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Research Article

Occlusal Indicators and Equilibration in Dental Practice: Awareness, Attitude and Implications for Patient Care among Dental Practitioners in Gujarat

Dr. Parveen Shaikh[1*], Dr. Rupal J Shah[2], Dr. Hemal Agrawal[3], Dr. Hemangi Lad[1], Dr. Bhavdeep Patel[1]

[1]Post Graduate Student, Department of Prosthodontics, Government Dental College and Hospital Ahmedabad, Gujarat, India

[2]Dean and Head of Department of Prosthodontics, Government Dental College and Hospital Ahmedabad, Gujarat, India

[3]Associate Professor, Department of Prosthodontics, Government Dental College and Hospital Ahmedabad, Gujarat, India

***Correspondence author:** Dr. Parveen Shaikh, Post Graduate Student, Department of Prosthodontics, Government Dental College and Hospital Ahmedabad, Gujarat, India; E-mail: parveenshaikh422@gmail.com

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Abstract

Background: Occlusal harmony is critical for the long-term success of dental restorations, prostheses and overall oral function. Occlusal indicators and equilibration techniques are essential tools that help clinicians assess, adjust and optimize occlusal relationships. Despite their clinical significance, their usage patterns, perceived accuracy and awareness among general and specialist dental practitioners remain underexplored, particularly in the Indian context.

Objective: This study aimed to assess the awareness, attitudes and practical application of various occlusal indicators and equilibration techniques among dental practitioners in Gujarat, India. It also sought to identify variations in clinical decision-making based on qualifications and experience levels and to explore practitioners' perspectives on traditional versus digital occlusal analysis tools.

Methods: A cross-sectional, questionnaire-based survey was conducted among 300 dental practitioners across Gujarat. The structured questionnaire included demographic details and 21 clinical questions focusing on the usage, frequency, confidence and perceptions surrounding tools such as articulating paper, shim stock, occlusal wax and T-Scan, as well as clinical practices related to occlusal equilibration. Data were statistically analyzed using SPSS 26.0, with chi-square tests used to determine associations between practitioner qualifications and clinical responses.

Results: All respondents reported awareness of occlusal contact registration tools, with articulating paper being the most commonly used (100%), followed by occlusal wax (74.7%) and T-Scan (57.3%). While 87.7% were familiar with the concept of occlusal equilibration, only 38.3% were fully aware of the limitations of traditional indicators. Usage patterns and confidence levels significantly varied by qualification; MDS in prosthodontics consistently demonstrated higher usage rates, awareness and preference for digital analysis systems. T-Scan was perceived as the most accurate indicator by 42.7% of respondents. Most participants (83.3%) believed occlusal equilibration should be routinely performed in full-mouth rehabilitations.

Conclusion: This study highlights a strong baseline awareness but significant variability in the practical use and understanding of occlusal indicators and equilibration among dental professionals in Gujarat. While traditional tools remain widely used, the adoption of digital systems is growing, especially among specialists. There is a need for enhanced training and continuing education to bridge knowledge gaps and promote evidence-based occlusal management.

Keywords: Occlusal Analysis; Articulating Paper; T-Scan; Shim Stock; Occlusal Equilibration; Dental Practice

Abbreviations

BDS: Bachelor of Dental Surgery; MDS: Master of Dental Surgery; TMD: Temporomandibular Disorder; T-Scan: Digital Occlusal Analysis System

Introduction

Occlusion, in dentistry, refers to the manner in which the upper and lower teeth come into contact during functional movements such as chewing and speaking. According to GPT-10-based synthesized definitions, occlusion is the static and dynamic relationship between the maxillary and mandibular teeth when they approach each other during mandibular movements. A stable, well-distributed occlusion is critical for preserving tooth structure, periodontal health and the integrity of the Temporomandibular Joint (TMJ) [1,2]. Malocclusion or occlusal disharmony can result in various clinical complications, including fractured restorations, occlusal trauma, Temporomandibular Disorders (TMD), muscle hyperactivity and accelerated tooth wear [3]. Therefore, a comprehensive understanding and management of occlusion is paramount to successful restorative, prosthodontic, orthodontic and periodontal treatment outcomes.

Occlusal indicators are diagnostic tools used to evaluate and visualize contact points and occlusal load distribution. These include conventional materials such as articulating paper, shim stock foil, occlusal wax and pressure-indicating pastes, which help clinicians detect premature contacts and occlusal interferences. However, traditional materials have well-documented limitations such as variable thickness, inability to indicate timing or force of contact and susceptibility to moisture distortion [4,5]. To overcome these limitations, modern digital technologies like T-Scan have emerged. The T-Scan system is a computerized occlusal analysis tool that provides dynamic, real-time data on the sequence, location and relative force of occlusal contacts. It enables clinicians to identify occlusal discrepancies that might go undetected using traditional methods. Multiple studies have validated the clinical utility of T-Scan in full-mouth rehabilitations, implant-supported prostheses and temporomandibular joint management [6,7]. Occlusal equilibration refers to the selective reshaping of tooth surfaces to eliminate deflective contacts and achieve stable, harmonious occlusion. According to Dawson, occlusal equilibration is the process of achieving optimal contact relationships between maxillary and mandibular teeth by minor reshaping of the occlusal surfaces [1]. It is particularly critical in cases involving full-mouth reconstruction, bruxism, TMD or after extensive restorative treatment. Despite the availability of both traditional and digital occlusal analysis tools, there exists variability in their usage, clinical interpretation and incorporation into everyday dental practice. Studies suggest that many general practitioners rely predominantly on articulating paper, often without full awareness of its diagnostic limitations [5,6]. Furthermore, the adoption of digital systems remains limited due to perceived cost, lack of training and insufficient awareness of their advantages. This study was conducted to assess the awareness, attitudes and implementation patterns of occlusal indicators and equilibration procedures among dental practitioners in Gujarat. By evaluating practitioner knowledge, preferences and perceived barriers, the study aims to highlight current gaps in occlusal diagnostics and suggest strategies to enhance clinical decision-making and patient care outcomes.

Methodology

Study Design

A cross-sectional, questionnaire-based observational study.

Study Area and Population

Conducted in Gujarat, India-one of the country's most populous states, with a vibrant mix of urban and semi-urban dental practices. Cities included Ahmedabad, Surat, Jamnagar, Rajkot, Vadodara and others.

Sample Size and Sampling

300 dental practitioners participated.

- BDS: 160 (53.3%)
- MDS in Prosthodontics: 95 (31.7%)
- MDS in Other Specialties: 45 (15.0%)

Participants were selected through purposive sampling using professional dental networks

Data Collection

A validated Google Forms questionnaire was used. It comprised:

- Demographics (Part A)
- 21 practice-related questions (Part B) regarding awareness, tool usage and beliefs about occlusal equilibration

Data Analysis

Responses were analyzed using SPSS v26. Descriptive statistics and chi-square tests were used. A p-value < 0.05 was considered statistically significant.

Survey Questions

1. Which occlusal indicators have you used or are familiar with?
2. How often do you use occlusal indicators in theclinical practice?
3. In your opinion, which occlusal indicator provides the most accurate assessment?
4. Do you believe digital occlusal analysis systems (like T-Scan) offer advantages over traditional methods?
5. Which thickness range of articulating paper do you use for detecting premature contacts in fixed prosthodontics?
6. How do you verify occlusal contact patterns during regular patient appointments?
7. Are you aware of the limitations of commonly used occlusal indicators (e.g., false positives, thickness variation)?
8. Which of the following best reflects your opinion on digital occlusal analysis (e.g., T-Scan)?
9. Do you educate patients that their occlusion may adapt or settle over time after restorations?
10. Are you familiar with the concept of occlusal equilibration?
11. Do you believe occlusal equilibration should be a routine part of full-mouth rehabilitation?
12. Occlusal equilibration should ideally be performed:
13. Which of the following tools is commonly used for occlusal adjustment in equilibration?
14. Do you use occlusal deprogrammers as part of your equilibration protocol?
15. When performing equilibration, how confident are you in interpreting occlusal markings?
16. In your clinical experience, how often do patients report improvement after occlusal adjustments?
17. In what situations do you most frequently use occlusal indicators?
18. Which of the following are limitations of articulating paper when used to assess occlusal contacts?
19. In which clinical scenarios do you find T-Scan most beneficial?
20. In which cases do you believe occlusal equilibration is indicated?
21. What are your primary goals when performing occlusal equilibration?

Results

The results of the questionnaire are described in graphs as attached ahead (Fig. 1-18)

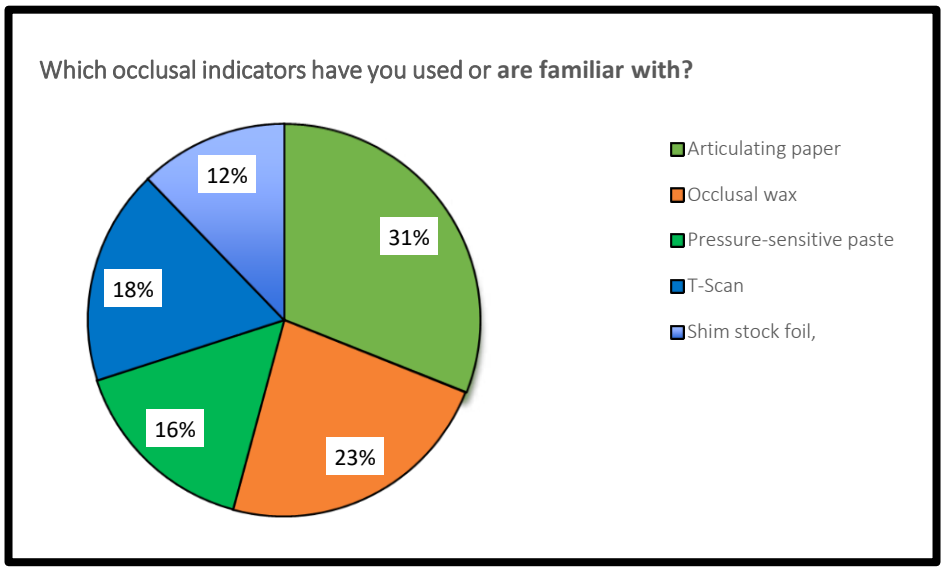

Figure 1: All participants (100%) reported familiarity with articulating paper, followed by occlusal wax (74.67%), T-Scan (57.33%), pressure-sensitive paste (51.00%) and shim stock foil (39.33%).

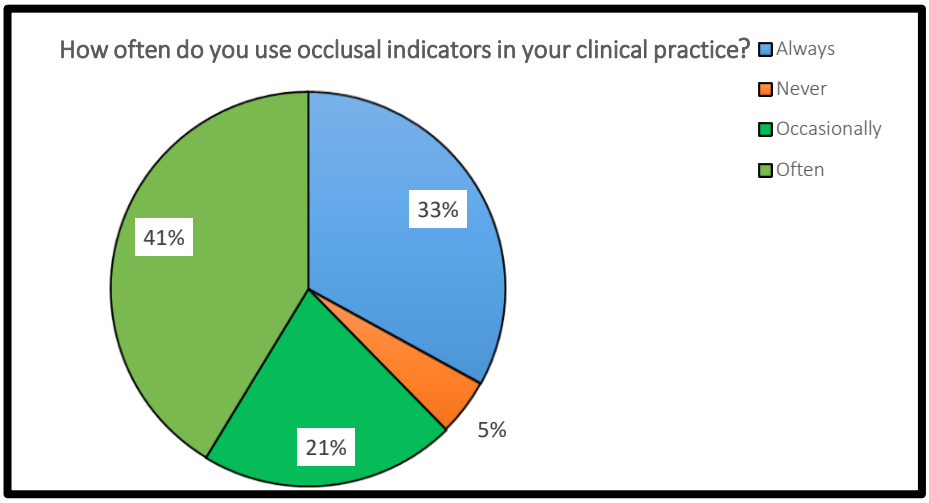

Figure 2: In clinical practice, 41.3% used occlusal indicators often, 33.0% always, while a small proportion (4.7%) never used them.

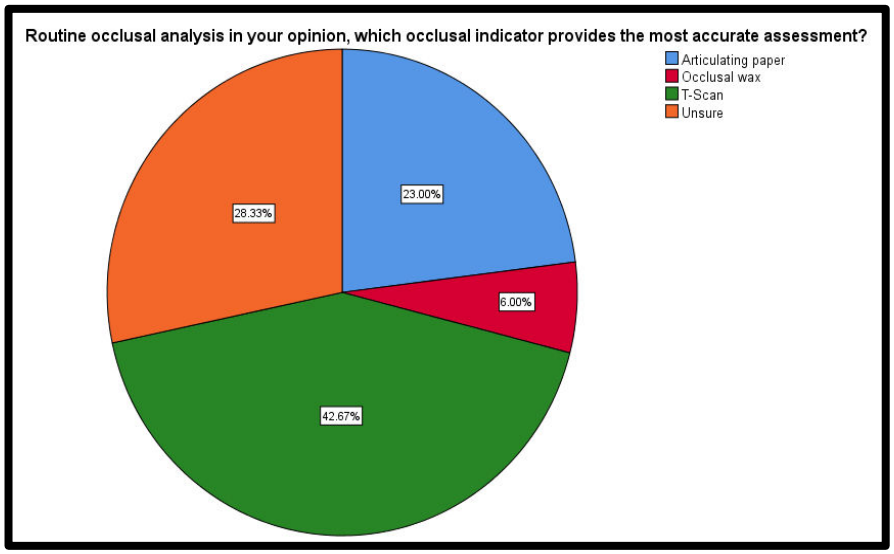

Figure 3: Regarding perceived accuracy, 42.7% favored T-Scan as the most precise indicator, although 28.3% were unsure.

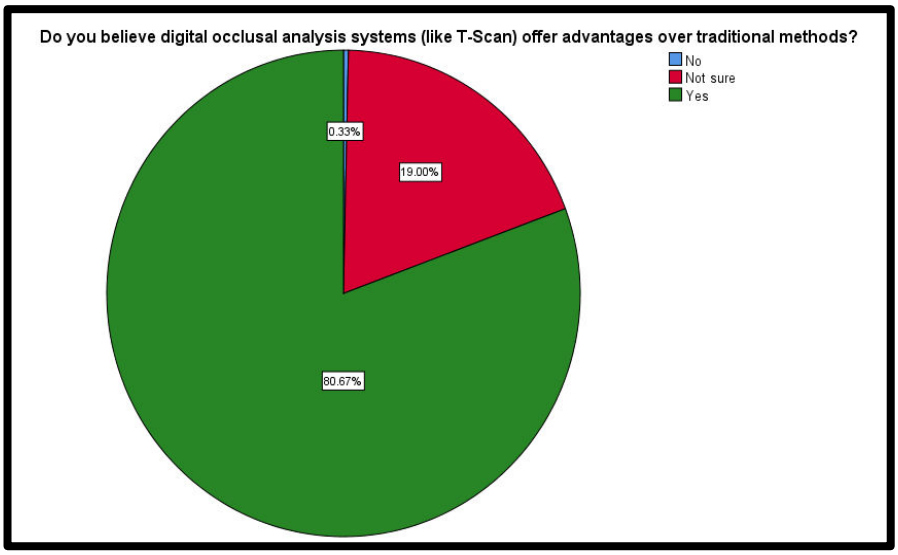

Figure 4: A significant majority (80.7%) believed digital occlusal analysis systems offered advantages over traditional methods.

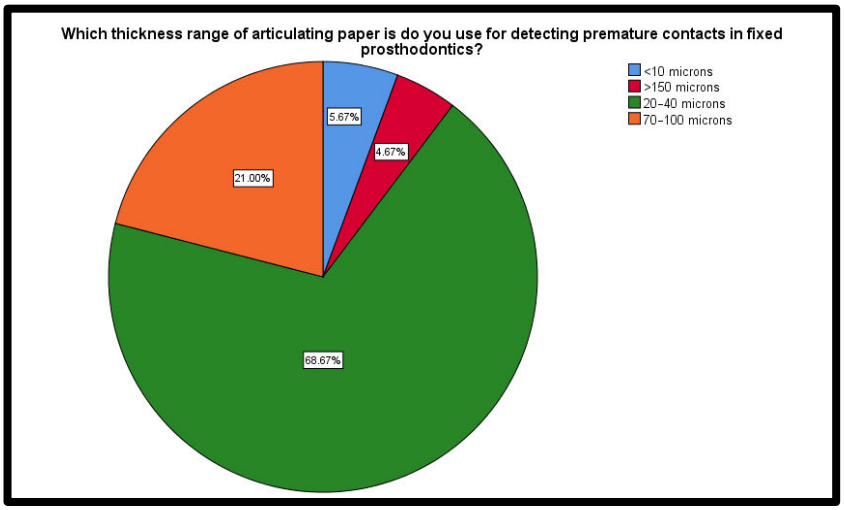

Figure 5: The most commonly used articulating paper thickness was 20-40 microns (68.7%).

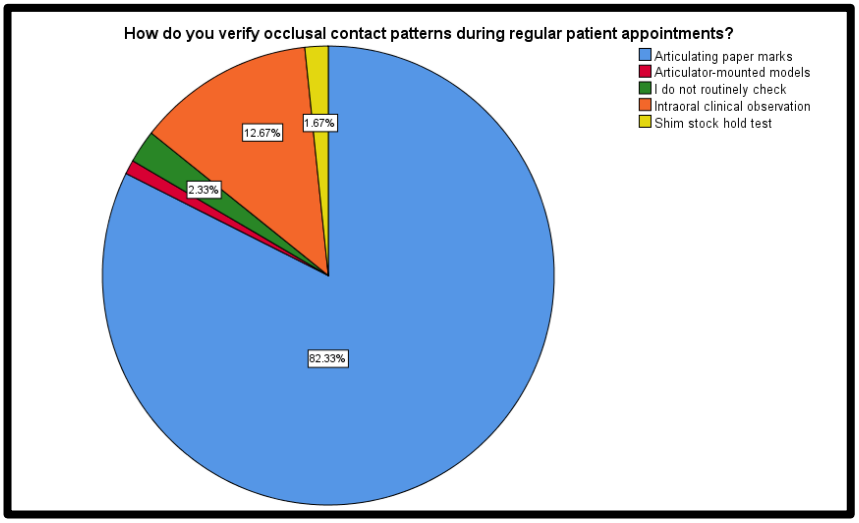

Figure 6: Verification of occlusal contacts was mainly done using articulating paper marks (82.3%).

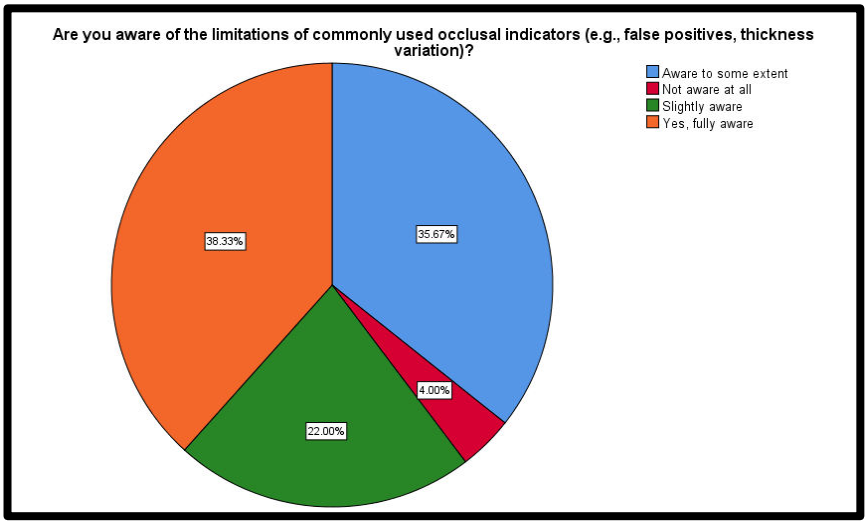

Figure 7: 38.3% were fully aware of the limitations of conventional occlusal indicators, many were only partially aware.

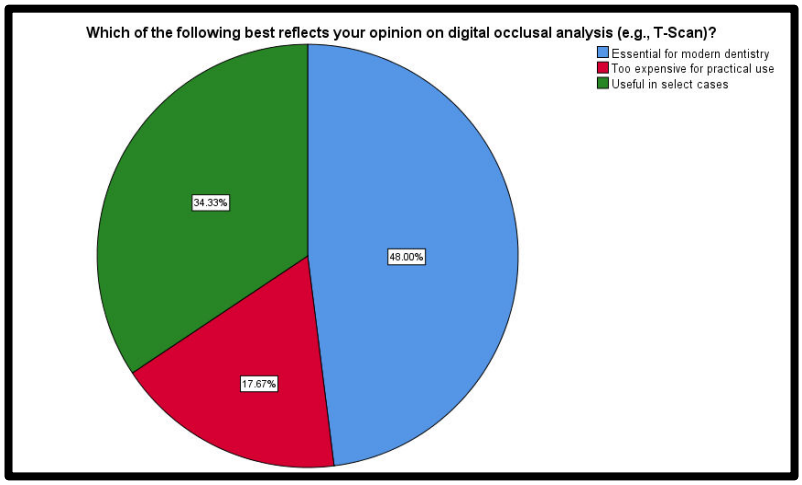

Figure 8: Opinions on digital analysis varied: 48.0% deemed it essential, 34.3% found it useful in select cases and 17.7% considered it too expensive.

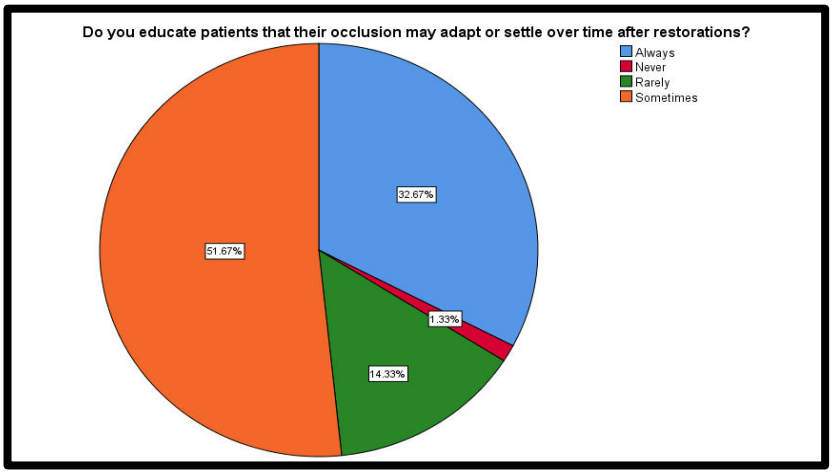

Figure 9: Patient education regarding post-restorative occlusal adaptation was commonly practiced, with 51.7% doing so sometimes and 32.7% always.

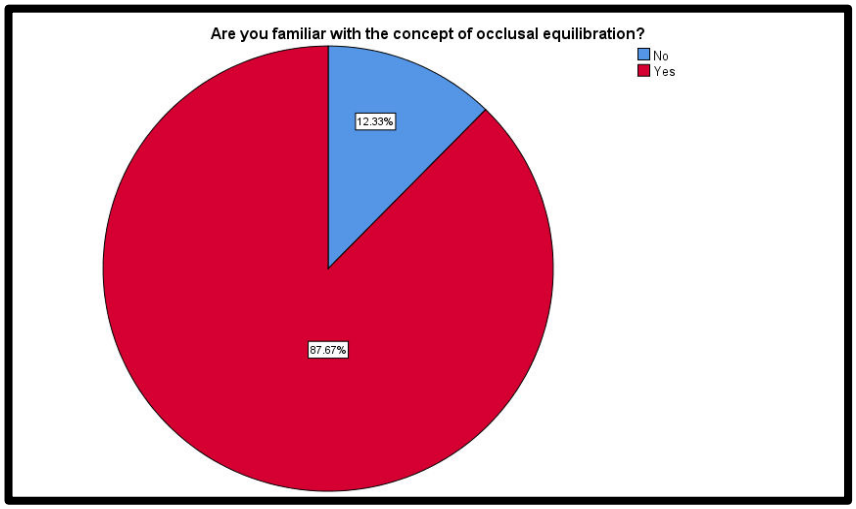

Figure 10: Most respondents (87.7%) were familiar with occlusal equilibration.

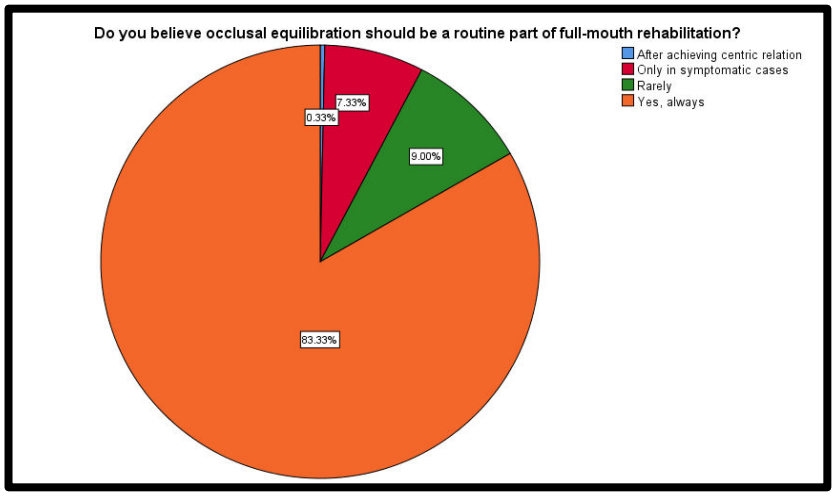

Figure 11: 83.3% believed it should always be part of full-mouth rehabilitation.

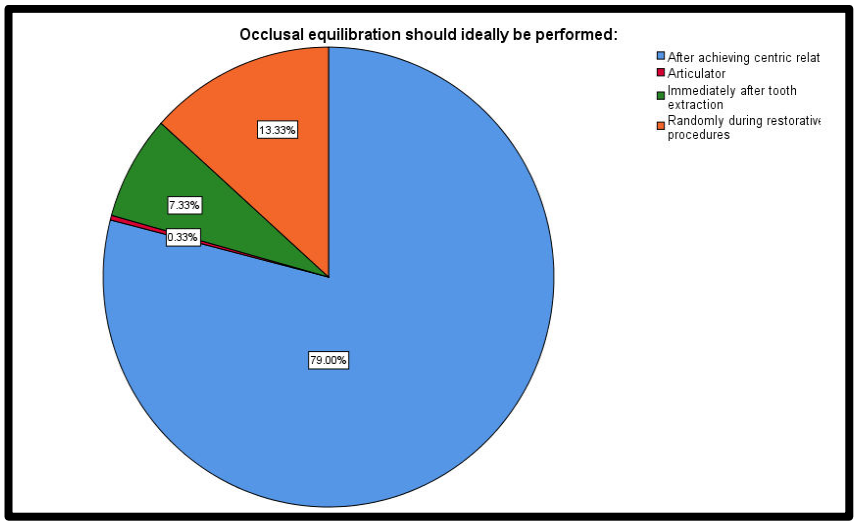

Figure 12: 79% of participants believed occlusal equilibration should be performed after achieving centric relation.

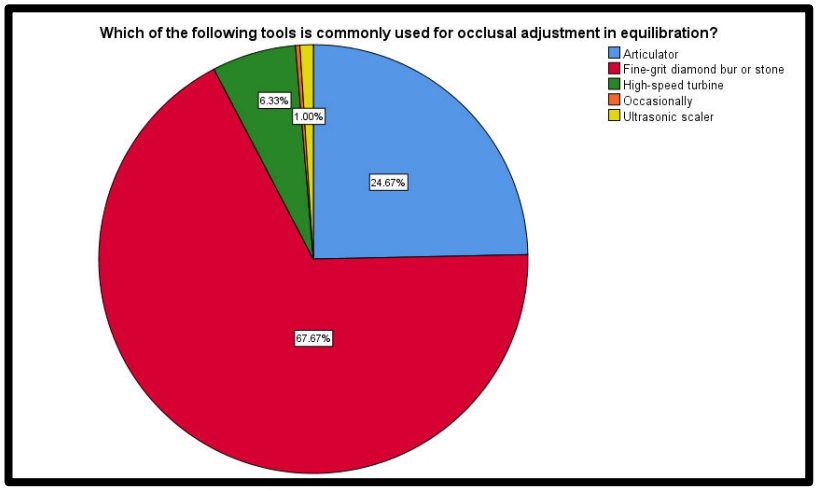

Figure 13: Fine-grit diamond burs or stones were the most commonly used tools for occlusal adjustments (67.7%) and In terms of clinical outcomes.

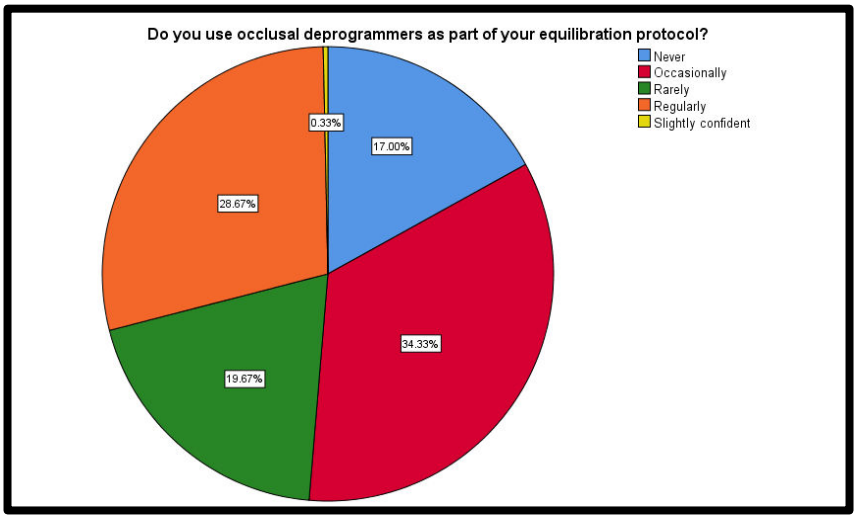

Figure 14: Occlusal deprogrammers were regularly used by 28.7%.

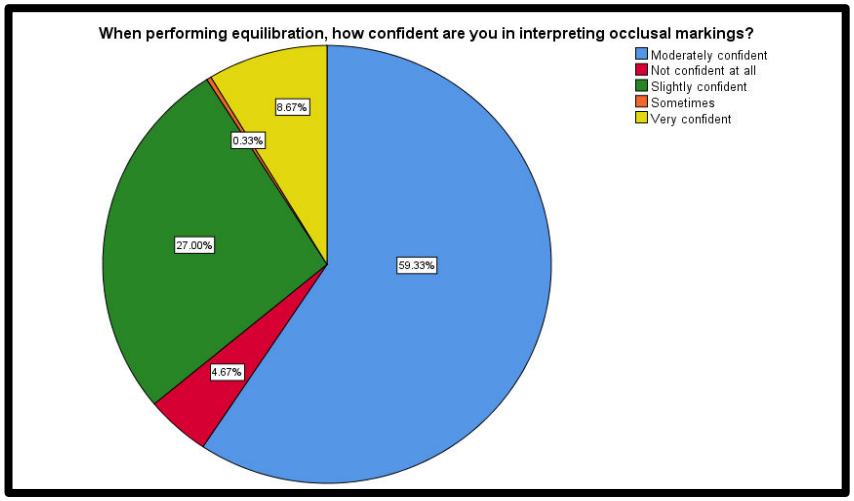

Figure 15: 59.3% felt moderately confident in interpreting occlusal markings.

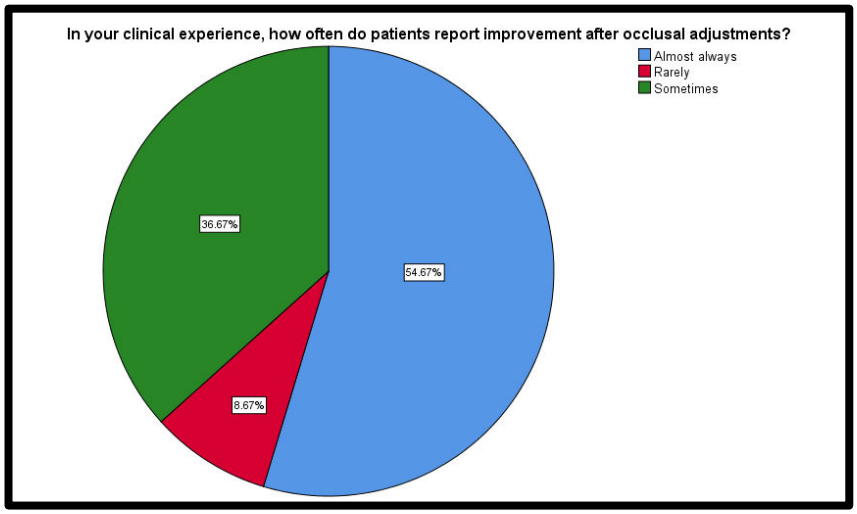

Figure 16: 54.7% reported that patients almost always experienced improvement after occlusal adjustments.

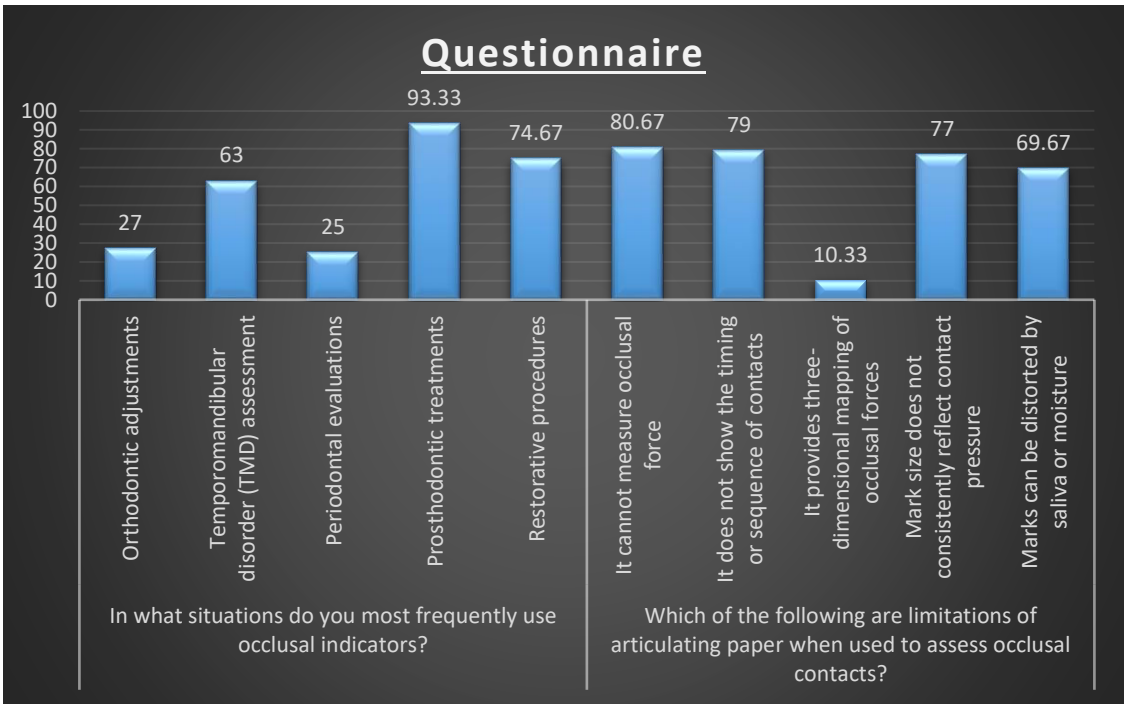

Figure 17: Occlusal indicators were most frequently used during prosthodontic treatments (93.33%), followed by restorative procedures (74.67%) and TMD assessment (63.00%). The main limitations of articulating paper included its inability to measure occlusal force (80.67%) and contact timing (79.00%), along with inconsistent mark size and distortion due to moisture.

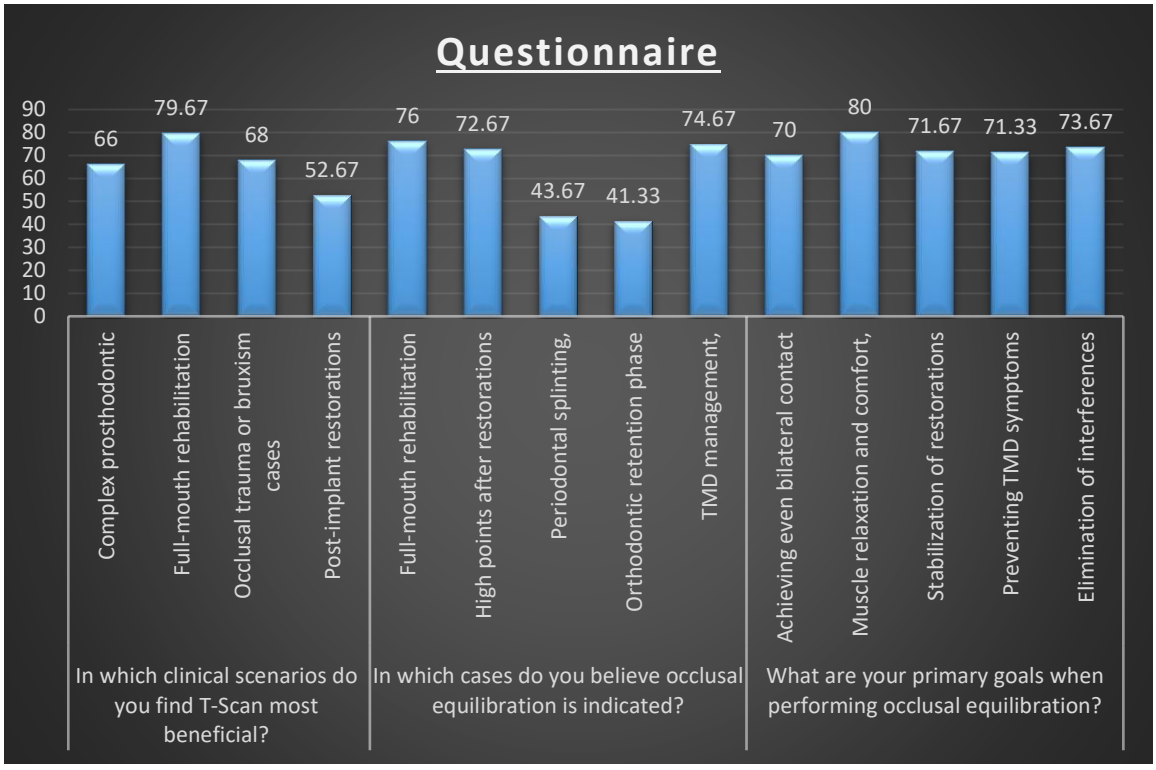

Figure 18: T-Scan was found particularly beneficial in full-mouth rehabilitation (79.67%), occlusal trauma or bruxism (68.00%) and complex prosthodontic cases (66.00%).Occlusal equilibration was most often indicated in full-mouth rehabilitation (76.00%), high points after restorations (72.67%) and TMD management (74.67%). The primary goals during equilibration were muscle relaxation (80.00%), elimination of interferences (73.67%), restoration stabilization (71.67%) and prevention of TMD symptoms (71.33%).

Discussion

This study provides valuable insights into the current awareness, usage patterns and clinical perspectives regarding occlusal indicators and equilibration techniques among dental practitioners in Gujarat. The findings highlight both encouraging trends and critical gaps that require targeted intervention in the form of continuing education, digital adoption and clinical standardization.

The results indicate that all respondents were aware of occlusal indicators, with articulating paper being the most universally used tool (100%), followed by occlusal wax (74.7%), shim stock and T-Scan (57.3%). This is consistent with findings by Kerstein and Radke, who emphasized that articulating paper remains a widely used yet misunderstood tool in occlusal diagnostics [6]. Despite its widespread usage, only 38.3% of respondents in this study were fully aware of its limitations, including its inability to measure occlusal force or indicate timing of contact [6].

Importantly, digital indicators such as T-Scan were recognized by 42.7% of respondents as the most accurate method. This supports the conclusions of Soni, et al., who advocated for the integration of computerized occlusal analysis in prosthodontic and implant practice for enhanced precision and reproducibility [7]. Moreover, MDS-qualified prosthodontists in this study demonstrated higher awareness and preference for T-Scan, echoing the results of Baba and Goodacre, who found that specialists are more inclined to incorporate digital tools into complex rehabilitative care [8].

The majority of respondents (87.7%) reported being familiar with the concept of occlusal equilibration and 83.3% believed it should be a routine part of full-mouth rehabilitation. These numbers align with Dawson's occlusal philosophy, which stresses the importance of achieving occlusal harmony through selective reshaping of tooth surfaces [1]. However, confidence in interpreting occlusal markings varied significantly, with general dentists expressing lower certainty compared to prosthodontists. This suggests that while theoretical knowledge is widespread, practical implementation remains inconsistent, likely due to inadequate hands-on training or lack of exposure to newer technologies.

Interestingly, although T-Scan was perceived to offer advantages, its usage remains limited, especially in general practice settings. Common barriers identified in the literature include cost, lack of training and unfamiliarity with interpretation protocols [5]. As Kerstein noted, many clinicians misinterpret articulating paper marks, leading to unnecessary or ineffective adjustments-a finding supported by our data.

Comparison with Other Studies

Kerstein and Radke found that clinician interpretation of articulating paper markings has a high error rate, particularly in identifying contact force-a limitation which T-Scan technology seeks to overcome [6]. Prasad, et al., also noted significant differences in thickness and marking quality among various brands of articulating papers, which may contribute to diagnostic inaccuracies when used without adjunctive methods [9].

The relatively low usage of deprogrammers or occlusal splints in equilibration protocols noted in this study contrasts with Okeson's recommendations, which emphasize the importance of muscle deprogramming before occlusal adjustments to ensure accuracy [2]. This divergence underscores the need for greater clinical exposure and interdisciplinary integration in occlusion management.

This study has limitations, including a regional scope confined to Gujarat and reliance on self-reported data, which may introduce bias and small sample size. To improve clinical practice, it's essential to enhance training on interpreting occlusal indicators and promote the use of digital occlusal tools in complex restorative cases. Standardized equilibration protocols should be developed and patients should be educated on occlusal adaptation post-restoration to optimize treatment outcomes.

Conclusion

This study reveals strong foundational awareness among Gujarat's dental practitioners regarding occlusal indicators and equilibration, but also highlights inconsistencies in application and understanding. Digital tools offer valuable advantages and should be integrated into modern practice through structured training. Enhancing both practitioner skill and patient education can lead to more predictable and successful dental outcomes.

Conflict of Interest
No conflicts of interest.

Informed Consent
Informed consent was obtained from the participant involved in this study.

Financial Disclosure
No financial support was received for the writing, editing, approval or publication of this manuscript.

Consent for Publication
Informed consent for publication was obtained from the patient involved in this case report, as documented in the manuscript.

Ethical Statement
This project was exempt from IRB review as it did not qualify as human subject research under federal regulations.

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