34 minutes lesser than Group 2 cases. In a similar study conducted by Jain et al (2010) an average time difference of 12 minutes was noted in the duration of surgery between 3-D and Locking plating techniques. This difference in time can be attributed to simultaneous stabilization of a Locking plate which also increases resistance to torque. But with the use of 3D, the bending of plates in 3-dimensional plane makes difficult to adapt.

To achieve accurate fixation, the bone plate must be meticulously conformed to the contours of bone. Bone plating is an exacting and technically demanding method of restoration of occlusion; a high degree of accuracy is required. If plate is not bent properly, the bone will conform to the plate instead. Every discrepancy before plate fixation will result in permanent malocclusion which is more commonly experienced during 3D plate adaptation.

Whenever a post-operative infection occurs with a mandibular fracture, numerous factors are involved. These include patient's general characteristics such as pre-existing medical disorders, smoking and chronic alcohol abuse, poor oral hygiene, and poor dental status, type of fracture, kind of treatment used and the time of treatment. Delayed treatment is associated with high rate of infection i.e. chances of infection increase when time span between time of fracture and the time of treatment. When treating a mandibular fracture, it should always be borne in mind that reduction of fracture does not equal stabilization and fixation does not strengthen bone; aftercare is just as important.

CONCLUSION

In conclusion, the results of our clinical study suggest that the Locking plating system is a suitable method for fixation of anterior mandibular fractures. We have made an attempt to compare the efficacy of 2.0mm locking miniplate with that of 2.0 mm 3 dimensional miniplate under the following parameters such as Postoperative occlusion, segmental mobility, postoperative neurosensory deficit and other complications (infection, fracture of plate and wound dehiscence).

Both 2.0 mm locking miniplate as well as 2.0 mm 3 dimensional miniplates achieved success in restoration of oral functions for fractured jaw. The difference in time can be attributed to simultaneous stabilization of a Locking plate which also increases resistance to torque. But with the use of 3D, the bending of plates in 3-dimensional plane makes difficult to adapt.

To achieve accurate fixation, the bone plate must be meticulously conformed to the contours of bone. Bone plating is an exacting and technically demanding method of restoration of occlusion; a high degree of accuracy is required. If plate is not bent properly, the bone will conform to the plate instead. Every discrepancy before plate fixation will result in permanent malocclusion which is more commonly experienced during 3D plate adaptation. 2.0 mm locking miniplates give more rigid fixation compared to 2.0 mm 3 Dimensional mini plates because of that the duration of IMF can be reduced or sometimes IMF can be avoided postoperatively.

Finally, we can conclude that 2.0 mm locking miniplates provide more rigid fixation compare to 2.0mm conventional 3D miniplates in symphysis, parasymphysis fracture of mandible often avoiding /decreasing the need for IMF. However, IMF is a useful method & is still practiced successfully to correct the minor occlusal discrepancies.

So, our study suggests the use of locking miniplates in preference to 3 Dimensional miniplates to achieve early mobility with assured stability in case of mandibular fractures. However, in cases of oblique fractures and severely displaced fractures, especially near the mental foramina area, where bending a quadrangular geometric plate can be difficult, standard plates can be a better option.

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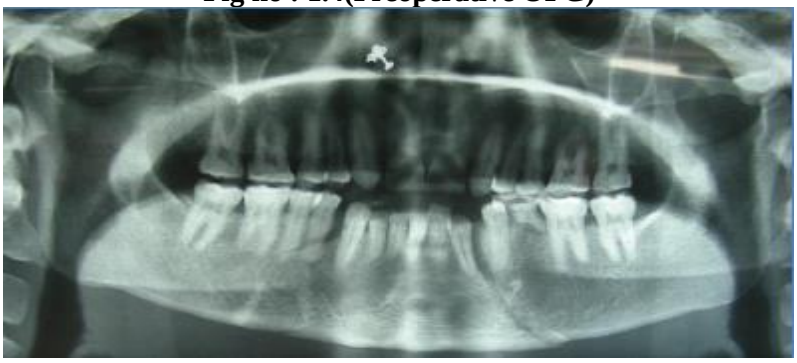

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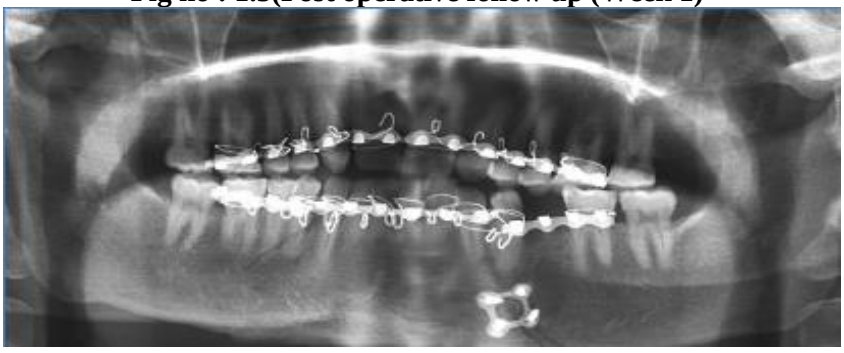

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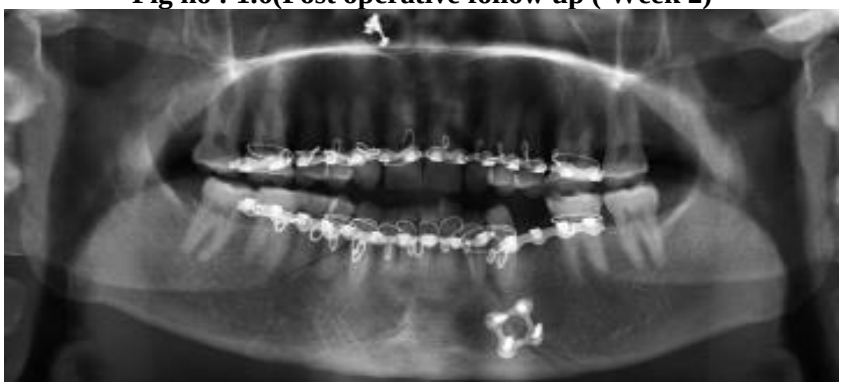

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LOCKING PLATES AND SCREWS

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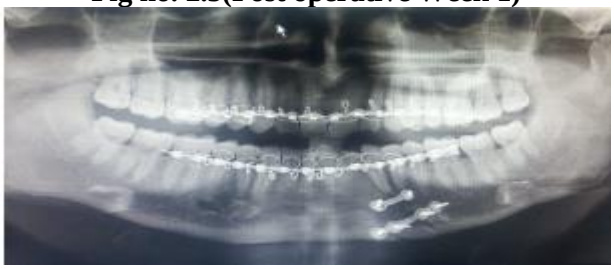

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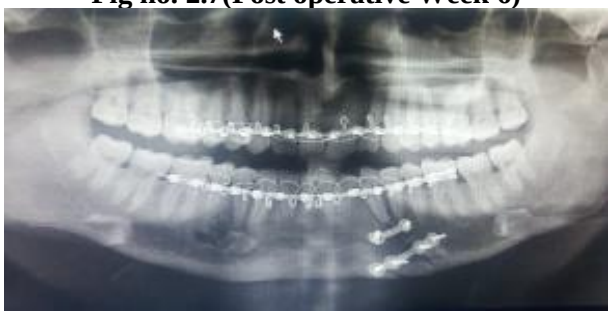

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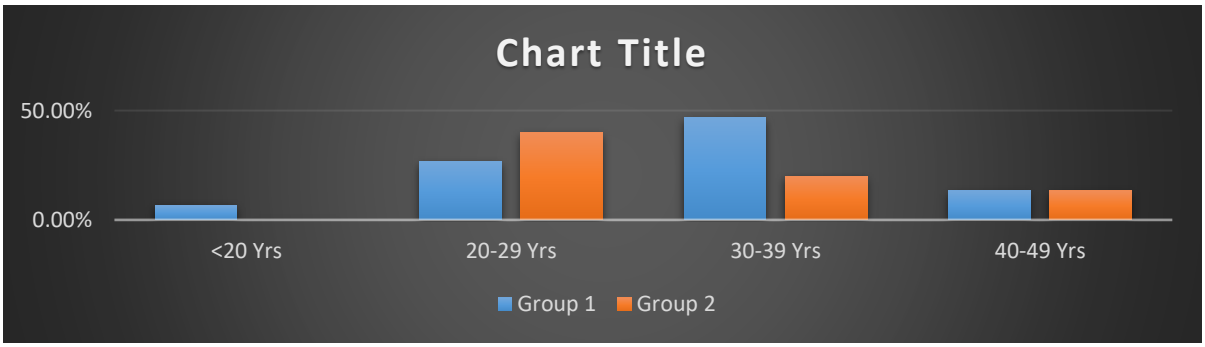
Table 1: Age Distribution in Group 1 & 2 patients

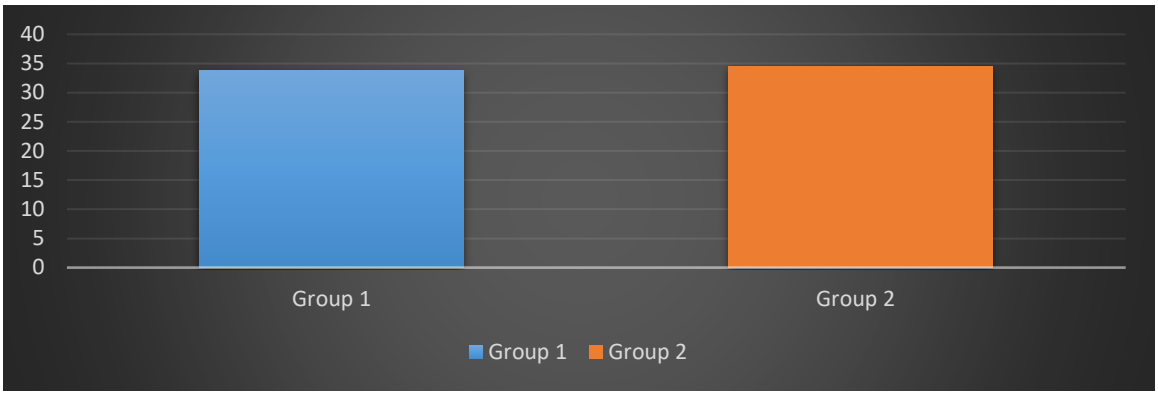
MINIPLATE	AGE					TOTAL	X2 VALUE	P VALUE
	<20yrs	20-29 yrs	30-39 yrs	40-49 yrs	>50 yrs			
2mm Locking	1	4	7	2	1	15	6.974	0.137
	6.7%	26.7%	46.7%	13.3%	6.7%	100.0%		
2mm Three Dimensional	0	6	3	2	4	15		
	.0%	40.0%	20.0%	13.3%	26.7%	100.0%		
Total	1	10	10	4	5	30		
	3.3%	33.3%	33.3%	13.3%	16.7%	100.0%		



In Group 1, the most common age group noted was 30–39 years. In Group 2, the most common age group noted was 20–29 years. Taking both the groups together, the common age group observed was in range of 20-40 years.

Table 2: Mean Age Distribution in Group 1 & 2 patients

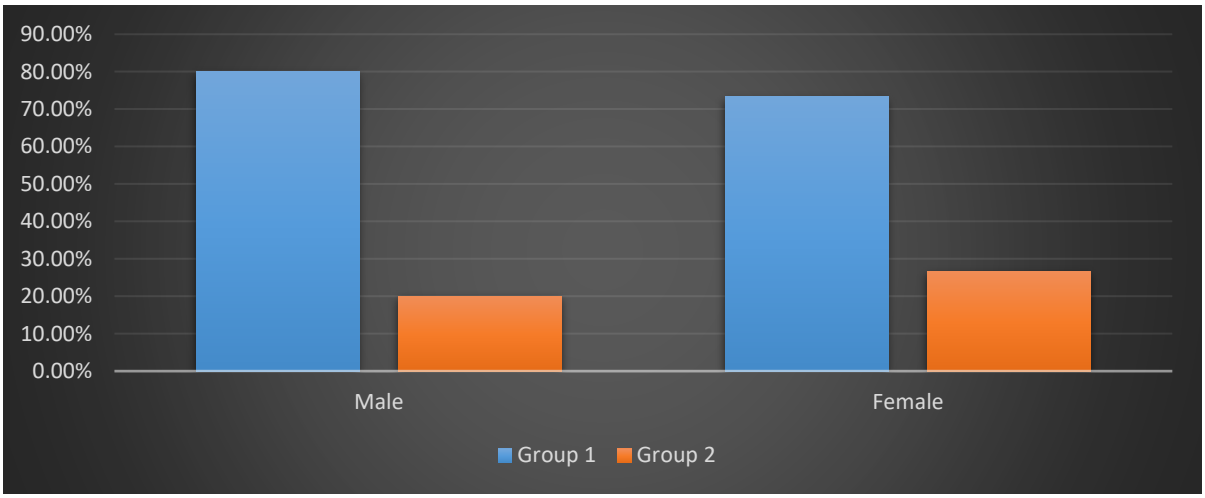
Miniplate	N	Mean Age(years)	SD	Min	Max	T value	P Value
2mm Locking	15	33.73	11.253	18	60	0.033	0.856
2mm 3 Dimensional	15	34.53	12.660	20	55		



The mean age sector recorded in Group 1 patient was 33.73 and the mean age sector recorded in Group 2 was 34.53. There was no significant difference in the distribution of mean age between the two groups.

Table 3: Gender Distribution in Group 1 & 2 patients

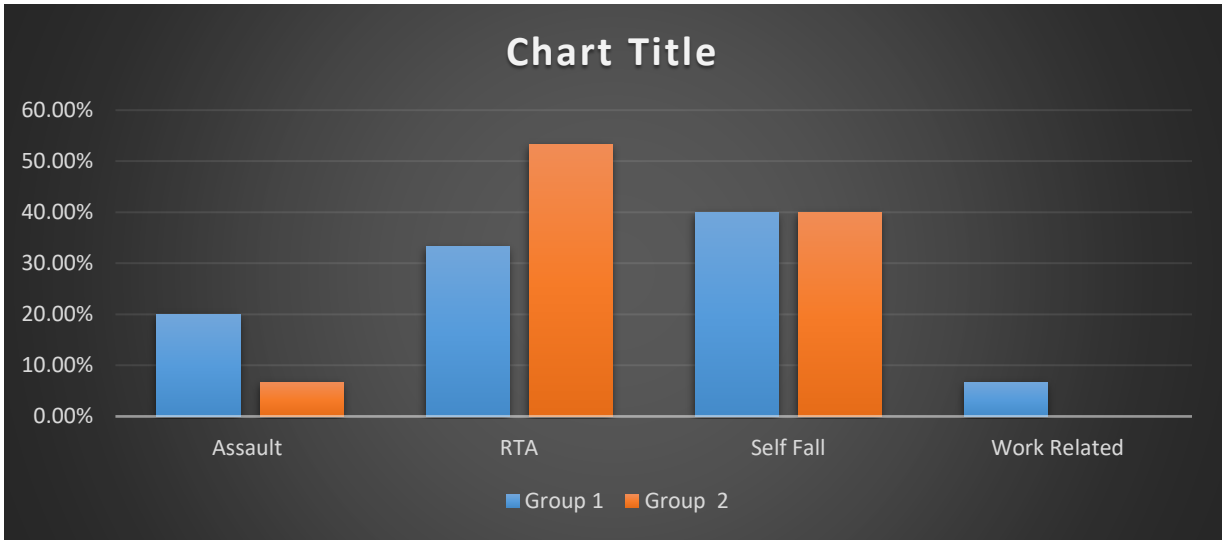
Miniplate	Gender		Total	X2 Value	P Value
	Male	Female			
2mm Locking	12	3	15	0.186	0.666
	80.0%	20.0%	100.0%		
2mm 3Dimensional	11	4	15		
	73.3%	26.7%	100.0%		
Total	23	7	30		
	76.7%	23.3%	100.0%		



Amongst 15 patients in Group 1, 12 (80%) were male and 3 (20%) were female. In Group 2 out of 15, 11 (73.3%) were male and 4 (26.7%) were female. There was no significant difference in the distribution of sex between Group 1 and Group 2. Overall, a male preponderance was noted for the mandibular fracture

Table 4: Etiology of Fracture in Group 1 & 2 patients

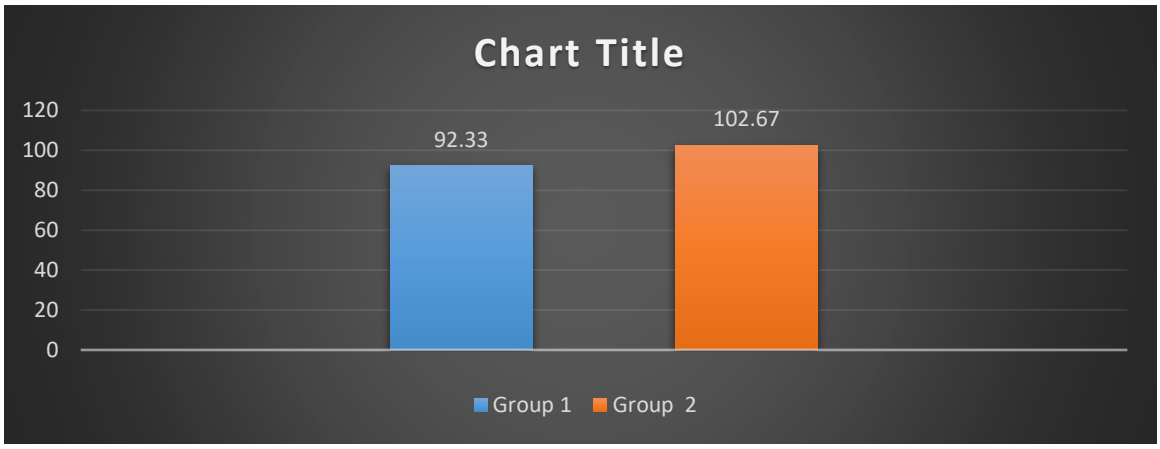
	Etiology				Total	X2 Value	p value
	Assault	RTA	Self-fall	Work related			
2mm Locking	3	5	6	1	15	2.692	0.442
	20.0%	33.3%	40.0%	6.7%	100.0%		
2mm 3 Dimensional	1	8	6	0	15		
	6.7%	53.3%	40.0%	.0%	100.0%		
Total	4	13	12	1	30		
	13.3%	43.3%	40.0%	3.3%	100.0%		



Etiological factors for fracture were mainly divided into four groups. Overall, RTA emerged as the most common etiological factor comprising 13 (43.3%) patients from both the groups, followed by self fall, which included 12 (40%) patients from both groups and then assault including 4 (13.3%) patients of the total. Only 1 (6.7%) patient in Group 1 had a work related fracture.

Table 5: Mean Duration of Surgery in Group 1 & 2 patients

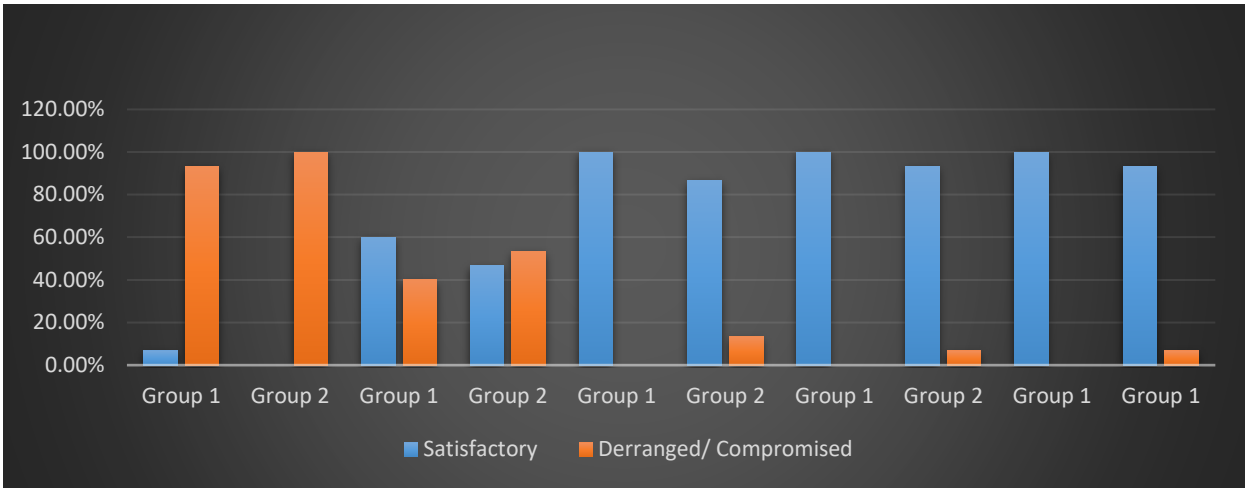
Miniplate		N	Mean	SD	Min	Max	t Value	P Value
2mm Locking		15	92.33	36.098	60	180	0.601	0.445
2mm 3 Dimensional		15	102.67	36.930	60	180		



The mean duration of surgery observed in Group 1 was 92.33 minutes whereas in Group 2 it was 102.67 minutes. Group 1 required 10.34 minutes less for surgery as compared to the time taken for surgery in Group 2. However, the difference in duration of surgery was not statistically significant.

Table 6: Occlusal Discrepancy during Follow-Up Visits in Group 1 & 2 patients

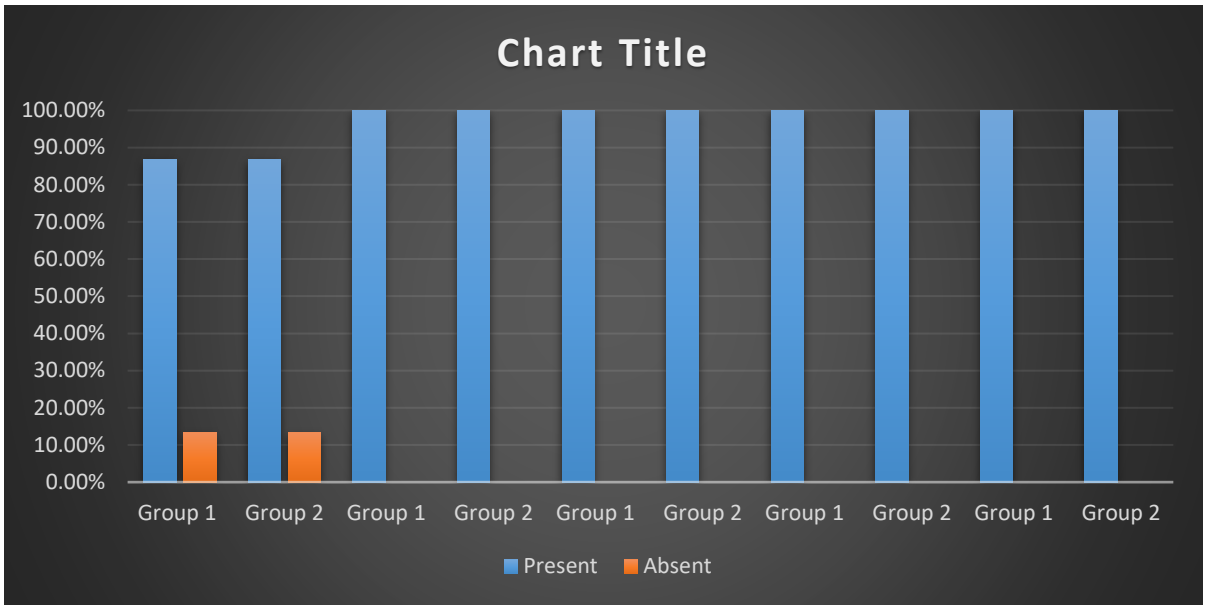
Visit	Miniplate	Occlusion		Total	χ^2 Value	p Value
		Satisfactory	Deranged / Compromised			
Pre Op	2mm Locking	1	14	15	1.034	1.000
		6.7%	93.3%	100.0%		
	2mm 3D	0	15	15		
		0.0%	100.0%	100.0%		
1 Week	2mm Locking	9	6	15	0.536	0.715
		60.0%	40.0%	100.0%		
	2mm 3D	7	8	15		
		46.7%	53.3%	100.0%		
2 Week	2mm Locking	15	0	15	2.143	0.483
		100.0%	0.0%	100.0%		
	2mm 3D	13	2	15		
		86.7%	13.3%	100.0%		
6 Week	2mm Locking	15	0	15	1.034	1.000
		100.0%	0.0%	100.0%		
	2mm 3D	14	1	15		
		93.3%	6.7%	100.0%		
12 Week	2mm Locking	15	0	15	1.034	1.000
		100.0%	0.0%	100.0%		
	2mm 3D	14	1	15		
		93.3%	6.7%	100.0%		



In the study Group 1, six patients (40%) had minor occlusion discrepancy in the immediate post-operative period but, with IMF, at the end of 2nd week all 15 patients attained satisfactory occlusion. In the study Group 2, eight patients (53.3%) had occlusal discrepancy in the immediate post-operative period. With IMF, satisfactory occlusion was attained in 13 patients (86.7%) at the end of 2nd week. However, one patient in Group 2 had persistent occlusion discrepancy till the end of follow-up period.

Table 7: Segmental Mobility during Follow -Up Visits in Group 1 & 2 patients

Visit	Miniplate	Segment Mobility		Total	χ 2 Value	p Value
		Present	Absent			
Preop	2mm Locking	13	2	15	0.000	1.000
		86.7%	13.3%	100.0%		
	2mm 3D	13	2	15		
		86.7%	13.3%	100.0%		
1 Week	2mm Locking		15	15	-	-
			100.0%	100.0%		
	2mm 3D		15	15		
			100.0%	100.0%		
2 Week	2mm Locking		15	15	-	-
			100.0%	100.0%		
	2mm 3D		15	15		
			100.0%	100.0%		
6 Week	2mm Locking		15	15	-	-
			100.0%	100.0%		
	2mm 3D		15	15		
			100.0%	100.0%		
12 Week	2mm Locking		15	15	-	-
			100.0%	100.0%		
	2mm3D		15	15		
			100.0%	100.0%		

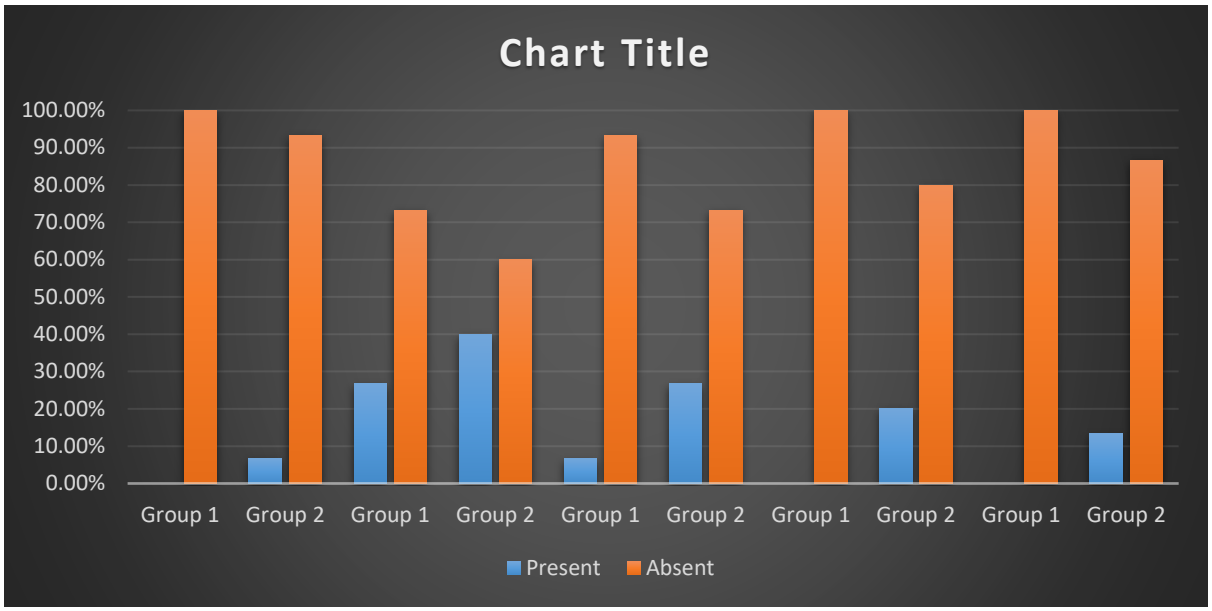


Graph 7: Segmental Mobility during Follow -Up Visits in Group 1 & 2 patients

Both the plating techniques provided adequate stability of fracture fragments and there was no segmental mobility elicited in any of the patients during follow-up visits in both the groups.

Table 8 : Neurosensory Deficit during Follow-Up Visit in Group 1 & 2 Patients

Visit	Miniplate	Neurosensory Deficit		Total	χ 2 Value	p Value
		Present	Absent			
Preop	2mm Locking	0	15	15	1.034	1.000
		0.0%	100.0%	100.0%		
	2mm 3D	1	14	15		
		6.7%	93.3%	100.0%		
1 Week	2mm Locking	4	11	15	0.600	0.700
		26.7%	73.3%	100.0%		
	2mm 3D	6	9	15		
		40.0%	60.0%	100.0%		
2 Week	2mm Locking	1	14	15	2.160	0.330
		67.7%	93.3%	100.0%		
	2mm 3D	4	11	15		
		26.7%	73.3%	100.0%		
6 Week	2mm Locking	0	15	15	3.333	0.224
		0.0%	100.0%	100.0%		
	2mm 3D	3	12	15		
		20.0%	80.0%	100.0%		
12 Week	2mm Locking	0	15	15	2.143	0.483
		0.0%	100.0%	100.0%		
	2mm3D	2	13	15		
		13.3%	86.7%	100.0%		

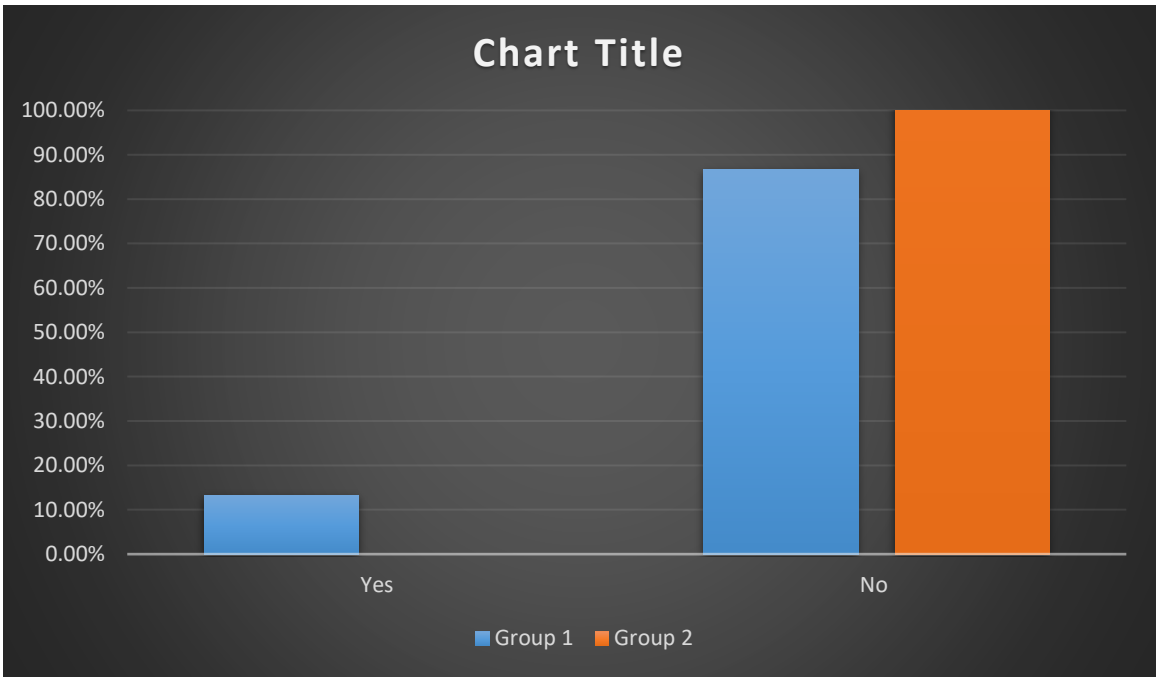


Graph 8 : Neurosensory Deficit during Follow-Up Visit in Group 1 & 2 Patients

Pre-operatively one patient in Group 2 had paresthesia. Post-operatively there was transient neurosensory deficit noted in four patients (26.7%) from Group 1 which recovered gradually and returned to normal at the end of 12 week. In Group 2, six patients (40%) had neurosensory deficit in immediate post-operative period which returned to normal in 4 patients but two patients (13.3%) had mild paresthesia till the end of 12 week

Table 9: Presence of Other Complications in Group 1 & 2 patients

Miniplate	Other complications		Total	χ 2 Value	p Value
	Yes	No			
2mm Locking	2	13	15	2.143	0.143
	13.3%	86.7%	100.0%		
2mm 3D	0	15	15		
	0.0%	100.0%	100.0%		
Total	2	28	30		
	6.7%	93.3%	100.0%		



Graph 9 : Presence of Other Complications in Group 1 & 2 patients

Out of all the patients, only 2 patients (13.3%) in Group 1 developed soft tissue infection/wound dehiscence which was managed conservatively and resolved gradually.

Navigating Complexities in Open Degloving Injury Reconstruction: A Case Study

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Abstract

Airway obstruction, cervical spine injuries, and cranial structural injuries can worsen gross maxillofacial injuries, making them difficult to treat. Such injuries can cause deformities that have long-lasting psychological repercussions, which can be disastrous if left untreated. Here we have a 39-year-old male rider who was engaged in a motorcycle-truck traffic incident. He suffered avulsion and degloving of the right eyebrow, right upper and lower eyelids, right cheek, and a portion of the right cheek in addition to the triangle forehead skin. Following that, a one-stage primary reconstruction and repair were carried out. For this patient, a multidisciplinary team approach including many specializations had positive results.

Keywords: Degloving injury, road traffic accident, reconstructive surgery, maxillary fractures

INTRODUCTION

Severe facial injuries can arise from high-speed motor vehicle collisions, assault, domestic violence, animal bites, and falls. Managing these injuries presents considerable challenges due to their potential for severe health impacts and even mortality. Extensive facial avulsion and degloving injuries caused by these mechanisms can lead to critical issues such as compromised airways, severe bleeding, loss of soft tissue, significant disfigurement, and subsequent changes in appearance and function after the trauma. Deformities resulting from such injuries can have enduring psychological effects that, if left unaddressed, can be devastating.[1-3]

Reconstructing intricate facial wounds presents significant hurdles for surgeons, as they must delicately balance achieving satisfactory cosmetic results with ensuring optimal functional recovery. Degloving lacerations illustrate severe soft tissue injuries where the skin and underlying tissues detach from muscles, bones, and fascia due to sudden shearing forces on the skin surface.[4-5]

Facial degloving injuries, while rare, pose distinctive challenges since there are no established treatment protocols.[6] Delayed treatment can worsen complications such as infection and necrotizing fasciitis of the avulsed tissue flap.[7] Moreover, damage to the flap's vascular supply can lead to complete necrosis of its full thickness.[8]

Case Report

A 22-year-old man arrived at the emergency department of NIMS Multispeciality Hospital, Jaipur following a traffic accident. She sustained a degloving injury on the right side of her face, affecting the cheek, oral commissure, lower eyelid, and temporal scalp. Additionally, the external auditory canal, including the fibro-cartilaginous area, was severed distally.

Upon assessment, the patient had a clear airway and was breathing adequately. Fluids were administered to maintain circulation, and bleeding was controlled. He was alert and slightly oriented, and was not able to walk during the examination, he reported a brief loss of consciousness after the accident. Computed tomography revealed no signs of brain injury but identified a fracture in the right zygoma region. There were no indications of eye injury, and her vision and pupillary reflexes were intact.[Figure-1]

FIGURE 1

The wound underwent thorough debridement using normal saline under general anaesthesia, with all non-viable tissues removed. The detached flap was meticulously repositioned and sutured to return the avulsed structures to their original positions. The external auditory canal, which had been detached, was carefully sutured back together. Layers of sutures were used to reposition and secure the lower eyelid. A postoperative dressing was applied to prevent hematoma formation. [Figure-2, Figure-3]

FIGURE 2

FIGURE 3

Following surgery, the patient was transferred to the general ward for observation and started on

antibiotics to prevent infection of the wound. Due to a zygoma fracture, the patient was placed on a soft diet. Plans were made for the patient to undergo open reduction and internal fixation of the zygoma fracture by trans-osseous wiring under general anaesthesia.

Unfortunately, the patient developed an infection in the avulsed flap the following day. As a result, the patient underwent debridement procedures until healthy granulation tissue was observed. Subsequently, the zygoma bone was stabilized using trans-osseous wiring, and a surgical drain was inserted at the site. [Figure-4, Figure-5]

FIGURE 4

FIGURE 5

DISCUSSION

Degloving soft tissue injuries account for approximately 4% of all traumatic injuries and are more prevalent among males and younger patients. Motor vehicle accidents represent the primary cause of degloving injuries in the head and neck region.[9] These injuries can be categorized into open or closed lesions. Open degloving injuries typically involve soft tissue avulsion, while closed injuries present as a cavity filled with hematoma and liquefied fat.[10] Open lacerations are more commonly observed in the head and neck area, whereas closed lesions are more frequent in the trunk and extremities.

The management of open degloving injuries varies from basic debridement with primary skin closure to intricate procedures involving skin grafts, local flaps, microvascular free flaps, replantation, or revascularization. The selection of treatment is guided by factors such as the location, size, and seriousness of the wound.

Vacuum-assisted wound closure is frequently employed for open degloving wounds to expedite the formation of granulation tissue before skin grafting.[11] However, achieving an airtight seal is challenging in the head and neck region due to the presence of multiple contours and hair.[12]

The primary approach to managing facial degloving injuries emphasizes achieving definitive primary skin coverage and facilitating early functional recovery. Despite meticulous wound debridement and closure, complications can still arise which includes infection and necrosis of flap.

The comprehensive management of extensive and overlapping facial avulsion and degloving wounds necessitates a multidisciplinary approach involving plastic surgeons, otorhinolaryngologists, oral and maxillofacial surgeons, and ophthalmologists who collaborate from the outset.

The collaborative approach ensures timely planning for specialized primary repairs, facilitating effective decision-making, and ultimately leading to favourable reconstructive outcomes.[13] Early, comprehensive reconstruction in a single stage has consistently demonstrated both functional and cosmetic benefits.[14-15] Wounds with contamination or embedded debris were meticulously cleaned, debrided, and repaired without delay, with a focus on preserving as much native tissue as possible to minimize infection risk and flap loss. This proactive strategy has consistently yielded superior results, including reduced infection rates, and improved cosmetic outcomes in soft tissue reconstruction efforts.Complications such as infection and skin necrosis can be caused by delay in the treatment of degloving injuries[16]

CONCLUSION

Managing open degloving soft tissue injuries presents a challenge as there is currently no established evidence-based approach for their treatment. Successful management of these injuries necessitates a multidisciplinary approach. Properly planning and staging surgical procedures are crucial to achieving optimal aesthetic and functional outcomes in such complex facial injuries.

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Comparative Analysis and Effect of Monopoly – Coating Agent on the Surface Roughness of Commercially Available Two Tissue Conditioners Subjected to Cleansing with Denture Cleanser After Immersing in Artificial Saliva – A Contact Profilometric In – Vivo Study

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Abstract

Purpose: In this in -vitro comparative study we aimed to conclude that silicone based and acrylic based tissue conditioner with applying monopoly coating agent has less surface roughness compare to silicone and acrylic based tissue conditioner without monopoly coating agent.

Result: In total 40 sample were evaluated within 4 groups. At 1- and 7-day interval surface roughness score of groups 2 were lower than control 1, control 2 and group 1. 0.311($p<0.05$)

Conclusion: Two different tissue conditioner acrylic and silicone based has less surface roughness after applying monopoly coating agent. Monopoly coating agent reduces surface roughness and increase longevity of tissue conditioner.

INTRODUCTION

The term "soft liners" refers to a class of resilient materials used to reline denture base surfaces in contact with the occlusal stress-bearing oral mucosa. Liners can be either hard, usually made of poly methyl methacrylate or it can be resilient when plasticizers are added to the resin.[1,2]

Tissue conditioners are used in the management of abused tissues underlying ill-fitting dentures, various types of functional impressions, contemporary relining of ill-fitting dentures as well as immediate dentures, and also for tissue conditioning during the implant process. Various recent research shows different types of tissue conditioners that can be used based on material type and multiple parameters to the smoothness and roughness of a denture.

The properties of the tissue conditioners are affected by the moist environment of the oral cavity, where ethanol and ester plasticizer are leached into the saliva and water is absorbed by the polymeric phase. The increased porosity of the tissue conditioners can lead to plaque accumulation, A chemical soaking technique is primarily the method of choice for geriatric patients and those with poor motor capacity.[3]

Many limitations have mentioned their use including difficult manipulation of resin in the mouth and its limited modelling compared to the modelling compound. On the other hand, modelling compounds are supposed to rapidly deteriorate intraorally, especially if used in conjunction with tissue conditioner materials. Another application of tissue conditioners along with modelling plastics is improving the adaptation of surgical obturators after maxillary resections. The surgical defects in these clinical conditions could be so large that the thickness of the lining material would affect the properties of tissue conditioners.[5,6]

Among various physical properties of tissue conditioners, there can be limitations for tissue conditioners resulting from the effects of the oral cavity environment on physical properties which necessitate frequent replacement of the material. The ethanol and plasticizers leach into the saliva, which is then absorbed by the polymeric phase of the gel. It has been shown that over a period of 1 week, water sorption increased from 0.2 to 5.6 mg/cm, and solubility ranged from 0.03 to 0.40 mg/cm for various commercial products. Loss of elastic properties required for the therapy, the usable period of TCs in the mouth cavity should be accordingly short. Surface-coated conditioners may provide an extended period of resiliency and a longer life under clinical conditions.[7,8,9]

Tissue conditioners have rough surfaces which lead to accumulating various microorganisms which lead to denture stomatitis, for that reason many dentists prefer to place the denture into various denture cleansers. The solutions used for denture cleaning can be divided according to their chemical composition: alkaline peroxide, alkaline hypochlorite, acids, disinfectants, and enzymes. The enzymatic solutions, containing protease and mutants, can break down the salivary glycoproteins and bacterial polysaccharides of plaque.[12]

Different effervescent denture cleansers are available as tablets or powder. Fittydent are commonly used denture cleansers, as Fittydent is effective in decreasing *Candida albicans* adherence on denture base materials while Corega denture cleanser can remove light stains and loosen debris from denture base. However, denture cleansers may also cause reduce denture base strength and also it increases the roughness of the material.[13]

The longevity of tissue conditioner is short, from weeks to a month which necessitates frequent replacement. Several surface-coating agents (monopoly, palaseal, and fluorinated copolymer) extend the life of a temporary soft denture liner because they maintain the resilient characteristics, keep it clean and smooth, and decrease the incidence of microbial growth, however, the effect of monopoly coating on the surface roughness of a tissue conditioner subjected to the action of denture cleanser and disinfectant has not been documented

Coating agent (monopoly) was prepared by mixing chemically activated methyl methacrylate monomer and clear methyl methacrylate polymer. The mixture was composed of one part powder to 10 parts liquid. The powder and liquid were placed together in a glass beaker in a water bath at 55°C and stirred for 8–10 min until the mixture started to thicken.

Thus, based on the above-mentioned factors, various variables and parameters for a tissue conditioner this study was carried out to evaluate the effect of

monopoly coating on surface roughness of acrylic (VISCO GEL, DENTSPLAY) and silicone-based (RELINE SOFT, GC) tissue conditioners subjected to artificial saliva and denture cleanser by evaluating roughness of acrylic and silicon based soft liner with and without monopoly coating.

MATERIAL AND METHODOLOGY

Material

1. Acrylic based tissue conditioner (Visco-gel, De Trey/ DENTSPLY, Weybridge, Surrey, United Kingdom) (Figure 1)
2. Silicone based tissue conditioner (GC reline soft) (Figure 2)
3. Denture cleanser (Fitty Dent, Group Pharmaceuticals LTD., Mumbai, India) (Figure3)
4. Acrylic Repair Material (DPI-RR Cold cure, The Bombay Burmah Trading Corporation, Ltd., India) (Figure 4)
5. Coating agent (Monopoly) (Figure 5)
6. Artificial saliva (Xerostat artificial saliva) (Figure 6)
7. Distilled water

Armamentarium

1. Rubber Bowl
2. Brush
3. Circular metal mold (Figure 7)
4. Glass slab and metal spatula

Equipment

Surface roughness tester, Mitutoyo.ISO 1997

Methodology

A. Source of data

This in vitro study will be conducted in the department of prosthodontics, pacific dental college and hospital, Debari (Udaipur).

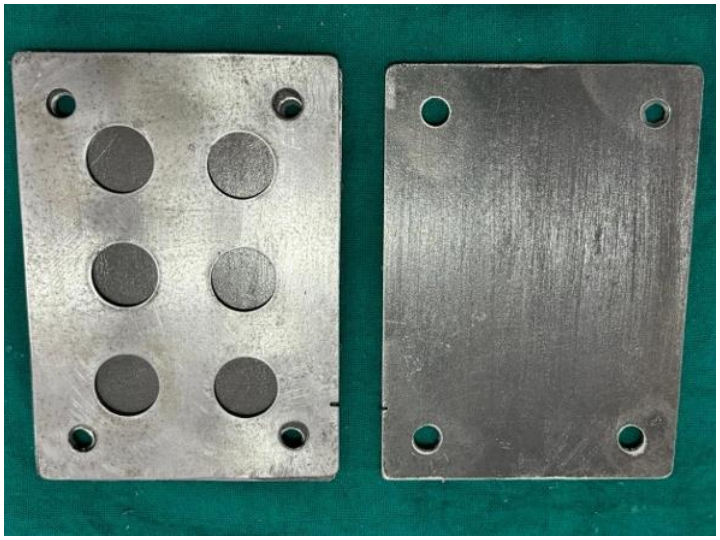
B. Study Design

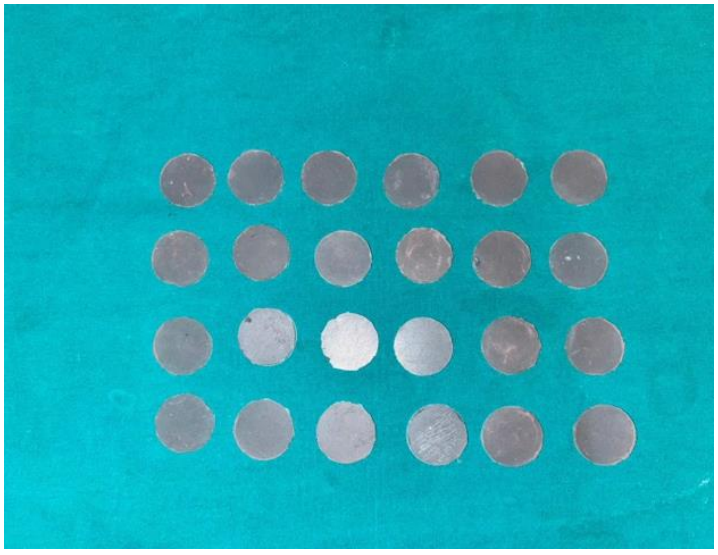
An experimental parametric in-vitro study will be conducted in the department of prosthodontics crown & bridge and Implantology, Pacific Dental College and hospital, Udaipur. The research design will be based on an experimental assessment of evaluation of two tissue conditioner agents with monopoly coating agent after immersed in artificial saliva, and denture cleanser.

C. Preparation of sample

1. A Metal mold of 2mm thickness and 20mm internal diameter was made and the specimens were prepared by mixing 3g (one measure) of powder of Visco-gel with 2.2ml (one measure) of liquid, for 30 seconds, and after 2 minutes, the Visco-gel was poured into the mold and was pressed for 2 hours. The specimens were removed and stored first into artificial saliva and then in denture cleanser. (Figure 2)

2. A metal mold of 2mm thickness and 20mm internal diameter was made and the specimens were prepared by mixing equal length of base paste and catalyst paste and mixed with plastic spatula and poured into metal mold and was pressed for 2 hours. The specimens were removed and stored first into artificial saliva and then in denture cleanser for 8 to 10 minutes.





D. Preparation of Monopoly coating agent:

Monopoly was prepared by mixing 200g of chemically activated methyl methacrylate monomer and 20g of clear dymethyl methacrylate polymer (1:10) in a glass beaker in a water bath at 55 C, (Figure 12) and stirred for 8-10 minutes until the mixture started to thicken. (Figure 13) The syrup-like liquid was then stored in a dark bottle at overnight and was applied to the tissue conditioner specimens as they were completed.

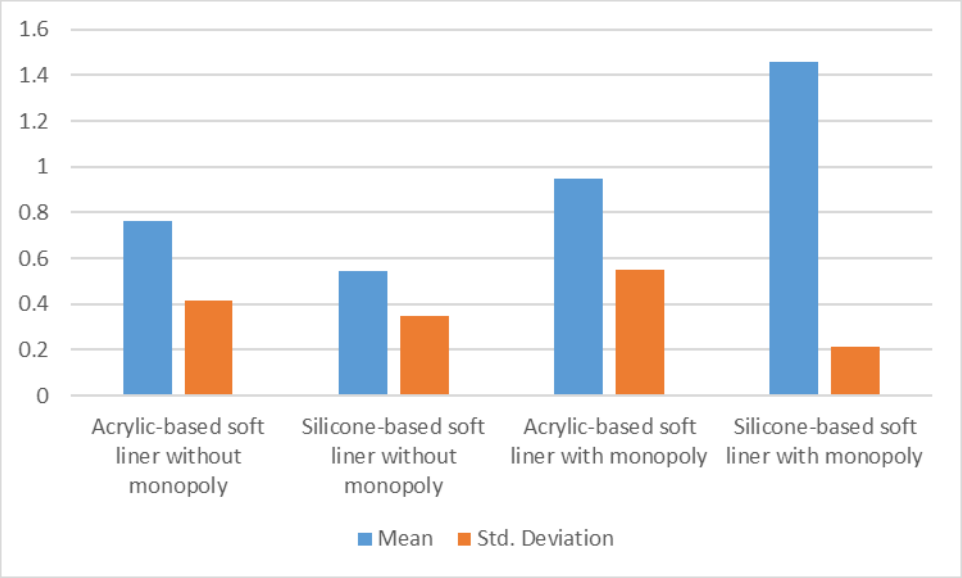
E. Grouping of samples

20 Disk shape specimen of visco-gel (Acrylic tissue conditioner) and 20 of GC- Reline soft (silicone tissue conditioner) were made and divided into four groups. (Figure 14,15)

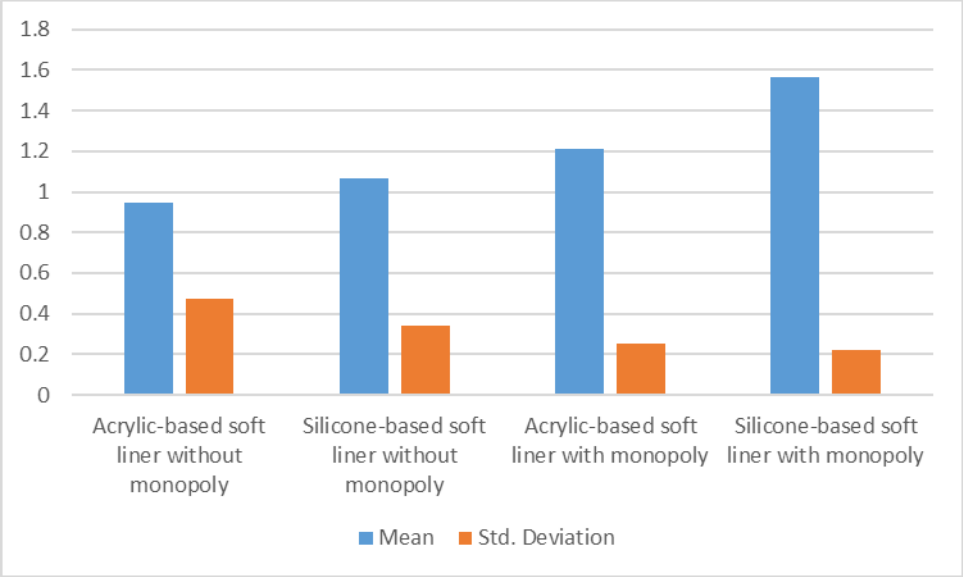
Control 1	ASL +AS+DC
Control 2	SSL+AS+DC
Group 1	ASL + MP+AS+DC
Group 2	SSL + MP+AS+DC

RESULT

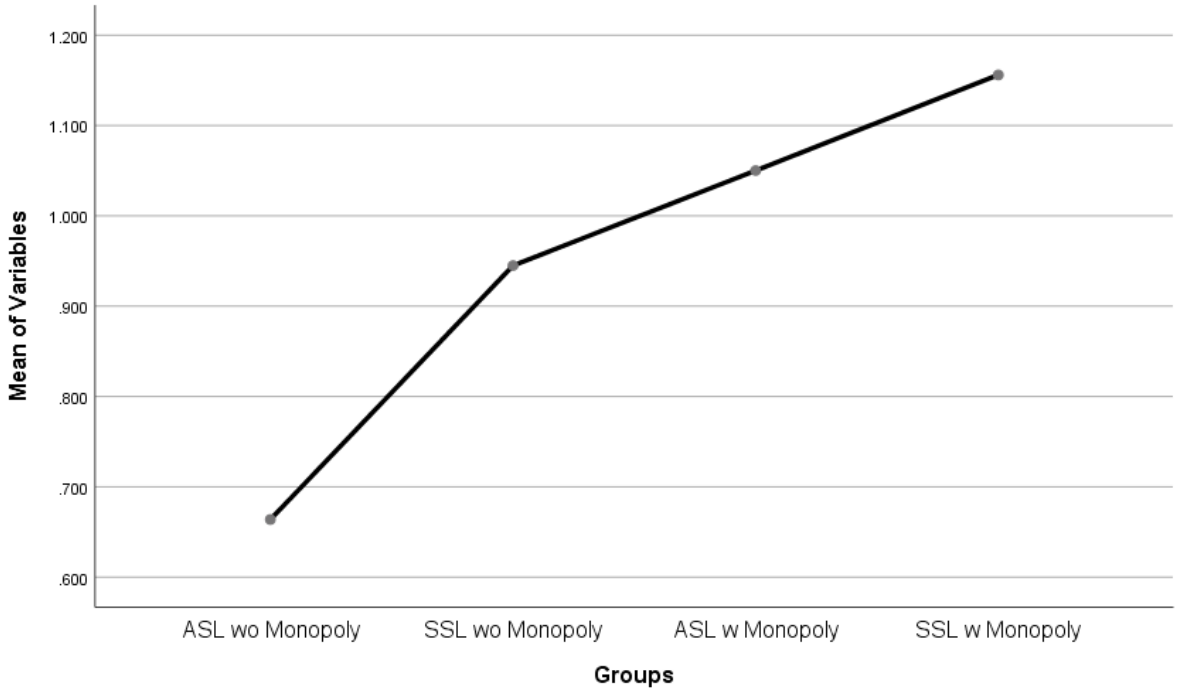
values for mean and standard deviation for all variables in study, where mean for Acrylic-based soft liner without monopoly was .763, Silicone-based soft liner without monopoly was .54490, Acrylic-based soft liner with monopoly was .950 and for Silicone-based soft liner with monopoly was .212 respectively.



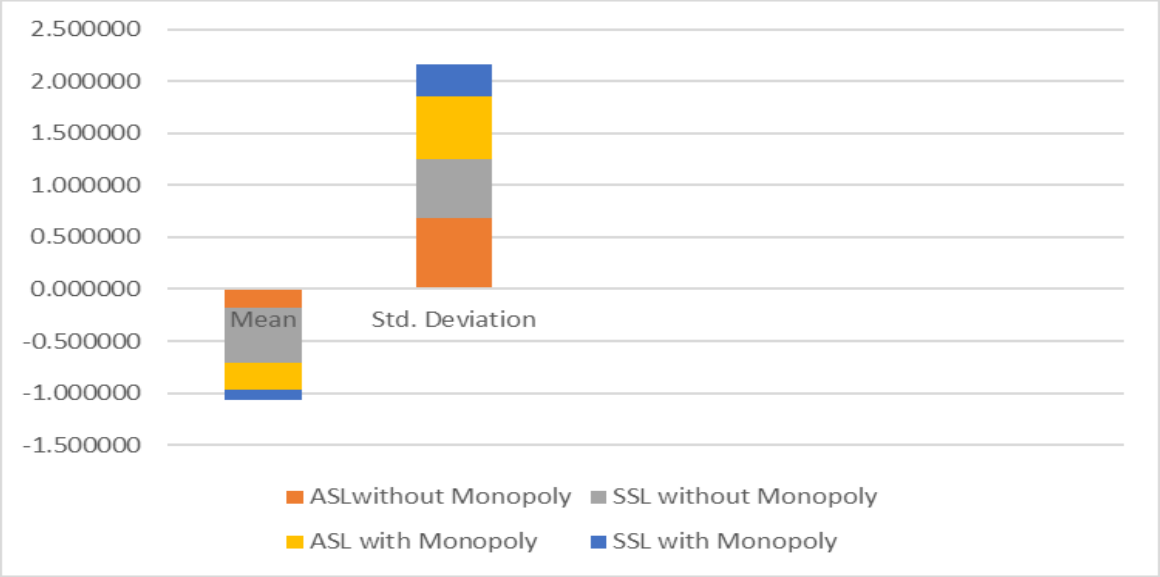
values for mean and standard deviation for all variables in study during 7th day, where mean for Acrylic-based soft liner without monopoly was .948, Silicone-based soft liner without monopoly was 1.0647, Acrylic-based soft liner with monopoly was 1.2092 and for Silicone-based soft liner with monopoly was 1.5627 respectively.



Comparisons of various study groups on day 1 and day 7 respectively, where obtained p value for both the groups on Day 1 and Day 7 were statistically significant on application of One wat ANOVA TEST, WHICH SIGNIFIES there was a significant change between groups on day 1 and day 7 respectively.



Comparison of mean values among groups on day 1 and day 7 , where obtained p value were statistically significant for all groups, on application of One way t-TEST, where Acrylic-based soft liner with monopoly has p-value 0.01 which is above other two groups among significant level.



DISCUSSION

Soft denture liners are generally classified into (a) Short term soft liners and (b) Long term soft liners[9]. The longevity of short-term soft liners or tissue conditioners may be, from a week to a month[33,34]. Tissue conditioners have been used in managing patients with abused tissues underlying ill-fitting dentures, and in making functional impressions. It also serves as a "shock absorber" between the occlusal surfaces of a denture and the underlying oral tissues[80]. One of the disadvantages of a tissue conditioner is that it gradually hardens and becomes rough with time, due to the leaching out of plasticizers and ethanol, affecting the mucosal health.

Surface roughness increases the area available for adhesion and provides niches in which micro-organisms are protected from shear forces, thus giving microbial cells time to become irreversibly attached to a surface [18,19] Hence, it is essential to have a surface which is relatively clean and smooth to maintain good oral health.

Monopoly is a cost-effective method of extending the longevity of a tissue conditioner, which act as a barrier and minimizes the leaching out of the plasticizer, and ethyl alcohol, which results in fewer surface irregularities and keeps the surface area clean and smooth.[35] It has also been reported that coating tissue conditioners with monopoly can extend the life the tissue conditioner to a year[37] as it maintains the resiliency of tissue conditioner38 and seals the pores, preventing the entry of microorganisms.

Hence, the effect of surface coating on the surface roughness of tissue conditioners subjected to the action of denture cleanser and disinfectant was evaluated and compared with control groups, not coated with monopoly, for a period of 7 days.

In the present study specimens were prepared by mixing 3g (one measure) of powder of Visco-gel with 2.2ml (one measure) of liquid according to manufacturer's instruction for 30 seconds and after 2 minutes, the visco gel was poured into the mold of 3mm thickness and 20mm internal diameter35 and was pressed with a glass slab for 2 hours. The specimens were removed and stored in the sterile glass jar having distilled water. Specimens of 2mm thickness were prepared because a 2mm thickness of soft lining material is most suitable for improving the pressure distribution on supporting tissues under the denture. Silicon based soft liner GC reline soft mixed using equal length of Base paste and accelerator paste and mixed in glass slab using metal spatula and after proper mixing it will pour in metal mould of 2mm thickness and 20mm length and 20 sample are prepared.

40 disk shaped sample were prepared and divided in 2 groups in which 20 sample and divided in 10 of acrylic based soft liner (Viscogel) and 10 of silicon based soft liner (GC Reline soft) without monopoly coating agent and other 20 in which 10 sample acrylic based soft liner (viscogel) and 10 silicone

based soft liner (GC Reline soft) with monopoly coating agent .

The mean surface roughness values of the specimens not coated with monopoly was significantly higher than that of specimens coated with monopoly. These results were in accordance with the findings of Gardner[37] who reported that longevity of tissue conditioner can be extended up to 1 year, by coating the tissue surface with monopoly, and that the monopoly coating maintains the resilient characteristics and keep the surface clean and smooth decreasing the incidence of microbial growth.

The surface coated tissue conditioners retained their surface integrity, which may be due to reduced leaching out of the plasticizers. This test result is accordance with Hiroshi nikava who reported same significant result and stated that coating of monopoly coating reduced surface roughness of tissue conditioners and increase their long term use[28].

In the present study intergroup comparison also done and it shows that group 1 and group 2 when immersed in artificial saliva and followed by denture cleanser it shows the value from day 1 to day 7,[45] shows that group 2 has less surface roughness when compare with group 1 when the final test done on end of 7 day the roughness value shows that group 2 has very less value compare with control 1,control 2, group 1 and shows that silicone based soft liner with monopoly coating agent after immersed in artificial saliva and denture cleanser shows less surface roughness then silicone based soft liner without monopoly coating agent , acrylic based soft liner without monopoly coating agent and acrylic based soft liner with monopoly coating agent.

In the present study the surface roughness of the specimens from both the groups were greater than 0.76µm, indicating that there is a possibility for plaque accumulation, since 0.2µm is considered the threshold below which no further bacterial adherence can occur.

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Assessment of Barr Bodies in Oral Exfoliative Cells for Sex Determination

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Abstract

Introduction: Individual identity is an imperative aspect in any investigation procedure. At times it becomes necessary to determine the sex of a particular individual, like for deciding questions relating to legitimacy, divorce and paternity for some criminal offences. Objective of this study was to assess presence of Barr bodies in oral exfoliative cells of both sex for gender determination.

Aim & Objectives: To Assess Barr bodies in oral exfoliative cells or sex determination

Method: Smear prepared from 30 men and 30 women were stained by the Papanicolaou stain. Cells be served for Barr bodies under oil immersion with compound microscope and the percentage of Barr body-positive cells determined.

Results: Two non-overlapping ranges for the percentage of Barr body positive cells have been obtained for men and women. In the male samples, the percentage of Barr body positive cells ranged from 0-4%. Out of the 30 male samples observed, 18 samples showed 1-4% presence of Barr bodies. In the remaining 12 samples no Barr-body positive cells (0%) were observed. Mean value for barr body positive cells in male samples was 1.46. In the female samples, the percentage of Barr-body-positive cells ranged from 22-74% and all the samples showed the presence of Barr bodies. Out of 30 female samples, 25 female samples showed more than 35% presence of barr body. Mean value for barr body positive cells in female samples was 43.56

Conclusion: Presence of Barr body in exfoliated cells can be demonstrated with a fair degree of accuracy in sex determination.
Keywords: Lyonization, Barr body, Papanicolaou stain

INTRODUCTION

Individual identity is an imperative aspect in any investigation procedure. Sometimes it becomes necessary to determine the sex of a particular individual, for the purpose of simple identification in the living, where the individual of one sex carries the features of the opposite sex; when a person appears to possess the primary sex organs of both the sexes; for the purpose of deciding whether an individual can exercise certain civil rights reserved for one sex only; for deciding questions relating to legitimacy, divorce, paternity, affiliation and also to some criminal offences; simple identification of dead individuals in an advanced state of decay where primary sex organs are lost due to decomposition.

It becomes a challenging task when insufficient samples are obtained. In such conditions, Nuclear sex determination makes way for identification of the individual. Nuclear sex chromatin can be demonstrated by various methods, among these, one of the common method is **Buccal smear** method. In this method, sex of the individual is identified using nuclear sex chromatin method[1]

Various cytologic studies prove the presence of condensed deeply stained chromatin material in nuclei of female cats in 1940's which was later termed as Barr-body by Murray Barr. These cells found to be present only in females which can be used as a vital tool for determination of sex of the individual. Significance of presence of such densely stained material in nuclear material was given by Lyon, who suggested that inactivation of one of the X chromo some in each somatic cell occurs during the early embryonic development and named such process as Lyonization. Simple techniques such as determination of sex from buccal smear were given by Moore and Barr.[2]

Inactivated X-chromosomes seen in female somatic cells are called Barr-bodies which are present adjacent to the nuclear membrane. Barr bodies are small, dark stained mass of inactive X-chromosomes in females within the nucleus. " Mc.Barr" and "Bertram" were the two scientists to observe the deeply stained chromatin body in the nerve cell of female cat in the year 1943. Later they came to know that the chromatin body was found absent in male cat. This chromatin body is called as a sex chromatin or Barr body.[3] Male have one "X" and one "Y" chromosome and both are active. In female there are 2 "X" chromosomes (xx chromosomes), among which one is active and other one is inactive. This inactive "X" chromosome represents the Barr body. When the body inactivates extra X chromosomes to keep the dosage of genetic products equal it is called **dosage compensation**.[4]

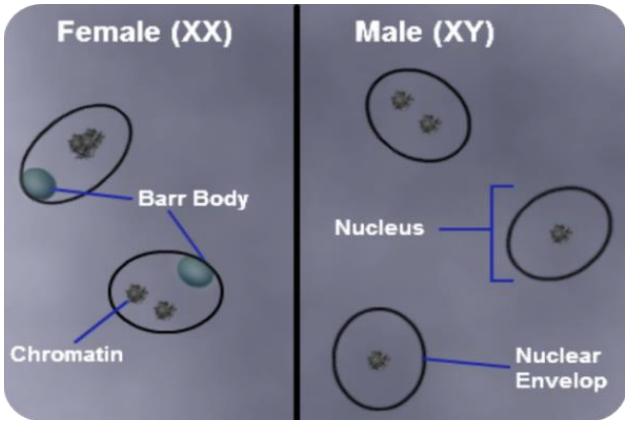

Figure 1a

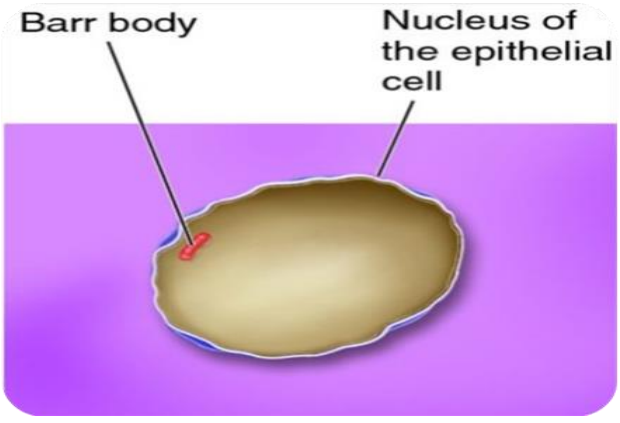

Figure 1b

Figure 1(a & b):Showing Barr body in female cells and no barr body in male cells

Aim & Objectives: To Assess Barr bodies in oral exfoliative cells or sex determination**.**

MATERIAL &METHOD

A cross-sectional study wasconductedamongst60 study subjects who reported to Department of Oral Maxillofacial Pathology, RUHS College of Dental Sciences, Jaipur between Dec 2015 and July 2016 . A simple random sampling by lottery method was done to select the study subjects for the purpose of the study . Ethical approval was obtained from the institutional ethical committee and declaration of Helsinki[5] followed . As per the study conducted by Reddy et al 72% positivity for females were found for assessment of Barr Bodies in oral exfoliative cells for sex determination so by taking 72% prevalence, 90 % power, 5% significance level with 95 % confidence interval and by using the equation 4pq/L2, sample size was calculated as 54. The present study was done on 60 study subjects which was divided into two groups consisting of 30 men and 30 women between the ages of 24 and 45 years. Participants were informed in their vernacular language regarding the procedure, and written informed consent was obtained.

In the present study, we have determined the sex of the individuals from exfoliative cytology. Smears prepared from 30 men and 30 women were stained by the Papanicolaou stain. Cells were observed for Barr bodies under oil immersion with compound microscope, and the percentage of Barr body-positive cells determined.

Samples of buccal mucosa smears from 30 men and 30 women were obtained by scraping with flat wooden sticks (exfoliative cytology).

- Patient's mouth rinsed thoroughly with tap water and followed with distilled water.
- Mucosa scraped gently from the deeper layer of mouth with the help of cleanly washed wooden spatula.
- Sample smeared over a small area on a clean dry slide and allowed for air drying.
- The smears were fixed in Zenker's fixative.
- The fixed slides then stained by using Papanicolou stain.
- Stained slides were mounted with cover slip using DPX solution.
- Morphological details of the exfoliative cells were studied with compound microscope under oil immersion (100X objective) lens and the microphotographs were taken.
- 100 cells were observed in each slide.
- Total number of Barr-body-positive cells was counted among these 100 cells.

Data Analysis

The data was entered in the MS EXCEL spread sheet, coded appropriately and cleansed for any possible typing error and then the data was analyzed by chi-square statistical test using SPSS 20 software as per study objective.

RESULTS

Table 1: DETECTION OF BARR-BODY POSITIVE CELLS IN MEN AND WOMEN

SEX	RANGE %	STANDARD DEVIATION
MALE	4	1.5024
FEMALE	74	11.8806

All the data were calculated and statistically analyzed with SPSS 20.0 computer software package for windows (SPSS IN., Chicago, IL.USA). The data expressed as mean+SEM.

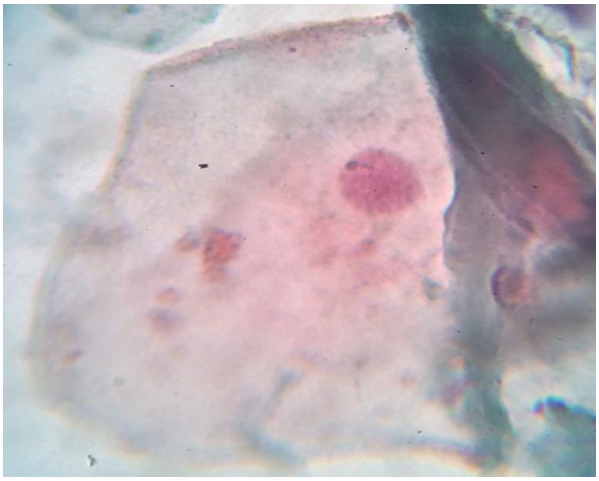

Figure 2a

Figure 2b

Figure 2 (a, b) showing Barr body (100x under oil immersion)

In the present study, the following results from the buccal smears of men and women were obtained. Two non-overlapping ranges for the percentage of Barr body positive cells have been obtained for men and women. In the male samples, the percentage of Barr body positive cells ranged from 0-4%. Out of the 30 male samples observed, 18 samples showed 1-4% presence of Barr bodies. In the remaining 12 samples no Barr-body positive cells (0%) were observed. In the female samples, the percentage of Barr-body-positive cells ranged from 22-74%and all the samples showed the presence of Barr bodies. Out of 30 female samples, 25 female samples showed more than35% presence of barr body.

DISCUSSION

Determination of individual's sex becomes an imperative aspect in any investigation procedure. Apart from criminal investigations, disputes related to legitimacy, divorce, paternity and affiliation also demands determination of individual's sex.

There are two methods for Sex determination analysis; morphological analysis orby molecular analysis. Morphological analysis can be done on hard tissues (odontometric, orthometric etc.) of para oral and oral regions or soft tissue analysis (Cheiloscopy, Rugoscopy etc.). Molecular analysis involves the study of DNA from extracted pulp, skin, cartilage, hair, buccal mucosa, epithelium attached to denture .[7]

Sex determination by buccal epithelial cells is one of the commonly used method in the determination of individual's sex. In this method, sex of the individual is identified using nuclear sex chromatin method. In this method we need to identify the presence of Barr Body in the nucleus of buccal epithelial cells.

Moore and Barr in 1955, first introduced the buccal smear technique to identify sex. Barr bodies are Feulgen-positive, hetero-pyknotic, basophilic, intra-nuclear structures, seen in mammalian cells during interphase. They are noticed as densely stained condensed chromatin masses adjacent to the nuclear membrane. They can be plano-convex, biconvex, spherical, rectangular or triangular in shape. Sometimes, they resemble the letter V, S, W or X under an electron microscope. They measure about 0.8 - 1.1 μmin diameter.[8]

Barr bodies are known to arise from inactivation of the X chromosome in a female cell. This process of inactivation is known as Lyonization. Only one of the X chromosomes is genetically active, the other X of either maternal or paternal origin under goes hetero-pyknosis and is rendered inactive. The molecular basis of X Inactivation involves a unique gene called Xist, whose product is a non-coding RNA that is retained in the nucleus, where it "coats" the inactive X chromosome and initiates a gene-silencing process by chromatin modification and DNA methylation. The Xist allele is turned off in the active X.[9]

Recent work has provided insight into how the travel of X inactivation is brought about. The XIST/Xistgene, located at the X-inactivation center, encodes a large untranslated RNA that coats the inactive X chromosome. By knockouts and transgenes, the Xistgene has been shown to be necessary and sufficient for X inactivation.[9]

The Barr body positive males are due to the inheritance of males to carry primary sex organs of both the sexes, as seen in Kleinfelter's syndrome. Though, inactivation process is not completely understood, but it has been suggested that it is under the control of inactivation center, located at Xq13.XIST, a gene which is transcribed from the inactive X, is necessary for initiation and propagation of X inactivation and does this by coating the inactive X chromosome. [10]

Inactivation of either the maternal or paternal X occurs at random among all the cells of the blastocyst about the 16th day of embryonic life. Manjula Bhai KH et al.[11]did not report any Barr-body-positive cells in men, this is in contrast to our study. However, there seemed to be a difference in the range and also the mean percent of Barr bodies among women in the present study as compared to other studies. Considering the fact that the future of an individual identification is based on the reliability of tests such a same logenin sex determination, DXYS156 tests etc. The inclusion of the study of Barr bodies in saliva for gender identification is also suggested to further strengthen the evidence**.**[12]

Any nuclear stain can be used for the demonstration of the Barr Bodies; most commonly used ones are hematoxylin and eosin (H and E), Papanicolou stain, Feulgen stains, guard stains, Cresyl violet, Carbolfuschin and fluorescent stains. In H and E and Papanicolou stains, the bacteria stains heavily, hence the Barr Bodies are not noticed prominently. Orcein also stains bacteria. Bacterial artifacts can be minimized with acid hydrolysis and thionine staining. Feulgen and guard stains are ideal but need to be standardized every time. Fluorescent stains being more confirmatory for the detection of the Barr Bodies but is expensive. In this study, Papanicolou stain was preferred as it stains Barr Bodies more prominently with fewer artifacts and is cost-effective.[2]

It has been observed that the frequency of Barr body is decreased during pregnancy and as well as in women who are on oral contraceptives.[13]

Reactivation of X chromosome was observed whenever the body was under physiological stress**.**[14]

Low frequency suggestive of reactivation of inactive X chromosome is associated with malignancy and is confirmed by enhanced glucose-6-phosphate dehydrogenase activity.[15]

Determination of sex by assessment of barr bodies have few limitations as well. Males with Klinefelter's syndrome tend to show one Barr body in each of their cells due to XXY and females with Turner's syndrome don't show any Barr body due to XO. In such cases the results may be wrong in that particular individual where the test would identify the individuals as females for men with Klinefelter's syndrome, and women with Turner's syndrome would test as men.[16]

CONCLUSION

The study showed that the assessment of Barr body in buccal mucosal cells can be demonstrated with a fair degree of accuracy using Papanicolou staining, to determine sex of individual, as two non-overlapping ranges for the percentage of Barr-body-positive cells had been obtained for men and women.

The sex of the individual can be determined accurately with the added advantages offered, such as the rapidity of processing and screening a specimen that results in saving of time.

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Smile Alignment: Mastering Class II Malocclusion Treatment

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Abstract

Class II malocclusion is a common orthodontic problem characterized by a discrepancy in the anteroposterior relationship between the maxilla and mandible. Effective management of this condition requires a comprehensive understanding of its etiology, accurate diagnosis, and a strategic approach to treatment. This abstract reviews the key considerations in managing Class II malocclusion, emphasizing the importance of timing, treatment modalities, and biomechanical principles.

Class II malocclusion can result from genetic, environmental, and growth factors, necessitating a thorough diagnostic process that includes clinical examination, cephalometric analysis, and model analysis. Treatment can be timed as a one-stage or two-stage process, depending on the patient's growth phase and severity of the malocclusion.

Various treatment modalities are discussed, including growth modification techniques such as functional and extraoral appliances, orthodontic appliances like braces and clear aligners, and temporary skeletal anchorage devices. For severe skeletal discrepancies in adults, orthognathic surgery combined with orthodontic treatment is often necessary.

In conclusion, the management of Class II malocclusion requires a tailored approach that considers the patient's unique needs, growth potential, and specific characteristics of the malocclusion. By employing a combination of treatment modalities and adhering to biomechanical principles, clinicians can achieve functional, stable, and esthetic results.

Keywords: Class II Malocclusion, Compliance, Myofunctional appliance

INTRODUCTION

To recognize a malocclusion, a clinician needs to understand ideal and normal occlusions. People with ideal occlusions have all 32 adult teeth in excellent relationships in all three planes of space. The tip of the mesio-buccal cusp of the upper first molar fits into the buccal groove of the lower first molar, and the tip of the upper canine crown fits into the embrasure between the lower canine and first premolar .Teeth, moreover, are normally angled in the mesiodistal plane, normally inclined in the buccolingual plane, and aligned without being spaced, rotated, or crowded along the crests of the alveolar processes (Andrews 1972).[1]

The correction of sagittal discrepancy has been considered a common goal for the patient and the orthodontist. A large proportion of clinical situations is not a single entity and is often associated with significant skeletal and dental imbalances in sagittal plane. Traditionally, orthodontic assessment and diagnosis is mainly based on Angle's sagittal classification of malocclusion.

The sagittal discrepancies essentially include Class I, Class II and Class III malocclusions; however, defining any one of these malocclusions is difficult because this arbitrary categorization consists of various abnormalities. In their original interpretation and understanding, these abnormalities represent the anteroposterior relationship between the maxillary and the mandibular first permanent molars as described by Edward H. Angle.[2]

'Class II' is a broad term designated to a set of various abnormalities that could be either simple or most complex. It is not a single clinical entity, rather it consists of various components of the craniofacial complex having variations in size, shape and position.[3] There are many different types of Class II patients with significant variations in skeletal, dental and soft tissue morphology.[4]

Patient compliance is one of the determinants of the use of various treatment options that are available in modern orthodontic practice. Lack of compliance in the present orthodontic patient population has been a major concern for the orthodontists. Over the few years, the percentage of patients exhibiting poor compliance has been increased tremendously, with only about 10% demonstrating excellent compliance. The clinician must be aware of the fact that patient compliance usually decreases when longer duration treatment is required.

Recently, a great variety of noncompliance appliances and techniques that are less dependent on patient compliance have been proposed in order to correct Class II malocclusion either by advancing the mandible in a more forward position or by distalizing the maxillary molars into a Class I relationship.

Etiology

The etiology of malocclusion is a fascinating subject about which there is still much to elucidate and understand. Theoretically, malocclusion can occur as a result of genetically determined factors which are inherited, or environmental factors, or a combination of both inherited and environmental factors acting together. For example, failure of eruption of an upper central incisor may arise as a result of dilaceration following an episode of trauma during the deciduous dentition which led to intrusion of the primary predecessor—an example of environmental etiology.

Caries (an environmental factor) has led to early loss of many of the deciduous teeth then forward drift of the first permanent molar teeth may also lead to superimposition of the additional problem of crowding[5].

Clinical Examination and Functional Assessment

Improvement in facial profile is the most important factor considered by most patients seeking orthodontic treatment. Therefore, the focus of orthodontic treatment should be to achieve pleasing facial profile and soft tissue characteristics rather than just cephalometric norms.

In the past few years, the scope of orthodontic assessment and treatment has been expanded, and the ability of the orthodontist to remarkably improve the patient's facial appearance has also been considerably enhanced[1].During the process of clinical examination, while evaluating patient's profile, it is important to study total profile, lip projections and nasolabial angle.

Objectives of treating Class II Div 1 Malocclusion

1. Aesthetics
2. Oral health
3. Function
4. Stability.

Objectives of treating Class II Div 2 Malocclusion

Class II division 2 malocclusion is one of the most challenging occlusal anomalies to manage due to the underlying aetiological skeletal and soft tissue factors. A recent Cochrane review was unable to find any high-quality evidence to advocate any treatment approach over another and much of the evidence around treatment effectiveness comes from case series, clinical experience, and expert opinion. Stable correction of a Class II division 2 incisor relationship has two key components to prevent re-eruption of the incisors after treatment :

1. Correction of the inter-incisal angle.
2. Reduction of the increased overbite.

MANAGEMENT OF COMPLIANT CLASS II PATIENTS

Functional appliances are most commonly used for the treatment of Class II division 1 malocclusions. If the arches are well aligned at the start of treatment, and the only problem is an anteroposterior discrepancy between the arches, then the functional appliance alone may be sufficient. In these cases, it is wise to slightly overcorrect the malocclusion to allow for some relapse and ask the patient to wear the appliance at night until the end of their growth period.

Functional appliances are often used as a first phase of treatment, followed by a second phase of fixed appliances. The functional appliance corrects, or at least reduces, the skeletal discrepancy in a process known as growth modification or dento-facial orthopedics. By correcting the anteroposterior problems with the functional appliance, the amount of anchorage required during the fixed appliance stage is reduced. However, since functional appliances also cause some tilting of the teeth, a significant part of the correction caused by a functional appliance is probably orthodontic camouflage.

TYPES OF REMOVABLE FUNCTIONAL APPLIANCES

- Activator and its modifications
- Balters' bionator
- Frankel functional regulator
- Twin block appliance

TREATMENT OF SKELETAL CLASS II DIVISION 1 MALOCCLUSION

There are three basic approaches to the treatment of Class II, division 1 malocclusion.

They are:

1. Growth modification
2. Camouflage
3. Surgical correction

1) CORRECTION OF MAXILLARY EXCESS:

A) HEADGEAR

Class II malocclusion exhibiting maxillary excess or prognathism can be intercepted by the use of face bow with headgear to restrict further maxillary growth. The maxillary excess in these patients can present as excess in the antero-posterior dimensions characterized by protrusion of the midface and excessive overjet.

It has been found that 400-600 grams of force per side applied for 12-16 hours a day produces favorable skeletal changes. The intermittent forces produce less tooth movement and are also less damaging to the periodontium. In addition, the intermittent force allows the children to wear them at home once they come back from school. The headgear consists of the head cap or a neck strap and a facebow that is attached intraorally to the maxillary molar on either side and extraorally to the neck strap or the head cap[6].

MANAGEMENT OF MAXILLARY EXCESS WITH MANDIBULAR DEFICIENCY

In some patients, Class II malocclusion is complicated by the presence of both maxillary prognathism as well as mandibular deficiency. In such patients a functional appliance such as activator with headgear is used to restrict maxillary growth and promote mandibular growth.

B) ACTIVATOR

The 'activator' is a loose fitting appliance, which holds the mandible forward due to the extended lingual flanges coming from the maxillary plate as a single piece appliance made of heat cure acrylic. The only wire component is a labial bow. The original appliance consists of a combined upper and a lower plate at the occlusal plane only one-wire elements was used i.e. A labial arch for upper anterior teeth[7] (Fig No 1).

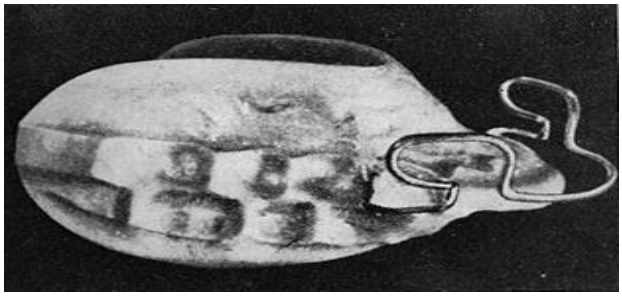

Fig No 1: Activator

C) FRANKEL APPLIANCE

Most significant development in removable functional appliance as far as orthodontics in North America is concerned is the Functional regulator of Rolf Frankel. Frankel drew from the concept of mandibular forward posturing plus the oral screen of Karaus. By reducing the size of oral screen, Frankel designed the appliance to be worn full time. Frankel intended to use oral vestibule, as a basis for treatment. Treatment in the transverse plane, as well as the traditional sagittal plan was his realistic goal[8].

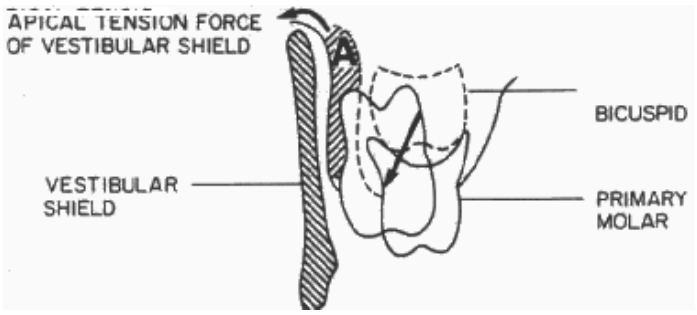

Fig No 2: Schematic view of the influence of vestibular shields on eruptive path and the dentoalveolar development.

The prime factor in success of his appliance was to stimulate the normal function and at the same time eliminates the lip trap, hyperactive mentalis, aberrant buccinators and orbicular actions. He called it an "exercise device".

Use of Frankel Appliance

Major use of the Frankel appliance is for Class II Division malocclusion.

Also effective in Class II Division 2 malocclusion, class III and open bite problems.

Frankel has designed four basic variations of the FR appliance:

FR1 - For correction of class I and class II division 1 malocclusion

FR2 - For correction of class II division 1 and 2 malocclusion

FR3 - For correction of class III malocclusion

FR4 - For correction of open bites and bimaxillary protrusions

Mode of action of the Frankel appliance

a) FR is not a tooth-moving appliance (i.e. FR is a tissue borne appliance)
b) FR withholds muscle pressure from the developing jaws and surrounding area having its arena of operation largely in the vestibule surrounding the alveolar bone.
c) Changes with FR in transverse dimensions is achieved by relief of force from the neuromuscular capsule (the buccinator mechanism)
d) Changes with FR in sagittal posturing is an entirely tissue borne manner[8].

D) TWIN BLOCK

William C.Clark developed twin block appliance in 1997 as a two-piece appliance resembling Schwarz double plate and a split activator. Twin block are bite blocks that effectively modify the occlusal inclined plane to induce favorably directed occlusal force by causing a functional mandibular displacement[9].

Occlusal Inclined Plane

The occlusal inclined plane is the fundamental functional mechanism of the natural dentition. Cuspal inclined planes play an important part in determining the relationship of the teeth as they erupt into occlusion. Occlusal forces transmitted through the dentition provide a constant proprioceptive stimulus to influence rate of growth and trabecular structure of the supporting bone (Fig No: 3).

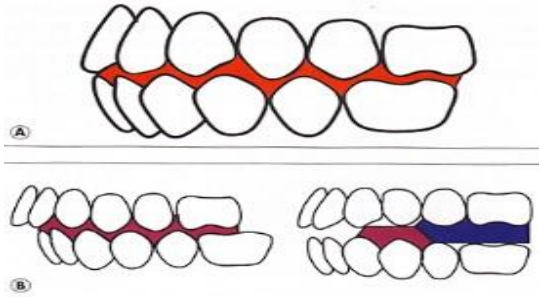

Fig No: 3 -Twin block modify the occlusal inclined plane to guide the mandible forward to correct occlusion.

Twin Block Appliance Therapy

Twin blocks are designed for fulltime wear to take advantage of all functional forces applied to the dentition including the forces of mastication.

It consists of upper & lower bite blocks that interlock at a 70^{o} angle. Wearing bite blocks is rather like wearing dentures and patients can eat comfortably with appliances in plane.

Advantages of Twin Block In comparison to other functional appliances, Twin blocks with occlusal inclined planes give greater freedom of movement in anterior and lateral excursion and cause less interference with normal function. The functional mechanism is very similar to the natural dentition. Another motivating factor is that the appearance is noticeably improved when twin blocks are fitted and the absence of lip, cheek or tongue pads places no restriction of normal functions[9].

Management of Class II Malocclusion

Classification of the noncompliance appliances used for Class II correction

During orthodontic treatment, the cooperation or compliance of the patient is a major factor for a successful treatment outcome. According to Haynes, compliance, as it relates to healthcare, is the "extent to which a person's behavior (in terms of taking medications, following diets, or executing lifestyle changes) coincides with medical or health advice."

During the last decades, many appliances and techniques that reduce or minimize the need for patient compliance have been introduced in order to correct Class II malocclusion. It should be noted, however, that these noncompliance treatment modalities are not solely indicated in patients with minimal compliance but can also be applied to compliant patients.

The noncompliance appliances used in Class II correction present some common characteristics:

- The forces applied in order either to advance the mandible or to move molars distally are produced by means of fixed auxiliaries, either intra- or intermaxillary.
- Almost always, they require the use of dental and/or palatal anchorage such as multibanded fixed appliances, lingual or transpalatal arches, and modified palatal buttons.
- In the majority of these appliances, and especially those used for molar distalization, much use is made of resilient wires, such as super-elastic nickel-titanium (NiTi) and titanium molybdenum alloys (TMA). However, anchorage loss often occurs during molar distalization with these modalities and represents a major negative aspect of their application.

Depending on their mode of action and type of anchorage, all these appliances can be classified into two categories.

1) Intermaxillary Noncompliance Appliances

which derive their anchorage in an intermaxillary manner, act in both maxillary and mandibular arches in order to advance the mandible.

e.g. the Herbst appliance (DentaurumInc., Ispringen, Germany), the Jasper Jumper (American Orthodontics, Sheboygan, WI) , the Adjustable Bite Corrector (OrthoPlus Inc., Santa Rosa, CA), and the Eureka Spring (Eureka Orthodontics, San Louis Obispo, CA, USA) .

2) Intramaxillary Noncompliance Appliances

which derive their anchorage in an intramaxillary or absolute anchorage manner, act only in the maxillary arch in order to move molars distally.

e.g. the Pendulum Appliance, the Distal Jet (American Orthodontics, Sheboygan, WI) , repelling magnets, the Jones Jig (American Orthodontics, Sheboygan, WI) , and palatal implants.

Overview of the Intermaxillary Noncompliance Appliances

The intermaxillary noncompliance appliances can be further classified according to the features of the force system which is used to advance the mandible. In this way, they can be classified into four main categories:

- Rigid intermaxillary appliances (RIMA)
- Flexible intermaxillary appliances (FIMA)
- Hybrid appliances (combination of RIMA and FIMA)
- Appliances acting as substitute for elastics.

Palatally Positioned Implants Used as Anchorage for Molar Distalization

Several implant systems have been used for maxillary molar distalization. These include the Graz Implant-Supported Pendulum (GISP), the Bioresorbable Implant Anchor for Orthodontics System (BIOS Implant System), the Straumann Ortho system, the Frialit-2 Implant System, the Oric Implant System, short epithetic implants, anchorage screws, mini-screws and the On plant System[10].

Bioresorbable Implant Anchor for Orthodontics System (BIOS Implant System)

Glatzmaier and colleagues were the first to introduce an implant supported force system for molar distalization, the BIOS Implant System. This consists of a biodegradable implant body and a variable metal abutment as superstructure. The implant body is fabricated from biodegradable polylactide and provides sufficient anchorage for 9–12 months until degraded. The design and dimensions of the BIOS implant originate from the ITI-Bonefit Screw Implant (Straumann, Waldenburg, Switzerland) with a fixture length of 6 mm[11].

Graz Implant-Supported Pendulum

Byloff et al described the use of the Graz Implant-Supported Pendulum (GISP) (Mondeal Medical Systems, Tuttlingen, Germany) to distalize the maxillary first and second molars in adults. The GISP consists of two parts: the anchorage plate, which is fixed to the palatal bone via four mini-screws and incorporates two cylinders, and the removable part, which is a Pendulum type appliance. The Nance button of the Pendulum Appliance has two cylindrical slots in the palatal surface, which correspond to the two cylinders of the anchorage plate. The system can be loaded 2 weeks after surgical placement, actively distalizes maxillary molars consecutively, serves as an active anchor unit, and provides stability against rotational movements. When the desired molar distalization has been achieved, the GISP can be

used to maintain the molar position, not only passively but actively by exerting counteracting forces to the mesial forces exerted on the molars during retraction of the anterior teeth, thus providing active anchorage[12].

Orthognathic Surgery

Treatment of Class II malocclusion was by mandibular advancement surgery. The most common mandibular advancement surgery done is the bilateral sagittal split osteotomy. Class II malocclusion can be treated by a combination of maxillary and mandibular surgeries, maxillary surgery alone or by mandible surgery solely depending on the underlying skeletal discrepancy.

DISCUSSION

The literature describes several methods for correcting Class II malocclusion during growth, including fixed orthodontic appliances and removable aligners combined with intermaxillary elastics, extraoral appliances, temporary skeletal anchorage, functional appliances, and various types of fixed and removable protraction appliances.

Orthodontic research has extensively investigated the optimal timing and approach for treating Class II malocclusion, considering whether to use a one-stage or two-stage treatment process.

Treating Class II malocclusion in adults poses unique challenges, as growth modification is not an option: **Comprehensive orthodontic treatment**: Often combined with dental extractions to manage crowding and achieve a functional occlusion. **Orthognathic surgery**: To correct skeletal discrepancies and improve facial esthetics.

CONCLUSION

Treating Class II, division 2 malocclusion in adults is notoriously difficult. Adhering to sound biomechanical principles to implement the treatment plan is the most reliable way to achieve consistent results with minimal complications. Treating skeletal Class II malocclusion during growth with a Bionator or an extraoral appliance yields predictable results. This approach brings about changes in facial growth patterns, establishes functional occlusion, ensures long-term stability, and achieves satisfactory facial esthetics. By applying the biomechanical concepts presented and using arch-wires specifically designed for particular objectives, clinicians can achieve the desired outcomes.

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Comparative Evaluation of Sagittal Condylar Guidance in Edentulous Subjects using Interocclusal Record and Radiograph Method Using Cone Beam Computed Tomography (CBCT) in Udaipur City Population – In Vivo Study

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Abstract

Aim: This in vivo study was conducted to compare sagittal condylar guidance angle measured (SCGA) using cone-beam computed tomography (CBCT) and interocclusal records in completely edentulous patients.

Materials and Methods: Based on the inclusion and exclusion criteria, 15 completely edentulous individuals were evaluated. Radiologically CBCT imaging were used to record SCGA.

Results: After recording, the CBCT of the patient SCGA was measured using the Frankfort horizontal reference line and mean curvature line. The most superior and most inferior points of the curvature were identified to determine the mean curvature line. SCGA was measured in the clinical method using interocclusal method in the same patients. Data obtained using both methods were subjected to statistical analysis.

The mean left and right SCGA using CBCT view was 34.67 and 34.53, respectively. The mean right and left SCGA using interocclusal records were 24.87 and 25.73 respectively. Intergroup comparison of condylar guidance of both sides where obtained results were statistically significant along with mean 9.66 and 8.93 respectively for Radiographic Right – Interocclusal Right and Radiographic Left – Interocclusal Left variables.

Conclusion: There was no significant difference in values of SCGA when evaluated using both techniques. Within the study's limitations, CBCT appears to be a viable alternative to traditional methods for recording.

Keywords: Cone beam computed tomography, Interocclusal records, Sagittal condylar guidance angle.

INTRODUCTION

The rehabilitation of completely edentulous patients presents a significant challenge for prosthodontists, as it requires the creation of complete denture prostheses that seamlessly integrate with the surrounding stomatognathic system[1]. Achieving optimal esthetics, function, and phonetics in complete denture fabrication hinges upon recording an accurate maxillomandibular relationship. This entails establishing precise vertical dimension of occlusion (VDO) and centric relations (CR) through meticulous clinical skills. Any errors made during the recording of maxillomandibular jaw relation records can lead to discomfort and potential unwearability of the dentures, underscoring the critical nature of this aspect of prosthodontic treatment[2].

According to The Glossary of Prosthodontic Terms 9 (GPT-9), condylar guidance (CG) can be defined as mandibular guidance generated by the condyle and articular disc traversing the contour of the articular eminence (AE)[3]. According to the glossary of prosthodontic Terms 10 (GPT-10), Condylar guidance can be defined as the mechanical form located in the posterior region of an articulator that controls movement of its mobile member. The sagittal condylar guidance angle (SCGA) is determined by the condyle and articular disc traversing the contour of the glenoid fossa and the articular eminence[4].

Various methods are employed for recording centric relations, categorized into static, graphic, functional, and cephalometric approaches. Functional methods, subdivided into intra-oral and extra-oral methods, are exemplified by techniques such as interocclusal protrusive wax records, Lucia jig, leaf gauge, and intraoral tracers. Among these, interocclusal wax records and graphical methods are most commonly used, though they are prone to errors due to factors related to patient, operator, or equipment/material[4].

Protrusive or lateral interocclusal records used to record SCGA on an articulator and also records were originally used for the registration of condyle translation. In 1905 Christensen advocated the use of protrusive wax records to determine SCGA directly on an articulator and recommended a 4-mm to 5-mm mandible protrusion during recording. In contrast, Posselt and Craddock recommended a 6-mm protrusion for wax registrations. A protrusive record of 6-mm distance is obtained and used for programming of the semi-adjustable articulator based on which the condylar guidance is set[5].

Recognizing the limitations and errors inherent in manual registration methods, alternative approaches utilizing radiographs have emerged. Radiographic methods offer advantages such as stable bony landmarks and reduced reliance on operator or patient neuromuscular control[3]. Cone beam computed tomography (CBCT), in particular, has gained popularity for its three-dimensional imaging capabilities, providing accurate multiplanar sections without superimposition[6]. Studies suggest that SCGA values obtained from various radiographic methods can be directly used in the programming of semi-adjustable articulators, potentially saving time and avoiding patient-sensitive clinical procedures[7].

Despite the advantages of radiographic techniques, challenges such as additional equipment costs and radiation exposure must be considered. Moreover, there remains a scarcity of evidence in the literature comparing sagittal condylar angle values obtained from different radiographic methods, highlighting the need for further research in this area[8].

This study aims to address this gap by comparing SCGA obtained from manual and CBCT methods, evaluating the potential of CBCT as an alternative aid for programming dental articulators. By elucidating the comparative efficacy of these methods, this research endeavours to contribute to the refinement of prosthodontic treatment protocols and enhance the quality of complete denture prostheses.

MATERIAL AND METHODOLOGY

MATERIALS

1. Plaster of paris
2. Die stone
3. Cold cure acrylic resin
4. Modelling wax
5. Petroleum Jelly
6. Sticky Wax

EQUIPMENT

1. Hanau wide vue articulator
2. Whip mix Facebow.
3. Extra oral tracers
4. Rubber bowl & Spatula
5. Lacron Carver
6. Wax knife & Wax spatula
7. B.P blade
8. Diagnostic set
9. Cone beam computed tomography – Carestream & Carestream software

METHODOLOGY

A. SOURCE OF DATA

This In- vivo study will be conducted in the Department of prosthodontics, Pacific Dental College and Hospital, Debari, Udaipur.

B. STUDY DESIGN

An In Vivo study was conducted in department of crown and bridge and implantology, Pacific Dental college and hospital, Udaipur. The study is to evaluate and compare the two techniques, manual (interocclusal records) by centric and protrusive method and radiographic (CBCT) in determining the sagittal condylar guidance.

C. CRITERIA

INCLUSION CRITERIA

1. Healthy Completely edentulous patient
2. Clinically symmetric ridges

EXCLUSION CRITERIA

1. Temporomandibular or cranio cervical disorders
2. Any pathologic condition involving the oral soft or hard tissues
3. History of craniofacial trauma or surgery
4. Gross asymmetry of the face.

D. PROCEDURE

Informed consent will be obtained from all the participants prior to their participation. Each subject will be seated in a dental chair with the head upright supported by the head rest, so the F-H plane is parallel to the floor. Different measurements relevant to this study will be recorded by one operator. Each parameter will be measured and the average value will be computed and recorded**.**

FOR CBCT

Conventional steps in the fabrication of complete dentures were carried out till Try in. A CBCT image of the midfacial region of each individual was obtained in centric position. Using appropriate software, axial sections perpendicular to condylar long axis were made at the level of the head of the condyle and inferior border of the zygomatic arch. To determine the maximum depth of glenoid fossa, a perpendicular line connecting the deepest point of the glenoid fossa was drawn onto another line connecting the two sides of glenoid fossa on the central section and two sections before and after. The FHP was constructed after identifying the “porion” and “orbitale” and another second line was constructed along the posterior slope of AE, connecting the most concave (highest) point on the glenoid fossa and the most convex (lowest) point on the apical portion of AE. The condylar inclination angle for both the sides was obtained by measuring the angle between FHP and the second constructed line for each individual. Finally, condylar inclination values obtained by the radiographic methods will be evaluated (Fig1, Fig2).

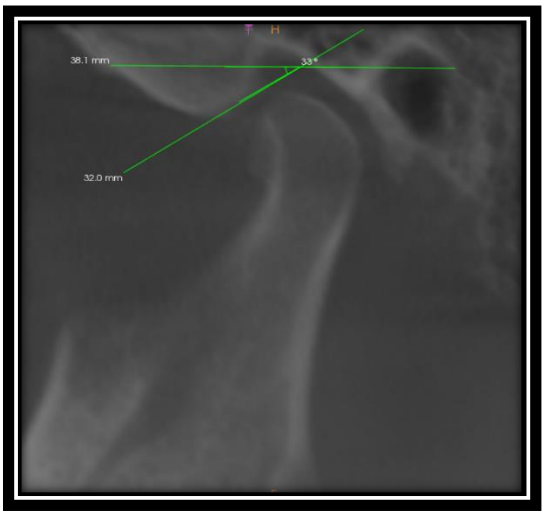


Fig: 1

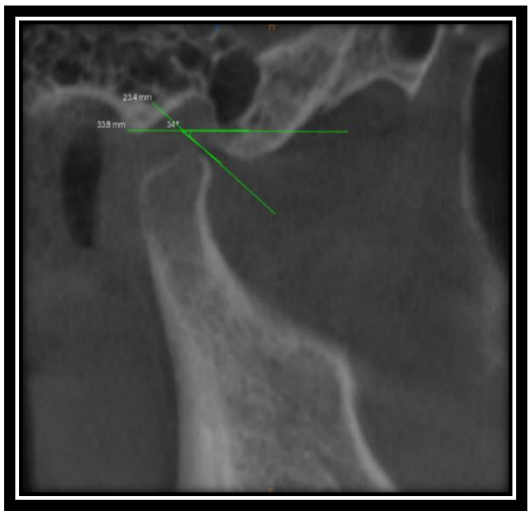


Fig: 2

For Manual method

Conventional steps in the fabrication of complete dentures were carried out till jaw relation. Facebow registrations were accomplished using the standard technique, and maxillary cast was mounted along with split cast using indirect technique (Fig3). After tentative jaw relation, mandibular cast was mounted to articulator using centric relation record(Fig: 4). The intraoral tracers were attached to the occlusion rims. Center-bearing plate on maxillary occlusal rim and center bearing point on mandibular occlusal rim were attached. The patient was guided about various movements that needed to be performed and after adequate training, the patients were able to give a definitive arrow point tracing with acceptable sharp apex. The arrow point tracing was secured by attaching transparent film of the same size on the recording plate. The transparent film was perforated 6 mm from the apex of centric point and the patient was guided to hold the stylus in this protrusion point. Type II dental plaster and Type IV Dental stone in the ratio of 2:1 was mixed and was placed in-between the rims and centric and protrusive records were obtained (Fig:4). This protrusive record was used to program the articulator (Fig: 5). The centric locknuts of the Hanau Wide Vue semi-adjustable articulator were released, incisal guide pin raised approximately half inch from the guide table. The protrusive record was placed and right and left side calibrations of horizontal condylar assembly were adjusted till the complete seating of the protrusive record without any gaps between the notches on the cast and split cast mounting. After tightening the locknuts, the protrusive relation record was then removed. Thus, horizontal condylar inclinations on both sides of the articulator were set. The right and left SCG value on articulator were tabulated for all the patients.

Fig: 3

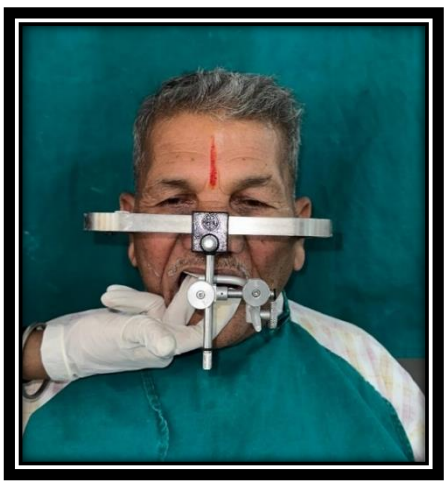


Fig: 4

Fig: 5

Fig: 6

E. Grouping of samples

15 subjects were selected, including all the inclusion and exclusion criteria. In all 15 subjects we had measure SCGA using protrusive inter occlusal records and using CBCT.

RESULTS

Table 1: Descriptive statistics for different methods

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Radiographic Right	15	30	41	34.53	3.270
Radiographic Left	15	31	42	34.67	2.845
Interocclusal Right	15	20	30	24.87	3.681
Interocclusal Left	15	20	31	25.73	3.634

Table 2: Intergroup comparison of condylar guidance of both sides

Variables	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Radiographic Right – Interocclusal Right	9.667	4.419	1.141	7.220	12.114	8.473	14	**.000***
Radiographic Left – Interocclusal Left	8.933	4.267	1.102	6.570	11.296	8.108	14	**.000***

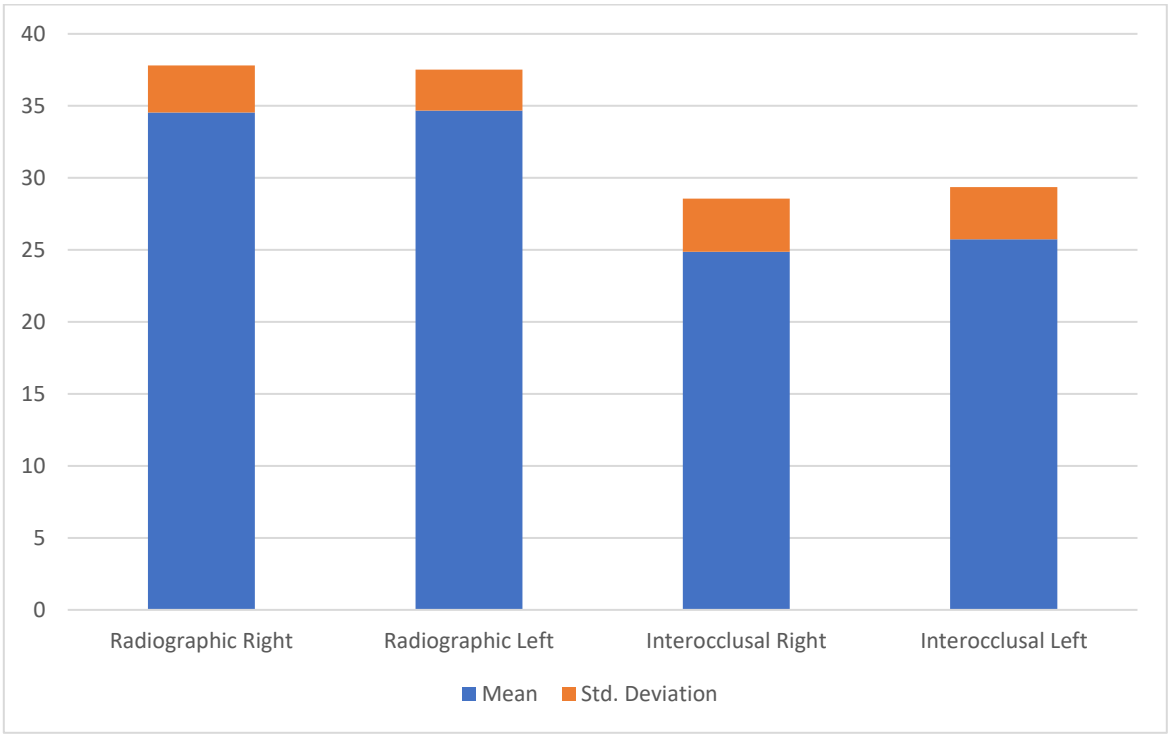
Data were given as mean±SD and the significant difference between the groups was assessed by using *t*-test. df: Degree of freedom, SD: Standard deviation.

Table 3: Correlation between condylar guidance of different methods

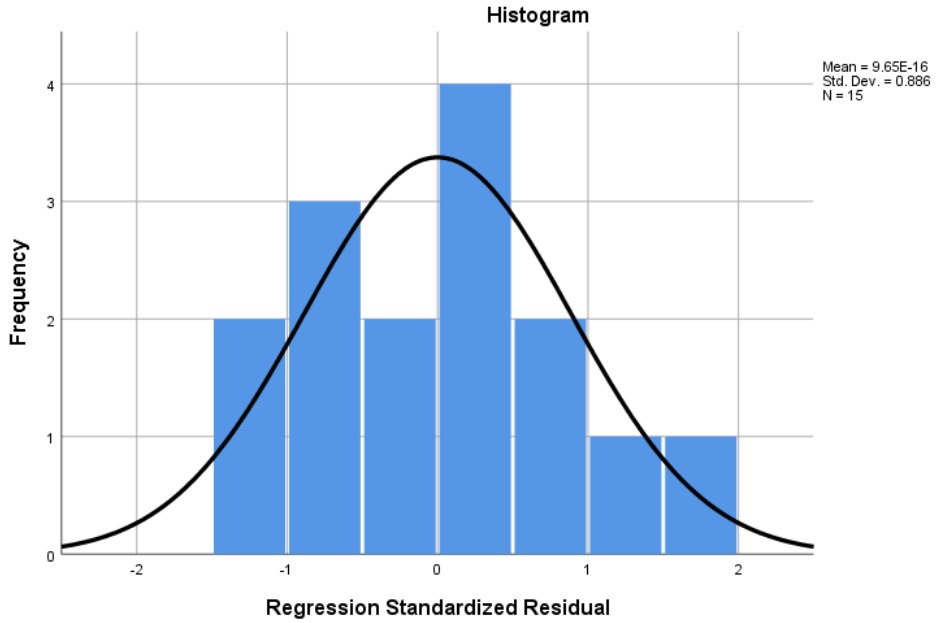
Correlations					
		Radiographic Right	**Radiographic Left**	**Interocclusal Right**	**Intercclusal Left**
Radiographic Right	Pearson Correlation	1	.196	.926**	.187
	Sig. (2-tailed)		.483	**.000**	.504
	N	15	15	15	15
Radiographic Left	Pearson Correlation	.150	1	.173	.926**
	Sig. (2-tailed)	.594		.538	**.000**
	N	15	15	15	15
Interocclusal Right	Pearson Correlation	.196	.173	1	.899**
	Sig. (2-tailed)	.483	.538		**.000**
	N	15	15	15	15
Interocclusal Left	Pearson Correlation	.187	.150	.899**	1
	Sig. (2-tailed)	.504	.594	**.000**	
	N	15	15	15	15
****. Correlation is significant at the 0.01 level (2-tailed).**					

Pearson's "*r*" coefficient correlation test applied.

Graph 1: Showing mean and standard deviation of different condylar guidance angles



Graph 2: Showing correlations between different condylar guidance



DISCUSSION

The Cone Beam Computed Tomography (CBCT) scan is a cornerstone in modern dentistry, providing clinicians with unparalleled insights into the maxillomandibular region. Its ability to produce accurate images of the maxilla, mandible, and surrounding structures makes it indispensable for various diagnostic and treatment planning purposes. One of its notable applications lies in measuring the curvature of the glenoid fossa, a critical parameter for understanding condylar guidance—the mandibular guidance generated by the condyle and articular disc within the glenoid fossa.

Precise recording of condylar guidance is essential to prevent occlusal interferences during mandibular movements, thereby reducing the need for chair-side prosthesis adjustments, which can be time-consuming and frustrating for both patients and clinicians. Traditionally, both intraoral and extraoral methods have been utilized to determine sagittal condylar guidance angles (SCGAs), crucial for programming articulators to reproduce the patient's temporomandibular articulation accurately.

A literature search found that there were few studies available using CBCT panoramic views and CBCT cross-sectional views for the determination of SCGA. We intended to evaluate which CBCT view is better and closer to the routinely suggested method ofextra oral gothic arch tracing method (EGTM). Studies by Schmitter[9] Shrestha[10], Prasad[11] found that SCGA measurement using the graphic method had lower reproducibility, which the authors attributed to variations among instruments, operators, etc.

Prasad and Mawani reported that SCGAs obtained radiographically are higher than those obtained from graphic records methods, our study showed similar results. Kwon et al. compared SCGA measured using a panoramic technique and two CBCT sectional views. They observed that SCGA differed significantly among the three methods which are in accordance with study done by R. Vijaya Kumar, et al. They also found a correlation between SCGA obtained using CBCT sectional views and protrusive occlusal record which is in agreement with our data obtained from this study[12].

Similarly in the present study when Intergroup comparison of condylar guidance of both sides SCG values obtained were found to be statistically significant for both Radiographic Right – Interocclusal Right as well as radiographic left and interocclusal left.

The sagittal condylar guidance angle is a critical factor in individualizing an articulator. Failure to properly record this angle may result in additional time spent on intraoral occlusal modifications. The correlation between posterior (joint-related) and anterior determinants has been controversial.

Christensen and Slabbert[13] reported that SCGAs obtained radiographically are higher than those

obtained from intraoral records. However, if the difference between two methods is consistent, a clinically applicable SCGA can be obtained by adjusting the value measured using radiographic images. There were strong correlations between the SCGAs measured radiographically and using the protrusive occlusal record. Therefore, measuring the SCGA using radiographic images might indeed be a useful method. Previous studies found that intraoral methods of SCGA measurement have lower levels of reproducibility, which is attributable to variations between the instruments and operators.

Similarly in the present study all the variables relating to radiographic images of left or right were found to be statistically significant which is in correlation with the study done by Christensen and Slabbert, where the only difference is among usage of methodology in both the studies.

Panoramic radiography and CBCT are now widely used in diagnoses. CBCT was used to determine the relationships between protrusive occlusal record and radiographic measurements.

If SCGA measurements can be applied to the virtual articulator setting in a CAD-CAM process, this would greatly increase their clinical application. The protrusive occlusal record and CBCT imaging method were found to be comparable in this study.

In a study done by TA Naqash et al (2021)[14], SCGA values obtained from Pantographic tracing(PT) were found to be closer to the SCGA values obtained from protrusive record than that from CBCT. The results are similar to the preliminary study conducted by Torabi et al, SCGA values obtained from PT (Cadiax®) are 2° higher than silicone intraoral records and statistically significant for all measurements. According to the literature, an error within 3.4° in the condylar setting seems acceptable for clinical use.

SCGA using CBCT images and pantographic tracings might indeed be a useful method. However, the value was low for PR indicating inconsistency. The present study is in agreement with the previous studies showing intraoral methods (PR) of recording SCGAs have a lower level of reproducibility and are subject to variation of instrument, operator, and occlusal records. PR technique for measuring SCGAs, regardless of the material used, is inconsistent and lacks precision; results from the previous studies have reported significant differences between instruments and also between consecutive registrations for the same patients. Gross et al. have reported that Hanau consistently gave the lowest SCGA values and Whip Mix the highest, in the same patient.

The problem with the Protrusive technique is that the SCGA values change with the degree of protrusion and represent only one point along the condylar path. Semi-adjustable articulators are unable to reconstruct the condylar movements adequately because of their fixed inter-condylar distance and straight condylar pathway.

Several reports on the condylar mechanism and efforts to register mandibular movements date back to the late 18th century. The goal of registering the condylar path is to recreate the patient's occlusion as exactly as possible on the articulator, and is therefore essential for successful prosthodontic rehabilitation. As this study was done using radiographs whereas majority of the study done till date are under CBCT or CT or by any other reliable means is used as methodology, this study holds very high accuracy level which is nearly equal to other scanning techniques and can be a reliable method of caring it out on radiographs.

CONCLUSION

This study compared the SCGA values obtained by CBCT cross-section view with that of values obtained using extraoral Gothic arch tracing method using a protrusive record of 6 mm. A significant difference between the SCGA values between the two groups was observed. However, no statistically significant difference was found between the right and left sides within the group. No statistically significant difference was seen in the SCGA values neither in the graphic tracing method groups nor with the CBCT methods. Based on the findings of this clinical study, the following conclusions were drawn:

1. The right and left SCG angle values obtained from both the PIR and CBCT methods were comparable with no significant difference (P>.05).
2. There was no significant difference between the right and left side SCG angle values obtained from CBCT and PIR methods.

3. With increasing age, SCG angle values obtained from both the methods tend to decrease.
4. CBCT scans, with advantages over other radiographic and clinical techniques, can be used to determine SCG to program semiadjustable and fully adjustable dental articulators.

In conclusion, within the study's limitations, CBCT appears to be a viable alternative to traditional methods for recording.

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Bullet Trajectories in Maxillofacial Injuries: Understanding the Pathways of Damage

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Abstract

Ballistic injuries to the maxillofacial region present unique challenges in both emergency management and long-term rehabilitation. These injuries result from the high-velocity impact of projectiles such as bullets or shrapnel, causing complex wounds that involve bones, soft tissues, and often adjacent structures crucial for facial aesthetics and function. This abstract reviews the current understanding and management strategies for ballistic injuries specifically affecting the maxillofacial region. The primary focus is on the pathophysiology of such injuries, emphasizing the mechanisms of tissue damage and the immediate and delayed complications that can arise. Special attention is given to the assessment of injury severity, including the role of advanced imaging modalities in accurate diagnosis and surgical planning.

INTRODUCTION

One of the most frequent causes of severe injuries is citizen gun ownership. The majority of the knowledge pertaining to gunshot wound (GSW) injuries and treatment came from firsthand experience gained throughout the 20th century's main conflicts. The guidelines that are in place were created during a time when military use was the only option for high-velocity rifles and deforming bullets, which cause more significant tissue damage. However, the nature of domestic GSW injury has altered due to advancements in weapons technology and the easier access to military-grade weaponry for civilians, making clinical decision-making more difficult[1].

Even in trauma centers with high patient volumes, where GSWs are more common, anecdotal evidence still plays a major role in treatment decisions. There's a widespread misconception that the bullets can be sterilized by the heat generated when gunpowder ignites during firearm discharge. In order to refute this idea, Wolf et al. coated bullets with a little quantity of S. aureus, fired them into sterile ballistics blocks, and then cultured the same S. aureus from the bullet tracts[2].

The literature also lacks comprehensive guidelines for managing retained bullets and large data sets. Only 14.5% of surgeons who responded to a survey in 2022 stated that their organizations had bullet removal protocols[3]. Many medical professionals think that in every situation, complete debridement and bullet removal are necessary. However, the precise tissue involvement and presentation of the injury vary greatly and determine the type and extent of intervention.

Frequently, formal debridement and bullet removal are not required and can result in more tissue damage or consequences including infection or iatrogenic Citizens' possession of firearms is one of the most common causes of serious injuries in the United States An estimated 120,232 gunshot injuries occurred annually from 2009 to 2017. Most of the information on gunshot wound (GSW) injuries and treatment was gathered from personal experience throughout the major conflicts of the 20th century.

Face trauma surgeons face a special and difficult problem when dealing with ballistic injury patterns to the cranio-maxillofacial area. Even the most skilled facial trauma specialist may find it difficult to identify typical anatomic planes because they may be lost in the blood and destroyed soft and hard tissues that result from ballistic injuries to the head and neck region.

HISTORY

Although there have been significant advancements in the field of wound ballistics since the 1830s, it wasn't until the 1870s that Kocher developed a hydrodynamic theory to explain the effects of gunshot wounds.

La Garde also studied the catastrophic injuries caused by high-velocity rifle bullet strikes, which were referred to as the "explosive effects" of rifle bullets.

FIREARMS AND AMMUNITION

A firearm is a weapon that uses extremely flammable, gas-producing gunpowder to shoot a projectile. This covers what are known as small arms, which include rifles, pistols, and shotguns[4].

The breech (the chamber where the bullet is seated and from which the combustive reaction is started), the barrel (which serves as the projectile's guide), and the handling section (stock) make up the basic anatomy of small arms, which are comparatively simple mechanical devices. The length of the barrel and the amount of pressure the breech can sustain serve as major distinguishing factors amongst small guns. Gunpowder combustion produces extremely high pressures (50,000–60,000 psi), which is why rifles are shoulder-fired weapons.

The word "ammunition" refers to full cartridges that hold a firearm's projectile, also known as a bullet. More appropriately, ammunition for rifles and pistols is referred to as a cartridge or round, which comprises the bullet as well as the primer, propellant (gunpowder), and casing[5].

The bullet known as an FMJ bullet is a nonexpanding solid bullet with a sharp tip and a thin metal jacket (typically made of copper). The military forces of the United States utilize these bullets. FMJ bullets are designed for three purposes. First, solid and expanding bullets typically weigh the same for a given caliber. Over the past 150 years, military rifles have changed to smaller calibers with lighter, quicker bullets that fly more steadily.

Projectiles and weapons are typically divided into two categories: high-velocity (such as rifle bullets or

explosive fragment missiles > 2000 f/s) and low-velocity (shotgun and pistol rounds, typically < 2000 f/s)[6].

There are five general categories of small arms: handguns, rifles, shotguns, submachine guns, and machine guns.

There are four basic types of handguns:

1. Single-shot pistols
2. Derringers
3. Revolvers
4. Auto-loading pistols (automatics)

Cartridge cases are classified into five types according to the configuration of their bases:

- Rimmed
- Semi-rimmed
- Rimless
- Rebated
- Belted

HARD TISSUE INJURIES AND THEIR MANAGEMENT

According to research on patterns and trends in injuries received in low-intensity military conflict scenarios, injuries to the extremities account for 73% of all injuries, followed by injuries to the head and neck (22%), thorax, and abdomen (5%). Ballistic projectiles and GSWs are their most frequent cause (41.4%), followed by blasts from improvised explosive devices (IEDs) that cause splinter and shrapnel injuries (39.2%).Low-intensity conflicts (LICs) have replaced conventional warfare as the more common kind of conflict.

SOFT TISSUE INJURIES IN MAXILLO-FACIAL REGION

One of the most frequent injuries to the head and neck region are soft tissue injuries, which are particularly common in emergency rooms and surgical casualties. Both separate soft tissue injuries and injuries with concurrent bone trauma are possible. Burns, bites, avulsions, contusions, and simple cuts are among the common soft tissue injuries on the face(Fig no.1).

The presence of important anatomical structures like muscles, ducts, arteries, and nerves complicates these injuries. Soft tissue injuries are made more complicated by the presence of hemorrhage and foreign debris. The face is an area with significant aesthetic and functional value. Thus, a variety of factors have a role in the management of these injuries.

The most frequent cause of soft tissue injuries in the face varies depending on the age, sex, and geographic location of the population. Depending on the underlying cause, some regions of the head are more likely to experience facial soft tissue injuries. The forehead, nose, lips, and chin make up the T-shaped area that is usually included, followed by the occiput and anterior temporal regions.

The most common etiology are:

a) Fall
b) Non Fall Impacts
c) Assaults
d) Road Traffic Accidents
e) Sporting Injuries
f) Others include occupational injuries, bites from humans or animals, and other miscellaneous causes

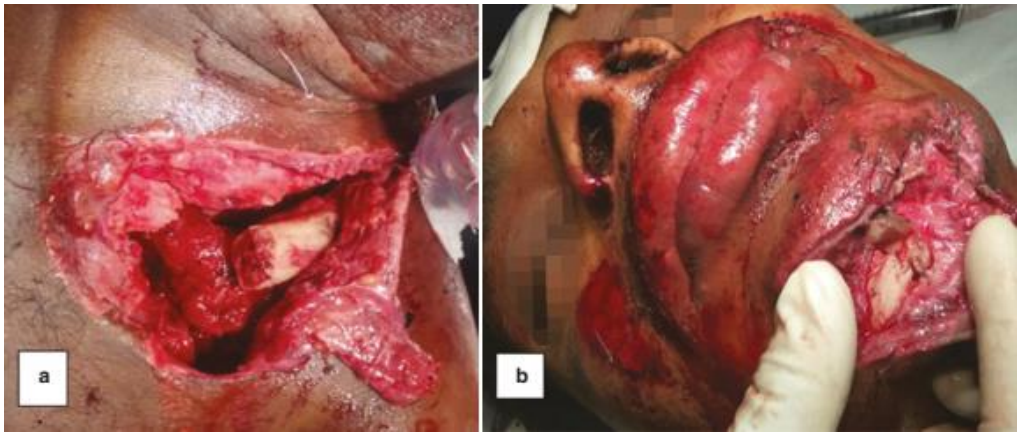

Figure 1: (a) Showing open wound where fractured left clavicle is visible from the wound surface. (b) Open wound of maxillofacial region where underlying mandible

CLASSIFICATION OF SOFT TISSUE INJURIES

(A) **Based on mechanism of injuries**

(I) Mechanical or physical injuries:

- When injury is caused due to blunt force:
  1. Abrasions
  2. Contusions
  3. Lacerations
- When injury is caused due to sharp force:
  1. Incised wounds
  2. Chop wounds
  3. Stab/punctured wounds

(II) Thermal injuries:

- Due to excessive cold: e.g., frostbite
- Due to moist heat: e.g. burns and scald wounds

(III) Chemical injuries: Due to corrosive acids and alkalis

(IV) Miscellaneous: Electricity, lightning, etc.

(V) Explosions: Blast injuries

(B) **Legal Classification**

1. Simple - soft tissue injuries without much tissue loss and can be managed conservatively. Heals rapidly without any permanent deformity.

2. Grievous injuries - described under Section 320 of Indian Penal Code as any injuries that endanger life and cause severe disfigurement or deformities like permanent hearing loss, vision loss, and severe head injuries. Tooth fracture or tooth loss following a blow in an interpersonal violence is also considered a grievous injury and penalized by the court of law. These injuries heal slowly and incompletely.

3. Dangerous - the grievous injuries that endanger life immediately after impact

COMMON SOFT TISSUE INJURIES

The common clinical presentation of soft tissue injuries included abrasions, contusions, and lacerations.

Figure 2: Showing multiple abrasions over face involving the supraorbital region nose, upper lip and chin

Figure 3: Showing contusion wound over right cheek and periorbital ecchymosis of right eye. The color changes can be appreciated intraorally

Figure 4: Showing split lacerated wound over nose, columella, lower lip and chin

Figure 5: Showing incised wound extending from dorsum of the nose till preauricular region caused by knife in case of assault

1. Abrasions - (also known as gravel rash) -It is destruction of the superficial layer of skin only. It is caused by frictional forces that are light enough to erode only the superficial layer of epidermis (Fig no.2).

2. Contusions (bruising) -This is effusion of blood into the tissues, due to the rupture of small blood vessels at the site of impact. There is no destruction of the superficial layer of skin (Fig no.3).

3. Lacerations-It is the tear or split of skin, mucous membrane, muscle, or internal organs produced by the application of blunt force to a broad surface area, which crushed or stretched tissues beyond the limits of their elasticity. They can be split lacerations , stretch lacerations, shearing lacerations, and cut lacerations(Fig no.4).

4. Incised wounds—The wound is longer than it is deep. It is caused by the pressure and friction of any sharp object against the soft tissues(Fig no.5).

5. Chop **wounds (slash wounds)**—They are deep bigger wounds with gaping caused by a blow with the sharp cutting edge of a heavy weapon, like an axe or chopper.

6. Stab or punctured wounds—Produced when the force is delivered along the long axis of a narrow or pointed object, such as knife, sword, chisel, scissors, nail, needle, spear, arrow, screw driver, etc. into the depths of the body. This type of wound is deeper than its length and width.

7. Crush **injury**—A crush injury typically occurs when the body part is crushed between two heavy blunt objects. Most severe trauma cases will have this type of injury.

Crush injuries have ragged edges, varying amounts of devitalized tissue, and, sometimes, tissue loss.

8. Avulsion **injuries**—These involve significant tissue loss. Avulsion can be considered a very severe form of abrasion, wherein all layers of skin are torn off and the underlying structures are grossly exposed. The term avulsion can also mean complete loss of a small body part such as eyelid, fingertip, part of ear, etc

DIAGNOSIS AND IMAGING

Initial imaging assessment of gunshot wounds (GSWs) typically occurs with radiographs in the trauma bay. It is good practice for the trauma team to mark each surface wound with a radiopaque marker, which provides the radiologist with information from which bullet trajectory can be inferred.

Trauma bay Focused Assessment with Sonography in Trauma (FAST) scan is used to evaluate for intraperitoneal and pleural free fluid, pericardial effusion, and pneumothorax and is typically performed by the trauma team.An unstable patient with a positive FAST scan should be taken to operating room for damage control surgery.[7]

Computed tomography (CT) is the most sensitive and specific modality with which to identify and evaluate ballistic injuries.[8] It is fast and provides excellent spatial resolution, allowing identification of all but the most subtle injuries. In stable and semistable patients, CT is the gold standard of evaluation. Although there are numerous CT scanning protocols proposed in the literature,[9] by consensus the authors of this article advocate the protocol in phase or CT cystography based on the ‘‘at the scanner’’ radiologist review of the initial imaging.

Magnetic resonance imaging (MRI) has no proven utility in the initial assessment of GSW but can be useful in the stable patient for evaluating the spinal cord, hepatobiliary system, brachial plexus, and brain parenchyma.

RECENT ADVANCES

Recent Advances in Soft Tissue Management

1. Use of growth factors - intimate role in the regulation of all phases of wound healing, i.e., chemotaxis, proliferation, matrix synthesis, inflammation, and angiogenesis. The enhancement of soft tissue wound healing can be done by various methods. Topical application of growth factors in a vehicle or by direct seeding of cells topically on the wound can enhance healing. Placement of growth factors or cells can also be done with a fibrin sealant or glue. Use of platelet-rich plasma (PRP) by degranulation of platelets with the secretion of its contents of growth factors into the surrounding fibrin matrix or, more recently, use of tissue-engineered equivalents of skin or mucosa can provide a scaffold that enhances healing.

2. Gene and stem cell therapy - in which the gene encoding for the therapeutic growth factor or protein is directly transfected into host cells. This is a promising approach for the treatment of acute and chronic wounds.

3. Tissue engineering - In 1987, the National Science Foundation bioengineering panel defined tissue engineering as "the application of the principles and methods of engineering and the life sciences toward the development of biologic substitutes to restore, maintain, or improve function."

Advances in management of gunshot injuries

Advances in Closed Reduction

MMF has a long history in the treatment of facial fractures dating back to 460 BC when Hippocrates used gold wire to fixate teeth for a mandible fracture.1 Over the years there have been many modifications, including Barton bandage, suspension wires, Ivy loops, arch bars, MMF screws, and embrasure loops.[10] Erich arch bars (Karl Leibinger Co, Mulheim, Germany) continue to be the most commonly used technique. MMF screw fixation has the benefit of speedy application, decreased risk of puncture injury to the surgeon, less damage to the periodontium, and simple application and removal. Their use is not without complications. The most commonly reported complications include screw loosening, iatrogenic damage to tooth roots, screw fracture, and ingestion. A combination between MMF screws and arch bars known as hybrid systems are the newest advances to closed reduction. Commonly used systems include the SmartLock System Hybrid MMF (Stryker, Kalamazoo, MI), the MatrixWave (DePuy Synthes West Chester, PA), and the OmniMax MMF System (Zimmer Biomet, Jacksonville, FL).

These systems are approved by the Food and Drug Administration for use in adults and children with fully erupted permanent dentition as a temporary means of fixation.These systems allow expeditious placement associated with MMF screws while maintaining lugs at crown level, allowing traction vectors closer to the occlusal table. Potential complications are similar to those of MMF screws. Although the hybrid systems are much costlier than Erich arch bars, Kendrick and colleagues' cost analysis of the Stryker SmartLock system versus traditional arch bars found no difference when accounting for operating room time, cost, and time saved.

Advances in Open Reduction

Virtual surgical planning/Stereolithography Among the greatest technological advances in craniomaxillofacial (CMF) surgery is computer-aided CMF surgery. Bell divides computer-aided CMF surgery into 3 main categories:

(1) computer aided presurgical planning,

(2) intraoperative navigation, and

(3) intraoperative computed tomography (CT)/MRI imaging.

Navigation/intraoperative computed tomography

The digital workflow makes it possible to visualize the entire mandibular and facial skeleton, which is somewhat unrealistic. Unfortunately, these conditions do not translate directly to the operating room. Blood, edema, and avulsive soft and hard tissue defects can make it difficult to see appropriate landmarks for repair. A custom-fabricated plate that looks perfect during VSP can result in malocclusion, facial asymmetry, and poor bony adaptation if the implant does not seat in its exact planned position.

CONCLUSION

In conclusion, ballistic injuries to the maxillofacial region present complex challenges that require a multifaceted approach to management and treatment. These injuries often involve significant trauma to both soft tissues and bone structures, leading to complications such as impaired function, aesthetic concerns, and increased risk of infection. Effective treatment typically necessitates a combination of surgical intervention, reconstructive techniques, and comprehensive rehabilitation to address both the immediate and long-term effects of the injuries.

The complexity of these injuries underscores the importance of an interdisciplinary approach involving maxillofacial surgeons, reconstructive specialists, and rehabilitation experts. Advances in surgical techniques, including the use of advanced imaging and biomaterials, have improved outcomes and facilitated more effective management of these injuries.

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To Evaluate and Compare the Wettability of Two Different Denture Base Resins to Distilled Water and Two Commercially Available Salivary Substitute - Original Research

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Abstract

Aim of the Study: The aim of the study is to evaluate and compare wettability of two denture base resins to distilled water and two commercially available salivary substitutes.

Objectives: Compare DPI resin wettability with distilled water, Salivary substitute A, and Salivary substitute B. Also, compare Valplast resin with distilled water, Salivary substitute A, and Salivary substitute B.

Materials and Methods: Sixty samples included 30 each of heat-cured polymethylmethacrylate (DPI) and nylon (Valplast). Divided into three groups each, contact angles were measured with WET MOUTH, BIOTENE, and distilled water using a goniometer.

Results: DPI resin with Biotene has the lowest contact angles, followed by DPI resin with Wet Mouth, Valplast with Biotene, Valplast with Wet Mouth, DPI resin with distilled water, and Valplast with distilled water.

Conclusion: Denture wettability by saliva, crucial for oral comfort, is enhanced by thickened saliva substitutes, aiding moisture, lubrication, and retention, particularly beneficial for xerostomia patients.

Keywords: Adherent, Denture base resin, Salivary substitute, Wettability, Xerostomia.

INTRODUCTION

The specialty of Prosthodontics has emerged as a science to provide the replacement of missing dentition for its form and function along with associated structures. Any successful complete denture treatment combines exemplary technique, effective patient rapport, patient education, and familiarity with all possible management options in order to provide maximum satisfaction to patient.

Saliva is the most significant component produced by the salivary exocrine gland in the stomatognathic system. Saliva is known to be an important factor for the maintenance of the system's health and function. The approximate volume of saliva present in the oral cavity is 1 mL with a mean range of salivary output being 500 to1500 ml. The percentage of unstimulated saliva contributed by parotid, submandibular, and sublingual glands is 20, 65, and 7 to8%, respectively, and about 10% of saliva is secreted from other minor glands. The unstimulated salivary rate below 0.1 mL/min is called hypofunction. The normal acceptable salivary flow rate is anything above 0.1 mL/min.

The complete denture retention can be affected by mechanical, surgical, physical, psychological, and physiological factors. The physical factors are further divided into cohesion, atmospheric pressure, interfacial surface tension, and adhesion.

Xerostomia is a condition characterized by qualitative and/or quantitative alteration in salivary secretion with/without increased dehydration of the oral mucosa. It is a commonly reported condition, with prevalence around 22%-26% in general population and up to 82%-83% in patients seeking palliative care.

Dry Mouth predisposes to oral irritation and epithelial atrophy, which may progress into inflammation, fissuring, and ulceration. Furthermore, lack of saliva significantly hampers denture retention and causes dysphagia. The physical forces involved in the retention of a denture are adhesion, cohesion, capillarity, atmospheric pressure, surface tension, and viscosity, which are directly or indirectly dependant on saliva.

Artificial saliva substitutes were introduced as a replacement for natural saliva in individuals presenting with hyposalivation. In such patients, for a denture to have sufficient adhesion to the supporting mucosa; the artificial saliva substitutes must flow over the denture surfaces with ease to ensure adequate wetting.

MATERIALS AND METHODOLOGY

Preparation of samples

Two sheets of modelling wax of 1 mm thickness were placed one over the other to get total thickness of 2mm. Two Square glass plates measuring 1.2 mm × 1.2 mm were stabilized on either side of the wax strips and the wax was cut along all the sides using a sharp carver. The resultant wax sample was checked for required thickness and uniformity using wax. Fabrication of heat cured acrylic resin samples. The wax samples were invested using dental plaster in varsity flasks. A heatactivated conventional acrylic denture base resin material (Dental Products of India) was using compression moulding technique.

Flasking and processing was done according to the manufacturer' s instructions. The samples were finished to get an even thickness of 2mm using flat cherry stones and sandpaper as in clinical practice. The samples were first cleaned for 5 min with soft cotton immersed in water saturated with household soap and then rinsed well with running water. They were cleaned with spirit to remove any soap residues.

Fabrication of Flexible acrylic resin samples

Wax pattern sample is made according to ADA specification no.12 for measuring the wettability using injection molding technique. Both halves of flask approximated and clamped tightly.

The plunger is inserted into the cartridge.

Cartridge fixed to flask assembly connected to the carrier, which exerts continuous pressure on the plunger and polymerization takes place.

After the processing, finishing and polishing of the samples is done.

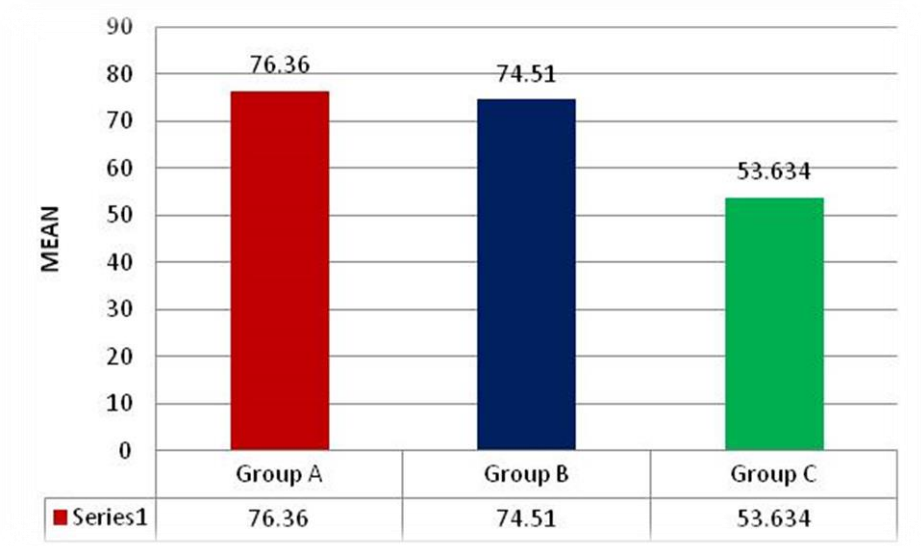
RESULTS

Dynamic contact angle analysis was used to measure the advancing and receding angles using goniometer. The fluid media was tested and dispensed in to the syringe on the specimen. The system allows standardized volume of fluid to be used on the specimen while measuring the advancing and receding contact angle. The contact angle is the angle formed by the base line of the drop and and a tangent at the third base line.

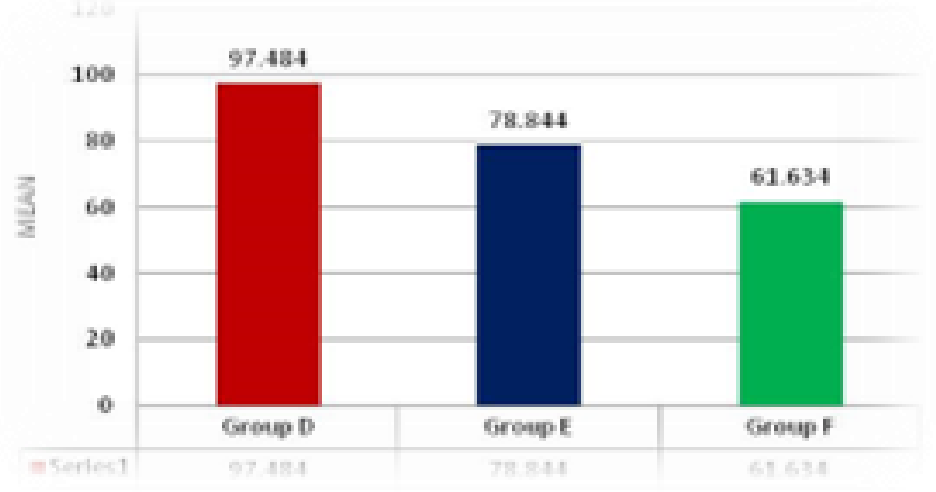
Advancing and receding contact angle of each of 3 media to 10 specimen of each denture base material were measured.

1. Group A- DPI denture base resin with distilled water.
2. Group B-DPI denture base with Wet mouth .
3. Group C- DPI denture base resin with Biotene .
4. Group D- valplast denture base resin and distilled water.
5. Group E- valplast denture base resin and Wet mouth.
6. 6.Group F- valplast denture base resin and Biotene.

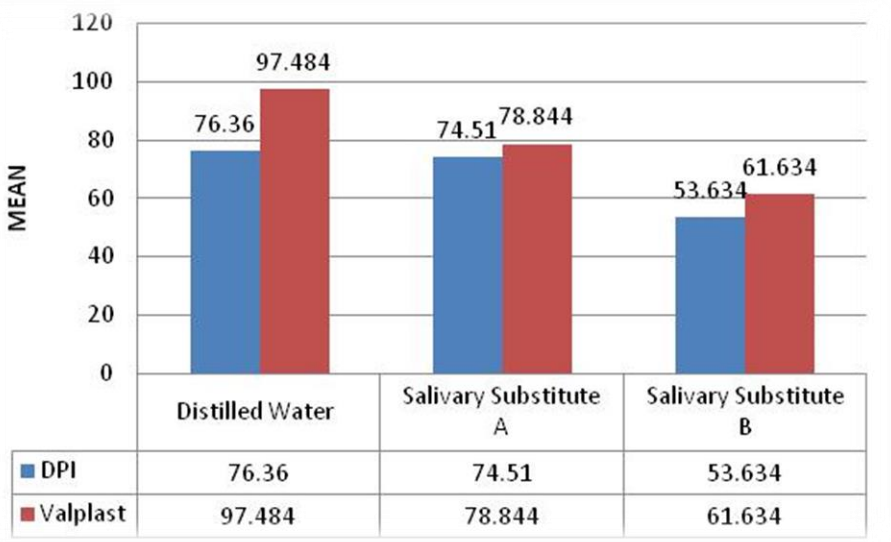
The mean contact angle for the Group A was 76.36 with the standard deviation of 2.587. The mean contact angle for the Group B was 74.510 with the standard deviation of 13.340. The mean Contact angle for the Group C was 53.634 with the standard deviation of 10.209. The intergroup comparison of contact angle between three groups was statistically significant with highest contact angle in the Group A and least in the Group C. The difference between Group A and Group B was statistically non-significant whereas the difference between Group A and Group C, between Group B and Group C was statistically significant and Graph).



GRAPH 1: INTERGROUP COMPARISON OF WETTABILITY OF DPI DENTURE BASE RESIN WITH DIFFERENT MEDIA



GRAPH 2: INTERGROUP COMPARISON OF WETTABILITY OF VALPLAST DENTURE BASE RESIN WITH DIFFERENT MEDIA



GRAPH 3: INTERGROUP COMPARISON BETWEEN DPI AND VALPLAST IN DIFFERENT MEDIA

DISCUSSION

The retention ability of the complete denture is directly related to the force required for full displacement of the denture or prosthesis from its basal seat and is a vital factor for the long-term functioning of the dental prosthesis. A vital need for the retention of the dentures is the wettability of the denture and the palatal surface with individual adhesion forces at both the edges. The force of retention is largely governed by contact angle between fluid and denture, contact surface area, fluid layer width, and surface tension of the saliva as initially suggested by Monsenego P et al in 1989.

Saliva plays a vital role in maintaining the health of the oral tissues and the retentive ability of the dental prosthesis and dentures. In subjects having dryness of the mouth (xerostomia), wearing dentures can be extremely discomforting. Artificial salivary substitutes can be used to decrease xerostomia. Many such substitutes are commercially available and are extremely helpful in treating xerostomia.

The forces needed to fully displace the dental prosthesis from its basal seat are directly associated with the retentive capacity of the denture. An essential prerequisite for denture retention is the wetness of the palatal surface and denture via individual forces of adhesion at both edges. The surface tension of saliva, width of the fluid layer, area of the contact surface, as well as denture-fluid contact angle, influence the forces of retention.

This research shows that the use of DPI with Biotene delineated superior wetting capability versus the remaining salivary substitutes.

There were noteworthy differences, statistically amid mean values of advancing angles with the use of DPI with Biotene versus the other experimental groups. This can be attributed to the lowest angle of contact by Biotene versus the remaining three groups of DPI and Valplast as the capacity of wetting enhances with decreasing contact angle. This is in accordance with the research of Sharma and Chitre and Mathrawala et al. who noted that the wetting capacity of Aqwet was superior to the remaining salivary replacement agents studied for lower wetting angle.

In the current study, the wettability of DPI Denture base resin with Biotene has the lowest advancing and receding contacting angle values followed by DPI Denture base resin with wet mouth, Valplast with Biotene, Valplast with wet mouth, and DPI Denture base resin with distilled water and valplast with distilled water respectively.

The receding contact angles were significantly lower than the advancing contact angles of the salivary replacements as well as distilled water. The retentive capacity of dentures is directly related to a phenomenon known as “contact-angle hysteresis,” which is the disparity amid the advancing fluid/solid contact angle as well as the receding angle. The contact angle formed when a fluid drop forms at the time of dispensing on a dry surface is known as the advancing contact angle. The receding contact angle

on the other hand is one that forms following the recession of the fluid from a solid surface that was formerly wet.

Measurements of advancing/receding contact angles to evaluate the wetting capacity of denture base agents were investigated by Monsenego et al. and Ramanna PK. From their in vitro research, they arrived at a conclusion that high-impact heat cure polymethyl methacrylate resins when employed as denture base agents, exhibit the greatest "contact-angle hysteresis" like a higher advancing contact angle plus lesser receding contact angle while showing the most superior wettability.

As per research on wettability and contact angles, wetting principally happens when solid and fluid come in touch. Greater wetting ability is exhibited by low contact angles of <90° while lesser wetting ability is noted when the contact angles are >90°. To be specific, contact angles <90° imply that surface wetting would be appropriate and that the liquid would spread over a greater surface area being more hydrophilic. On the contrary, contact angles >90° imply that surface wetting would be inappropriate and that the liquid would refrain from contacting the surface leading to the formation of a drop, being more hydrophobic. Total wetting happens if the angle of contact is 0° as the drop transforms to an even puddle.

The limitations of this research are that the sample size was low and there was a lack of patient reaction for determination of the effectiveness of efficiency of the salivary substitutes which did not lead to correlating of the results to clinical use. Surface contagion of the area investigated may create a variation in the surface tension of water that induces a minor blunder in the measured contact angle values. It is also recommended that the effects of dissimilar surface treatments on the wetting ability of denture materials be assessed in further longer duration trials.

CONCLUSION

This study concluded with the clinical significance as the quality of life of the patients with xerostomia can be improved using a suitable saliva substitute. The wettability of DPI Denture base resin with Biotene has the lowest advancing and receding contacting angle values followed by DPI Denture base resin with wet mouth, Valplast with Biotene, Valplast with wet mouth, and DPI Denture base resin with distilled water and valplast with distilled water respectively.

Consistency, quality, and optimal salivary flow are nearly essential not only for the fabrication of the denture, but also for the stability and retention of the denture.

The prosthodontist during fabrication of the complete dentures in edentulous patients must give due attention to the patient's salivary nature as this can lead to success and lasting effect of the denture.

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A Comparative Study to Evaluate the Shear Bond Strength of Different Surface Treated Fiber Posts Luted with Different Luting Agents: An In – Vitro Study

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Abstract

Background and Objectives: To evaluate the shear bond strength of different surface treated fiber posts luted with different luting agents.

Methods: Post space was prepared in sixty endodontically treated single-rooted teeth and distributed into 3 groups (n=20). Group-A received no surface treatment. Group-B and Group-C were treated with 10%Hydrofluoric Acid and 24%Hydrogen Peroxide. Each group subdivided into 2 subgroups (n=10) i.e. Total etch resin cement and self adhesive cement. Pull-out evaluation test was performed to measure bond strength.

Results: Statistical analysis performed using post-hoc Tukey HSD and Bonferroni test. Specimens treated with 24%Hydrogen Peroxide, luted with Total Etch resin cement showed the maximum bond strength (17.317 Mpa). No significant difference in bond strength values were observed between the luting agents, however significant difference ($p < 0.05$) was observed in relation to the surface treated specimens.

Conclusion: Surface treatment is a necessary protocol in enhancing the bond strength of the fiber posts irrespective of the luting cement used in the post and core system.

Keywords: Fiber posts, Shear bond strength, Total Etch Resin Cement, Self Adhesive cement

INRODUCTION

Endodontically treated teeth are affected by a higher risk of biomechanical failure than vital teeth. Posts have been used for restoration of these teeth since many years ; but post retained crowns may present both biologic and mechanical failures commonly due to loss of retention. [1] Long-term studies on post and core technique reveal variable survival rates, indicating the possibility of root fractures. Weaknesses in stress distribution at material interfaces highlight the importance of posts with biomechanical properties similar to dentin to prevent such fractures. [2]

Advances in adhesive techniques have revolutionized restorative dentistry, allowing for the preservation of more tooth structure. This includes bonding fiber posts to root canal dentin, which offers flexibility and a modulus of elasticity akin to dentin, thus enhancing the overall strength of the restoration. Furthermore, fiber-reinforced materials eliminate risks associated with metal posts and provide aesthetic benefits, especially crucial for anterior teeth. Additionally, their retrievability makes them advantageous for potential future retreatment needs. However, despite these benefits, further clinical evaluation is necessary to fully understand their long-term performance. [3]

Proper post space preparation and effective bonding with resin cement are critical for retention and resistance to fracture. Glass-fiber posts, known for their aesthetic appeal and ability to bond well to root dentin, distribute stress more evenly, reducing the risk of root fractures. Retention largely depends on the type of luting cement used, with resin cements offering properties closer to dentin and thus providing better performance.[4]

The unique adhesive procedure for fiber posts involves considering the histological characteristics of dentin and understanding the properties of different bonding materials. The even distribution of forces through effective bonding reduces the occurrence of root fractures, although "deboning" remains a common failure mode. Several factors influence the bonding capacity of fiber post systems, and controlling these factors is crucial for achieving a strong bond between the post, cement, and dentin interface. Techniques such as silane or sandblasting surface treatment have been found to enhance bond strength, leading to more reliable restorations. [5,6]

Surface treatment of fiber posts significantly affects retention. Studies have shown that treatments like silane coupling agents or hydrofluoric acid etching can improve adhesion by enhancing the bond strength between the post and composite materials. [7] Silane coupling agents, in particular, alter the physical and mechanical properties, thereby improving the overall performance of the restoration. [8,9]

Thus restoration of endodontically treated teeth requires careful consideration of various factors, including material selection, post design, adhesive techniques, and surface treatments. Fiber-reinforced posts offer several advantages over traditional metal posts, including flexibility, aesthetic appeal, and retrievability. Effective bonding with resin cement is crucial for long-term success, and surface treatments can significantly enhance the bond strength between the post and composite materials.[3,10]

The objective of many studies in this field is to compare the shear bond strength between differently surface-treated fiber posts using various luting cements. Pull-out tests and other methods are utilized to assess the bond strengths, with the goal of understanding how different surface treatments and cement types affect the overall performance of the restoration.

MATERIAL AND METHODOLOGY

a) Study Design

An in-vitro observational descriptive study which included sixty extracted single rooted human teeth with well-preserved coronal and radicular structures without endodontic treatment were selected from the Department of Oral and Maxillofacial Surgery, Pacific Dental College and Hospital, Udaipur. The method for sample collection was non probability sampling technique. In the present study, 60 samples were tested.

b) Eligibility criteria

Inclusion criteria

1. Teeth that were extracted due to any dental problem
2. Approximately Straight roots

3. Root length of at least 13-18 mm

Exclusion criteria

1. Root with vertical fracture
2. Grossly decayed teeth
3. Teeth with failed endodontic treatment

c) Sample Preparation :

The teeth were collected, stored in distilled water at room temperature after extraction and cleaned with hydrogen peroxide solution to get rid of the debris attached with the teeth. Specimens were sectioned with diamond rotary instrument at coronal level under water spray to standardize size of specimens at 16 mm from root apices. They were then embedded into chemically cured acrylic resin block of 4cm x 4cm in size till cemento enamel junction. Each group comprising of 20 samples and each subgroup containing 10 samples. (Flowchart)

d) Procedure

1. Root canal preparation

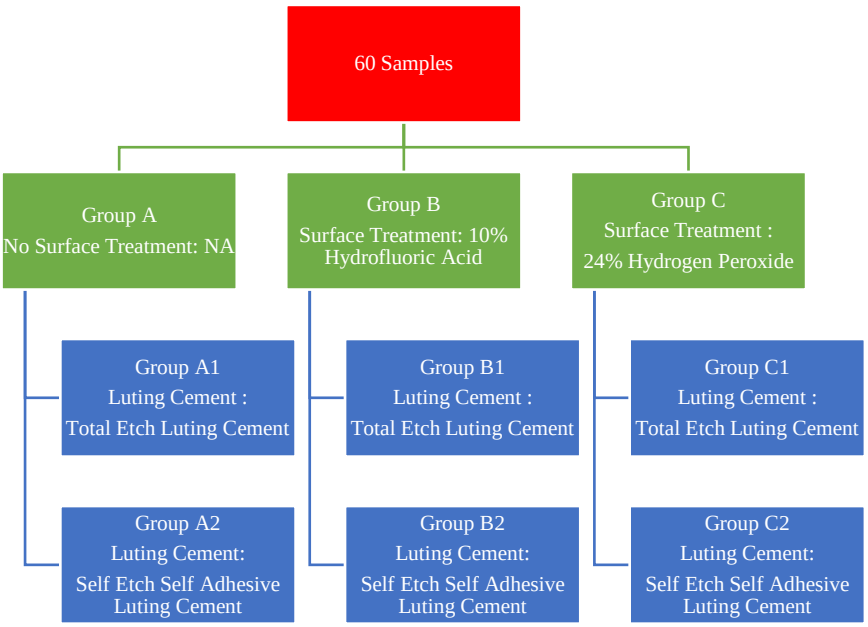
Access opening was done using a round diamond bur (MANI India pvt ltd) Followed by determination of working length using #15 K file (Dentsply USA). The teeth were treated endodontically according to a Step back technique. All procedures were followed by irrigation with 1% sodium hypochlorite and copious irrigation with normal saline. The prepared canals were dried with paper points followed by obturation with gutta percha cones (Dentsply, USA) using cold lateral condensation technique using canal sealer (Sealapex, Sybron-Endo, USA).The same was evaluated using intraoral periapical radiograph.

2. Preparation of the coronal tooth structure

The access cavities and apexes were sealed. Teeth were horizontally de-coronized 3 mm above the CEJ. The remaining tooth structure coronal to CEJ helped to simulate the ferrule effect, which was instrumental in protecting the tooth from fracture.

3. Dowel/Post space preparation & Post insertion

The dowel space was first prepared incrementally using Gates Glidden drills of size 1, 2 and 3 having diameter 0.6, 0.7 and 0.9 respectively, followed by use of Peeso reamers respectively to remove 10 mm of gutta-percha from the canal and was verified by taking intra oral periapical radiographs. 4-5 mm gutta percha were left inside apically. Previously decided surface treatments were done and respective luting agents were applied for each group.**(Flowchart 1)**



Flowchart 1 : Grouping of Samples

4. Surface treatment protocol

1) Hydrofluoric acid (10%)

The post surface was etched with 10% hydrofluoric acid gel applied over the post surface for 1 minute. It was rinsed and dried. The silane agent was then applied on the post surface for 1 min. **(Figure:1)**

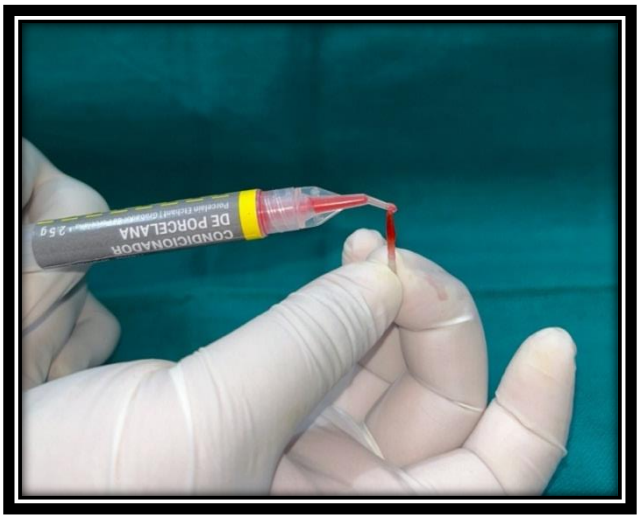


Figure: 1 :Application of 10% Hydrofluoric Acid Gel on Fiber Post

2) Hydrogen peroxide (24%)

The fiber post was immersed in 24% hydrogen peroxide solution in measuring cylinder for 1 minute.It was rinsed and dried. The silane coupling agent was applied for 1 minute allowing solvent evaporation. **(Figure:2)**

Figure 2: Immersion of post in 100ml of 24% Hydrogen Peroxide

5. Luting protocol

1) Total Etch Resin Cement

Root canal was etched by 37% phosphoric acid for 15 seconds and were rinsed with water.The canal will be dried with paper points. Adhesive agent was applied all over etched surface and light cured.A small amount of cement was flowed into canal using syringe tip. Some quantity of cement was dispensed and applied all over the post. The post will be placed into root canal under gentle finger pressure and light cured with the UV light. **(Figure:3)**

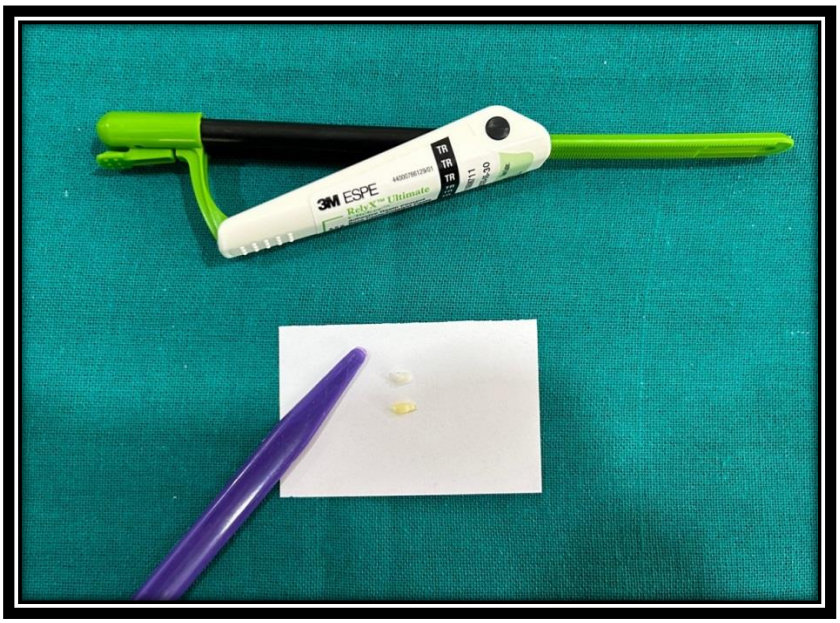


Figure 3 : Fiber post luted with Total Etch Resin Cement

2) Self adhesive resin luting agent

The post was cleaned with isopropyl alcohol and dried with air. A small amount of cement was flowed into canal using syringe tip. Some small quantity of cement was dispensed and applied all over the post. The post was placed into root canal under gentle finger pressure ad light cured with UV light. **(Figure:4)**

Figure 4 : Self Adhesive Resin Cement pushed in post space preparation before inserting fiber post

6. Laboratory Testing

All the prepared specimens were kept under universal testing machine(Instron) and shear bond strength (SBS) was measured . Each specimen was fixed on inferior part of universal testing machine. **(Figure:5)** The force required to dislodge each post were recorded in Mpa.

Figure 5: Instron Universal Testing Machine. Specimen fixation on the inferior part of mandril – Pull out test is performed.

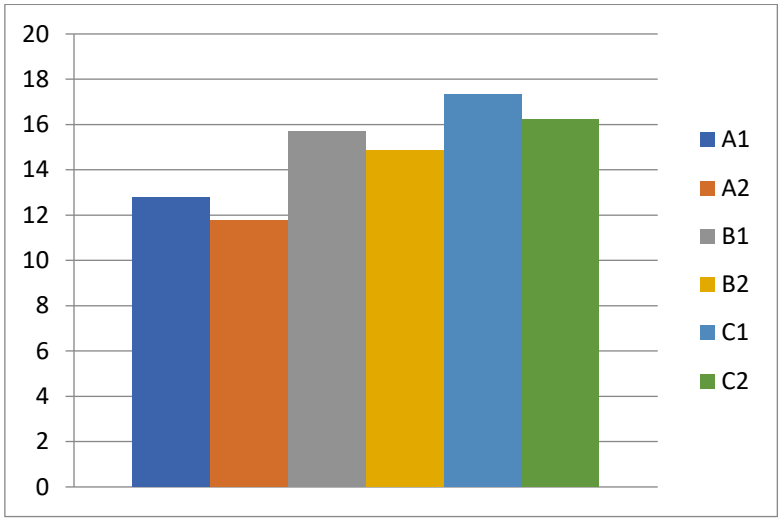
RESULTS

60 Samples were tested for shear bond strength in Universal Testing machine. We can find the subgroup C1 with highest mean shear bond value followed by Group C2, B1, B2, A1 and A2. (Table 1 & Graph 1).

Table 1 : Results for Shear Bond Strength of various group in Mpa

Sub Group	Group A Surface Treatment = NA		Group B Surface Treatment = 10%Hydofluoric Acid		Group C Surface Treatment = 24% Hydrogen Peroxide	
	A1	A2	B1	B2	C1	C2
Luting Cement	Total Etch Resin Cement	Self Etch Self Adhesive Resin Cement	Total Etch Resin Cement	Self Etch Self Adhesive Resin Cement	Total Etch Resin Cement	Self Etch Self Adhesive Resin Cement
1	12.87	11.86	15.98	14.76	17.3	16.26
2	12.54	12.5	13.84	13.57	17.58	15.76
3	13.6	10.4	17.65	15.75	17.11	16.95
4	11.76	13.63	14.26	14.56	16.96	15.25
5	14.24	9.87	16.85	14.22	17.56	17.05
6	10.76	10.45	15.46	15.27	16.28	16.5
7	11.84	12.94	15.74	13.98	18.28	15.98
8	13.04	9.84	16.23	15.56	16.65	15.65
9	13.25	13.56	14.28	15.7	17.95	16.45
10	13.77	12.87	16.84	15.34	17.5	16.26
Mean	12.767	11.792	15.713	14.871	17.317	16.211

Graph 1 : Mean Shear Bond Strength in Mpa



After obtaining these values statistical analysis was performed with post-hoc Tukey HSD method. P values were obtained for each comparisons. (Table 2). These values were verified with Scheffé, Bonferroni and Holm methods. (Table 3)

Table 2 : post-hoc Tukey HSD Test results

Control	Test	Tukey HSD Q statastic	Tukey HSD p-value	Tukey HSD Inference
A1	A2	3.0097	0.288793	INSIGNIFICANT
	B1	9.094	0.0010053	** P<0.01
	B2	6.4949	0.0010053	** P<0.01
	C1	14.0454	0.0010053	** P<0.01
	C2	10.6313	0.0010053	** P<0.01
A2	B1	12.1038	0.0010053	** P<0.01
	B2	9.5046	0.0010053	** P<0.01
	C1	17.0552	0.0010053	** P<0.01
	C2	13.641	0.0010053	** P<0.01
B1	B2	2.5992	0.4526225	INSIGNIFICANT
	C1	4.9514	0.011467	*P<0.05
	C2	1.5373	0.8778374	INSIGNIFICANT
	C1	7.5506	0.0010053	** P<0.01
	C1	4.1365	0.0538326	INSIGNIFICANT
C1	C2	3.4141	0.1698156	INSIGNIFICANT

Table 3 : Tukey HSD, Scheffé, Bonferroni and Holm methods

Control	Test	Bonferroni and Holm T-statastics	Bonferroni p-value	Bonferroni inferfence	Holm p-value	Holm Inference
A1	A2	2.1282	0.5685065	insignificant	0.1137013	insignificant
	B1	6.4304	5.18E-07	**p<0.01	3.11E-07	**p<0.01
	B2	4.5926	0.0003992	**p<0.01	0.0001863	**p<0.01
	C1	9.9316	1.31E-12	**p<0.01	1.22E-12	**p<0.01
	C2	7.5175	8.93E-10	**p<0.01	6.55E-09	**p<0.01
A2	B1	8.5587	1.88E-10	**p<0.01	1.50E-10	**p<0.01
	B2	6.7208	1.76E-07	**p<0.01	1.17E-07	**p<0.01
	C1	12.0598	0.00E+00	**p<0.01	0.00E+00	**p<0.01
	C2	9.6457	3.62E-12	**p<0.01	3.14E-12	**p<0.01
B1	B2	1.8379	1.073724	insignificant	0.1431632	insignificant
	C1	3.5012	0.0140635	*p<0.05	0.0056254	**p<0.01
	C2	1.087	4.2278405	insignificant	0.281856	insignificant
	C1	5.3391	2.86E-05	**p<0.01	1.53E-05	**p<0.01
	C1	2.9249	0.0754268	insignificant	0.0251423	*p<0.05
C1	C2	2.4141	0.2878745	insignificant	0.0767665	insignificant

It was analyzed when no surface treatment was employed i.e. Subgroup A1 and A2 the difference for shear bond strength is statistically insignificant, whereas these both have significant statistical difference when compared with all other groups. These analysis suggest surface treatment to fiber post increases shear bond strength.

For subgroup B1 and B2, hydrofluoric acid was used as a surface treatment agent. Comparison is statistically insignificant irrespective of cement used. Hence, cement doesn't play role when Hydrofluoric acid gel is used.

For Subgroup C1 and C2, same scenario is seen, inter comparisons of these groups are statistically insignificant. Showing role of Surface treatment more significant in this study.

Among all Group C2 which has surface treated fiber post with 24% Hydrogen Peroxide and etched with total etch resin cement shows highest mean shear bond strength.

With all the analysis performed we can observe that

- When same surface treatment was used, difference between cement did not affect shear bond strength significantly.
- When different surface treatments were employed statistically significant differences were noted, despite use of same or different cement.

Results indicates significance of surface treatments in post and core system. In which 24% Hydrogen Peroxide has highest effect on shear bond strength followed by 10% Hydrofluoric Acid.

DISCUSSION

Endodontic treatments have revolutionized dentistry, allowing damaged teeth to be salvaged and restored to functionality. However, the success of such treatments hinges not only on the procedures within the root canal but also on the subsequent restoration of the tooth. One crucial

aspect of this restoration process is the use of posts to support and retain coronal restorations. Traditionally, metal posts have been favored for their strength, but they pose challenges in terms of aesthetics, especially with translucent ceramic crowns. Here, the narrative shifts towards exploring the advantages of fiber posts in endodontic restorations.[11]

Fiber posts have emerged as a promising alternative to metal posts due to their biomechanical properties that closely mimic natural dentin. Studies have shown that fiber posts possess excellent transverse strength and act as shock absorbers, reducing stress on the restored tooth. Additionally, the light-transmitting nature of fiber posts facilitates improved polymerization of composite resins within the root canal, enhancing mechanical properties such as elasticity and hardness.[12]

In the realm of adhesive cements, which are crucial for bonding fiber posts to radicular dentin, challenges arise due to the high configuration factor within the root canal system. This factor leads to gaps at the cement-dentin interface, compromising bond strength. Moreover, the choice of resin cement can influence the luting ability of fiber posts, with mismatches between adhesive systems and resin cements potentially leading to compromised bonding.[13]

To address these challenges, researchers have investigated various surface treatments for fiber posts. Hydrofluoric acid and hydrogen peroxide have emerged as potential candidates. [14,15,16] Hydrofluoric acid, despite its effectiveness in creating surface roughness for micromechanical interlocking, has been associated with damage to glass fibers, affecting post integrity.[17] On the other hand, hydrogen peroxide has shown promise in enhancing surface morphology and promoting micromechanical retention without causing substantial damage to fiber posts.[15,16])

Studies comparing different adhesive systems have demonstrated varying results, with three-step etch & rinse adhesive systems exhibiting higher bond strengths compared to single-bottle etch & rinse or self-etch primer systems. This difference in performance underscores the importance of selecting the appropriate adhesive system for optimal bonding efficacy.[18]

The presented study delves into the shear bond strength of fiber posts treated with different surface treatments and luted with different resin cements. Results indicate a significant increase in bond strength with surface treatments, particularly with hydrogen peroxide compared to hydrofluoric acid. Additionally, the use of total etch resin cement consistently yielded higher bond strengths than self-etch adhesive cement, regardless of the surface treatment employed.

These findings challenge the traditional approaches to endodontic post and core systems, highlighting the importance of surface treatments and adhesive selection in achieving optimal bond strength and restoration longevity. While fiber posts offer advantages in terms of biomechanical properties and aesthetics, their successful integration into endodontic treatments relies heavily on meticulous surface preparation and compatible adhesive systems.

CONCLUSION

The recent study was carried out with the purpose to compare and evaluate the shear bond strength of different surface treated fiber posts luted with different luting agents. This invitro study could help predict the shear bond strength of the fiber posts treated with Hydrogen Peroxide (24%) and Hydrofluoric Acid gel (10%) ; luted with Self etch adhesive cement and Total etch resin cement and facilitate determination of which combination offered a higher value of the bond strength.

Within the limitations of this study following conclusions can be drawn:

- 24% Hydrogen Peroxide has highest effect on shear bond strength compared to 10% Hydrofluoric Acid.
- For luting cements, application of the total etch resin cement shows consistent higher values than the self etch adhesive cement irrespective of employed surface treatment, but the difference was statistically insignificant ; concluding surface treatment as a necessary protocol in the post and core system.
- 24% Hydrogen Peroxide and Total Etch Resin cement (3M ESPE) showed the maximum value for shear bond strength with the mean value of 17.317 Mpa.

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