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Original Article

Knowledge, Attitude, and Practice among Prosthodontists in Tamil Nadu and Puducherry Regarding Dynamic Navigation for Implant Placement – A Questionnaire Survey

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Abstract

Introduction: Dynamic navigation, one of the most recent advancements, may enable surgeons to place implants with precision comparable to stereolithographic guidance based on 3D, prosthetically driven designs. Nowadays, guided, full-arch, immediate-function therapy for the edentulous and terminally dentate patient is easier to administer and more predictable because of the development of intraoral surface scanners and computer-aided design/computer-aided milling.

Aim: To investigate prosthodontist's knowledge, attitude, and practice about dynamic navigation for implant placement.

Methodology: A cross-sectional questionnaire-based study was conducted among prosthodontists who are practicing in various dental clinics, hospitals, and dental institutions in Tamil Nadu and Puducherry after obtaining ethical approval from the Institute Ethics Committee (IEC/TDCH/74/2024). The questionnaires were distributed through online platforms, email, and WhatsApp. The questionnaire consists of 28 questions, such as 12 knowledge, 10 attitude, and six questions in practice which were framed after content validation. The participants were given a reasonable timeframe to complete the survey. Based on the confidence level (95%) and relative precision (5%), the sample size was estimated to be 180.

Results: The knowledge of the prosthodontist was found to be better than the attitude and practice related to dynamic navigation.

Conclusion: Dynamic navigation aids implant surgeons in obtaining accurate outcomes for implant site preparation. Therefore, further knowledge about dynamic navigation can be improved by conducting various workshops that help in the ease of implant placement approach.

Key words: dynamic navigation, digital dentistry, guided implant, computer-assisted surgery

INTRODUCTION

For patients who are partially or completely edentulous, dental implants are the gold standards of care. In fact, there has been a growing desire for prosthetic-driven implant placement, which demands greater accuracy for the best possible functional and esthetic restoration.[1] The enduring success of implant restoration is significantly dependent on the accurate positioning and angulation of the dental implant. Incorrect placement of the implant can lead to a more complex restoration process, adverse healing of bone and tissue, and possible harm to nearby anatomical structures. This can be mitigated by achieving a three-dimensional implant placement that adheres to an optimal prosthetically driven concept, thereby facilitating the restoration process and improving esthetic results.[2] In the past decade, 3D printing technology has become increasingly accessible to health-care professionals, enabling them to provide treatments that are more precise,

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economical, and time-efficient for their patients. This groundbreaking technique facilitates the production of functional models, prosthodontic restorations, orthodontic devices, surgical guides for implant placement, and maxillofacial prosthetics.[3]

Freehand implant placement is a frequently utilized method by surgeons that yields precise outcomes; however, it significantly depends on the surgeon's expertise and proficiency. Digital radiography, utilizing computed tomography (CT) and cone beam CT (CBCT), has facilitated the pre-operative assessment of bone volume, quantity, and quality. In addition, it enables the identification of critical anatomical features, such as blood vessels, nerves, sinuses, and foramina, which may impact the positioning of dental implants. With the development of 3D printing technology, computer-assisted implant surgery (CAIS) is increasingly favored due to its ability to facilitate more accurate three-dimensional guided implant placement. Reports indicate that it may also lower the likelihood of adverse outcomes and surgical complications. CAIS employs specialized computer software to create a treatment plan and determine implant positioning in three dimensions, utilizing the patient's CBCT scan as a reference. Computer-guided surgery has enabled researchers to streamline and greatly enhance clinical procedures when compared to conventional implant surgery. This approach provides various benefits, including increased precision in fixture placement, enhanced patient comfort, and the ability to create temporary prosthesis before surgery.[4] To minimize patient deviations from the virtually planned implant position during surgery, navigation implant surgery was recently introduced.

There are primarily two categories of techniques utilized in computer-assisted surgical implant placement systems: Static computer-aided implant surgery (sCAIS) and dynamic computer-aided implant surgery (dCAIS).[5]

sCAIS systems employ STL templates that are reinforced by both soft and hard tissues, with teeth being integrated during the drilling and placement of the implant. In contrast, dCAIS systems facilitate real-time tracking of the implant; they utilize an optimal marker for drilling and subsequently correlate this data with the three-dimensional pre-operative virtual plan established through CBCT.[6] Dynamic navigation has several advantages when compared to sCAIS and traditional freehand implant placement.

However, dental practitioners' knowledge, attitudes, and practice patterns are crucial to the effective integration of dynamic navigation into clinical practice. The purpose of this study is to investigate prosthodontists' knowledge, attitude, and practice about dynamic navigation for implant placement.

METHODOLOGY

A cross-sectional questionnaire-based study was conducted among prosthodontists who are practicing in various dental clinics, hospitals, and dental institutions in Tamil Nadu and Puducherry after obtaining ethical approval from the Institute Ethics Committee (IEC/TDCH/74/2024). The questionnaires were distributed through online platforms, email, and WhatsApp. The questionnaire consists of 28 questions, such as 12 knowledge, 10 attitude, and six questions in practice which were framed after content validation.

The participants were given a reasonable timeframe to complete the survey. Based on the confidence level (95%) and relative precision (5%), the sample size was estimated to be 180.

Inclusion Criteria

The prosthodontists who are private practitioners and academicians in various institutions were included in the study.

Exclusion Criteria

BDS graduates, practitioners, faculties, and post graduates of specialties other than prosthodontics, individuals who were not willing to participate in the study were excluded from the study.

Statistical Analysis

The survey data, collected through Google Forms, underwent cleaning and preprocessing before analysis using IBM Statistical Package for Social Sciences Statistics (Version 26.0). Descriptive statistics were employed to summarize demographic variables and participant responses, providing insight into the distribution and central tendencies of the dataset. Cross-tabulations were used to compare responses across different occupational groups, with Pearson's Chi-square test and Fisher's exact test determining statistical significance at a threshold of $P < 0.05$.

RESULTS

Demographic Analysis

The study comprised 180 valid respondents with no missing data. The mean age was 33.31 years (standard deviation = 4.615), with a range spanning from 20 to 45 years. Occupation-wise, participants were categorized

as private practitioners (40.0%), college faculty (18.3%), and those engaged in both fields (41.7%).

Knowledge and Awareness of Dynamic Navigation

Awareness

71.7% correctly identified dynamic navigation as a computer-assisted system for real-time guidance. There was a significant occupational variation ($\chi^2 = 15.346$, df = 6, $P = 0.018$), with college faculty demonstrating higher awareness (69.7%) compared to private practitioners (58.3%) [Figure 1].

Commonly used radiography

CBCT was identified as the most commonly used imaging modality (97.8%), with no significant occupational variation ($\chi^2 = 5.045$, df = 4, $P = 0.283$).

Real-time adjustments in surgery

84.4% agreed that dynamic navigation allows real-time adjustments ($\chi^2 = 9.404$, df = 2, $P = 0.009$).

Perceived Benefits and Suitability

Suitability for all cases

76.7% believed dynamic navigation was suitable for all implant cases, with no significant differences across occupations ($\chi^2 = 0.556$, df = 2, $P = 0.757$).

Pre-operative planning considerations

90.0% highlighted bone and nerve structures as the primary anatomical considerations, showing no statistical significance across occupational groups ($\chi^2 = 6.235$, df = 4, $P = 0.182$).

Technology Adoption and Practical Considerations

Training and workshops

61.1% had received training in digital dental workflows ($\chi^2 = 11.647$, df = 2, $P = 0.003$), whereas only 36.1% had attended a workshop on dynamic navigation ($\chi^2 = 24.892$, df = 2, $P < 0.001$) [Figure 2].

Adoption likelihood

The likelihood of adopting dynamic navigation varied significantly ($\chi^2 = 17.537$, df = 8, $P = 0.025$), with private practitioners showing more reluctance compared to those engaged in both academia and private practice [Figure 3].

Predictability of implant outcomes

58.9% of participants agreed that dynamic navigation enhances implant outcome predictability ($\chi^2 = 14.789$, df = 8, $P = 0.063$) [Figure 4].

Time efficiency

While 39.4% strongly agreed that dynamic navigation saves time ($\chi^2 = 21.275$, df = 10, $P = 0.019$), private practitioners

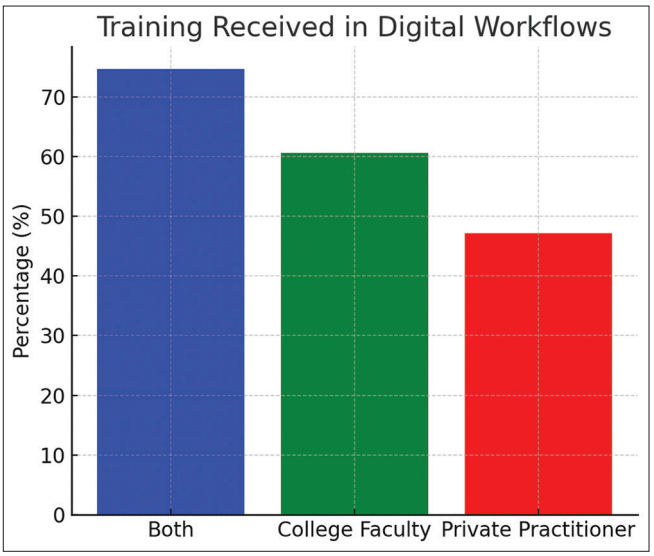

Figure 2: Training and workshop in dynamic navigation

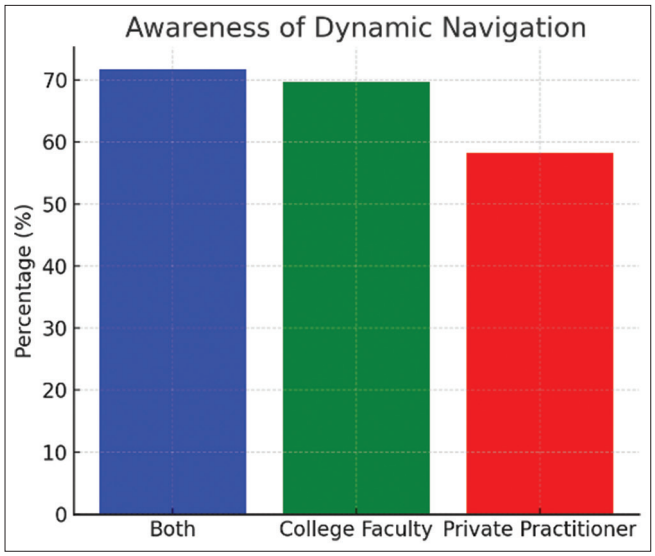

Figure 1: Awareness of dynamic navigation

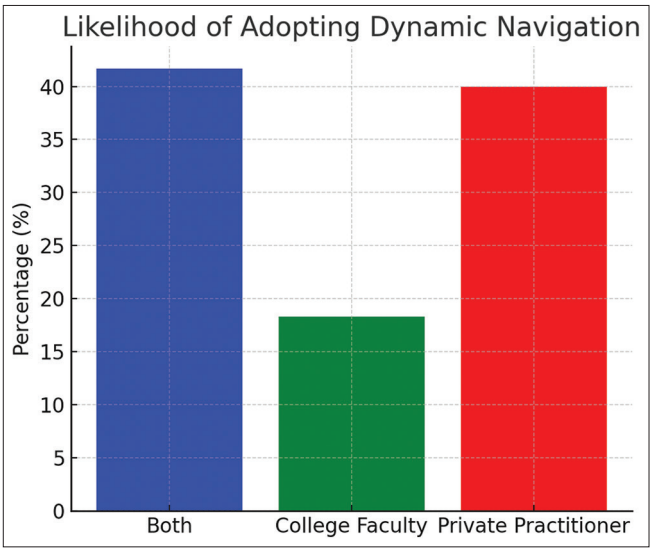

Figure 3: Adopting dynamic navigation

were less convinced than their academic counterparts [Figure 5].

The findings highlight a generally positive perception of dynamic navigation in dental implantology, particularly concerning accuracy and real-time adaptability. However, barriers such as cost, training, and workflow integration remain evident. The statistical significance of training disparities suggests a need for more widespread educational initiatives. Future research should focus on longitudinal clinical outcomes to assess the real-world efficacy of dynamic navigation systems.

DISCUSSION

One of the most rapidly developing fields in digital dentistry since the launch of virtual dental implant planning in 1999 is computer-guided implant surgery (CGIS).

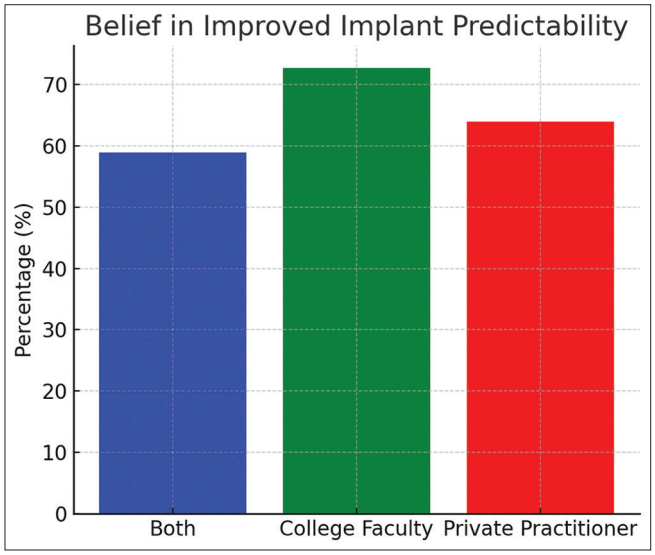

Figure 4: Implant predictability

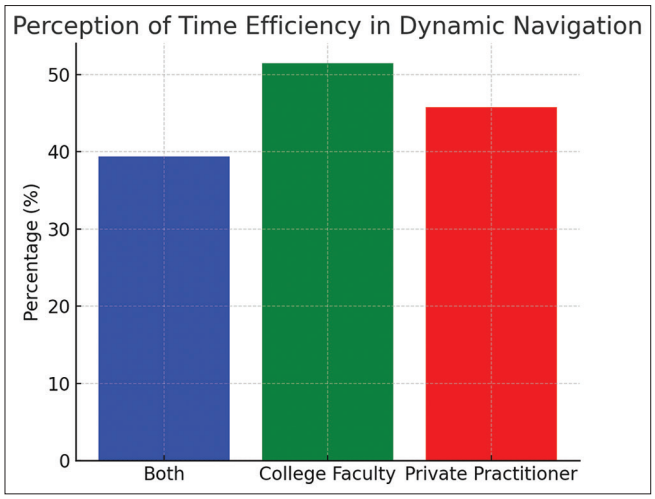

Figure 5: Time efficiency

It mostly entails imaging the intended prosthesis, placing a simulated implant, creating a stereolithographic surgical guide for the actual implant placement, and doing a CT of the jaw. Using radiographic anatomical considerations and optimal prosthesis location, this approach makes it easier to surgically put implants. Increased implant position accuracy, less invasive surgery, less chair-side time, and improved patient acceptance of dental implant treatment were all expected benefits when they were first introduced. Furthermore, CGIS has been shown in multiple studies to have an implant survival rate of 91–100%.[7]

In our research involving 180 participants, we found that 27 individuals were highly inclined to implement dynamic navigation for implant procedures. Conversely, the study conducted by Sanhitha *et al.* indicated that while 71.4% of participants favored dynamic navigation over guided navigation, only 14.1% had actual experience with dynamic navigation. Furthermore, 73.8% expressed a positive attitude toward the concept, yet only 36% demonstrated a comprehensive understanding of it, with 61.3% showing partial understanding and 35.1% lacking understanding altogether.[8] Similar to the findings of Lahoti, who found that 97% of practitioners were interested in using CGIS,only 40% had actually reported using them,the majority of participants, or 65.7%, expressed interest in using DynamicNavigation in their clinical practice, but only 8.9% of them had used the system,whereas 91.1% had not.[9]

Most practitioners noted that the unavailability of pre-operative implant planning software, training courses, and lectures were the most common limitations. The primary disadvantages of CGIS included its steep pricing and limited availability. The CGIS approach requires multiple steps, resulting in longer treatment planning durations. For those practitioners with minimal experience and no formal training, adapting to the complex equipment and planning software presents a steep learning curve. In addition, practitioners pointed out that limited communication with manufacturing facilities posed a challenge. All these factors collectively created significant barriers that hindered the adoption of CGIS. Despite its popularity, these challenges have limited the implementation of CGIS.

In our study, out of 180, only 10 participants strongly agreed that dynamic navigation saves time during implant placement whereas 71 participants were not able to say that it may save time or not. This is mainly due to the lack of awareness among the prosthodontist regarding workflow of dynamic navigation and these findings are consistent with research by Sanhitha *et al.* in which 77.4% of participants concurred that Dynamic Navigation is faster than the traditional implant placement approach. Out of

180 participants, 67 participants believe that the primary disadvantage of employing Dynamic Navigation in clinical practice is expense, and the same proportion of persons are willing to use Dynamic Navigation to place implants if given the opportunity. According to a 2010 study by Arisan *et al.*, guided flapless surgery reduced treatment duration by half when compared to the traditional method.[10]

It was hypothesized that the lack of accessibility to Dynamic Navigation training courses nationwide would prevent this method from being used. Training programs for practitioners would enhance their knowledge and application of computer-guided implant technology, further optimizing treatment results for patients in need of dental implant rehabilitation. Dynamic navigation supports implant surgeons in achieving good results in terms of accuracy in implant site preparation. This issue seems to be independent of the operators' skills in implantology and their knowledge of navigated surgery.

CONCLUSION

The success of implants is determined by multiple factors, with the 3D configuration of the implant site being the most critical. An innovative advancement in CBCT-guided surgery that may enhance placement precision is dynamic navigation. Enhancing surgical accountability and transparency to improve patient outcomes is a promising approach that involves validating and confirming the accuracy of real-time positional data. Dynamic navigation supports implant surgeons in achieving precise results for site preparation. It is unlikely that the surgeon's level of expertise in implantology and guided surgery is related to this issue. Thus, further understanding of dynamic navigation can be fostered by organizing a variety of workshops that facilitate a smoother implant placement process.

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