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Assessing dental implant biomaterial awareness across Indian sectors: A multi-city survey with emphasis on hafnium utilization

Sushma. B[1], Dr Vaishnavi Rajaraman*[2], Dr. Padma Ariga[3], Dr. Manjula Vellingiri[4], Dr. Saravanan Sekaran[5]

[1]Student, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India.
[2]Assistant Professor, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India.
[3]Professor, Department of Prosthodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India.
[4]Post-graduate student, Department of Prosthodontics, RUHS College of Dental Sciences, Jaipur, Rajasthan
[5]Associate Professor, Department of Prosthodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India.
vaishnavir.sdc@saveetha.com*

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Abstract

Objective

The objective of this survey was to assess the understanding and perception of the pan-Indian population regarding the biomaterials employed for dental implants.

Methodology

This multicenter survey was conducted from March to June 2023 after approval from the Institutional Review Board at Saveetha Dental College. This survey included an indigenously prepared questionnaire containing 10 questions, which was electronically created and circulated via social media, email, and personal contact. The questionnaire assessed the attitudes and awareness of various sectors of the population about dental implant biomaterials. All the responses were recorded, and statistical analysis was done.

Results

A total of 286 responses were collected out of the 500 forms circulated. The Indian Population is unaware of all the available dental implant biomaterials.

Conclusion

The KAP survey analysis reveals significant disparities in awareness about dental implant biomaterials across various demographic groups in India. While some segments demonstrate a strong understanding, others lack essential knowledge, underscoring the need for targeted educational initiatives. These programs are crucial for bridging knowledge gaps and promoting informed decision-making regarding dental implants. Overall, enhancing public education on emerging materials and technologies, such as hafnium-coated implants, is essential for advancing dental care and fostering an informed population.

Keywords: Implant biomaterials, Hafnium Coatings, Dental implant, KAP Survey, Geographic and Demographic Analysis

1. INTRODUCTION

Dental implant biomaterials are important components of modern dentistry that play an important role in the effective repair of lost teeth. The biomaterials used in dental implants must be carefully chosen since they have a direct impact on their functionality, biological compatibility, and durability [1,2]. Titanium and its alloys are among the most frequently employed biomaterials for dental implants. Titanium has superior biological compatibility, anti-corrosion properties, and

mechanical characteristics, making it an ideal choice for implant applications [3,4].

The titanium exterior may additionally be modified to enhance bone integration with the implant. Titanium implants can firmly anchor to the jawbone by promoting bone growth, ensuring sturdiness and durability. Zirconia, a ceramic substance, is another intriguing biomaterial that is attracting interest. Due to their tooth-colored look, zirconia implants have aesthetic qualities that make them particularly ideal for placement in the anterior region [5]. Additionally, zirconia has high mechanical and biocompatibility qualities that produce adequate bone integration and longevity [6].

Researchers have been investigating the possibility of biodegradable biomaterials in dental implants recently. These substances, including polyglycolic acid (PGA) and polylactic acid (PLA), progressively deteriorate in the body, negating the requirement for a second surgery to remove the implant [5,7]. When the patient's jaw is severely resorbed, biodegradable implants are very advantageous. Studies are also being done on hybrid biomaterials, which combine several materials, including titanium and ceramics. These hybrids strive to maximize implant efficacy even further by utilizing the benefits of each component. For instance, a ceramic coating might improve aesthetics and bone integration, while a titanium core might provide mechanical strength [8].

Continuous research and technological breakthroughs have contributed to the evolution of dental implant biomaterials. To speed up osseointegration and shorten healing duration, researchers are actively investigating innovative surface changes, the use of nanotechnology, and biologically active chemicals [9]. An improved clinical outcome is also promoted by the emergence of 3D printing technology, which has opened up new paths for personalized implant designs and a more exact fit[10]. This study's goal was to evaluate how the general Indian community understood and perceived the biomaterials used in dental implants.

2. MATERIALS AND METHOD

Study Design

The survey was a multicity study involving participants from numerous geographic locations. Before collecting data, approval was obtained according to the Declaration of Helsinki and received endorsement from the Saveetha Dental College Institutional Review Board (IRB) SRB/SDC/UG-1908/23/PROSTHO/027.

Data Collection

Each center used standardized questionnaire report forms indigenously created for this study. These forms collect data from different ages and genders on demographics, designation or occupation, awareness of the population, implant biomaterials for fixtures and implant components, the gold standard used, newer metals (ex. hafnium), and advances in biomaterials.

Sample size determination

The necessary sample size for sufficient statistical power was determined through the use of a power analysis. After considering sample attrition, the sample size was set to be 200. The questionnaire was circulated through social media and manual methods, and responses were collected and tabulated. A total of 185 respondents have answered the complete survey. Out of these, six were duplicate entries and hence a final sample of 179 was analyzed.

Ethical consideration

During the trial, absolute patient privacy will be upheld. To maintain anonymity, all data will be de-identified before analysis. Patients' informed consent will be sought before using their data for the study.

Descriptive statistics

The study population's clinical and demographic traits will be summed up using descriptive statistics. Using the relevant statistical tests, such as chi-square, t-tests, or ANOVA, the major outcomes will be contrasted among the various biomaterial groups. There will also be subgroup analyses based on the patient's age, sex, and designation or occupation.

RESULTS

The results section provides a thorough analysis of the KAP survey data, providing detailed insights into the various segments of the Indian population's awareness levels about dental implant biomaterials. The information clarifies the differing levels of knowledge among various geographic and demographic groupings. Some groups showed a strong understanding of the material, while other groups showed a clear lack of expertise. These results highlight the necessity of focused educational programs meant to reduce inequalities and promote fair understanding among all societal groups. By addressing these inequities head-on, we may enable people to make informed decisions about dental implant operations, which will ultimately lead to a more informed and involved public.

The age group of respondents ranged from 18-60 years, with maximum responses of 56.4 % in the age 18-25 years. About 38.5% of responses were from the age range 26-40 years (Figure 1).

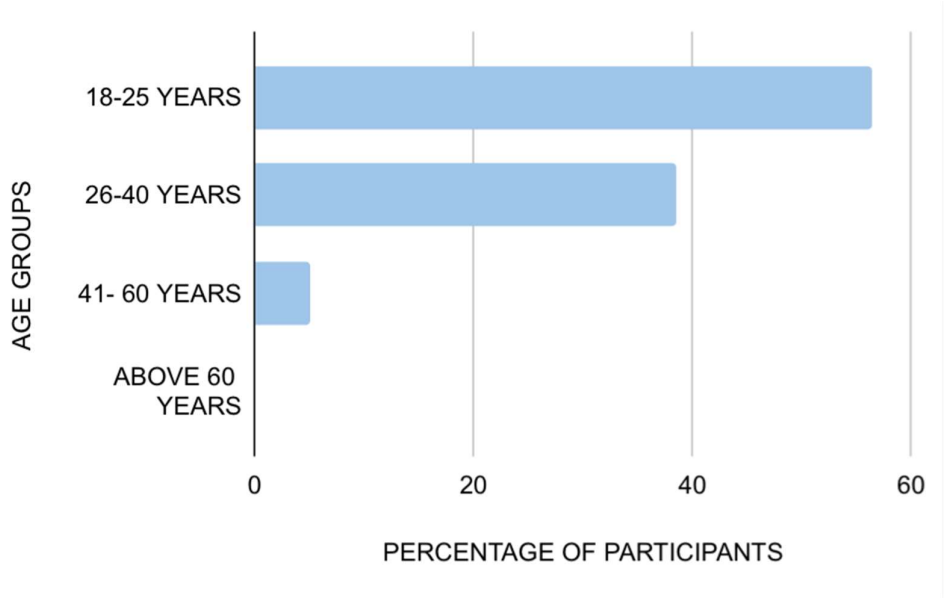

Figure 1: The age group of participants who took part in the study

The gender distribution of responses was almost equal with about 51% females and 49% males. 33.33 % of the population were undergraduates pursuing dentistry, 10% were postgraduates from various department specialties in dentistry, 28.2% were faculty in dental colleges specializing in one of the branches of dentistry, 12.8% were general dentists, 15.67% were medical professionals.

Awareness about dental implant biomaterials

79.5% of the population were of the opinion that they had an awareness of dental implant biomaterials (Figure 2). Of these 56.4% were of the opinion that base metals are commonly used, 28.2% felt precious metals were used and 15.4% felt that metals other than the ones in this classification were used as dental implant biomaterial.

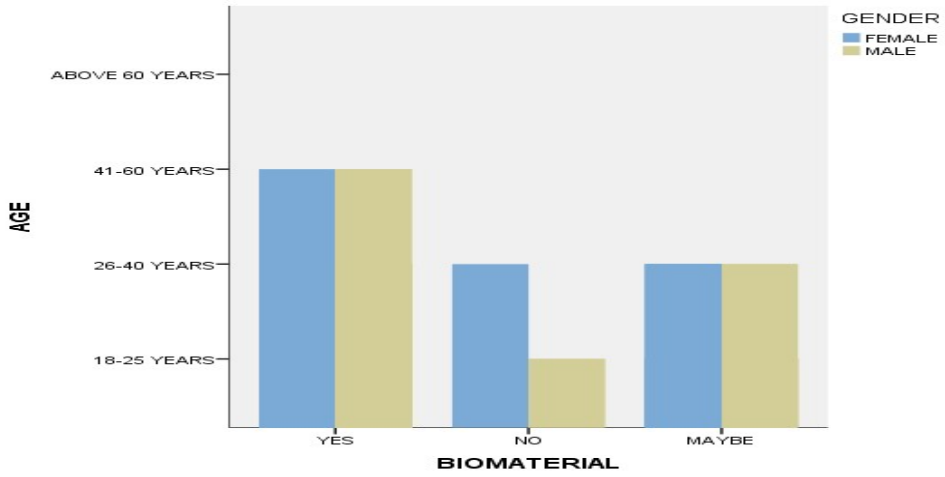

Figure 2: Awareness of biomaterials used for dental implants

When asked a question about the various biomaterials used for components of dental implants as an alternative to titanium, the majority of the population suggested the use of titanium-hafnium alloy (30.8%) which is illustrated in Figure 3.

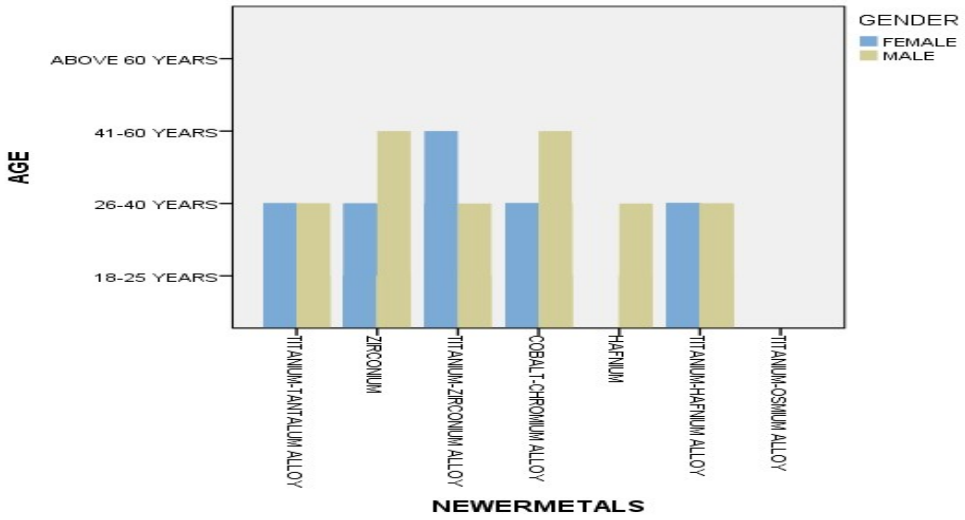

Figure 3: Awareness of various alloys for dental implants

5.1% of people who took the survey felt it would be used only as an abutment for implant fixtures. 7.7% were of the opinion that metals are used in alloy combinations as dental implants. 10.3% felt that the metals are used as dental implants and 76.9% of respondents were of the opinion that it has multiple avenues including implant abutment, dental implants as well as alloyed with other metals for dental implant (Figure 4).

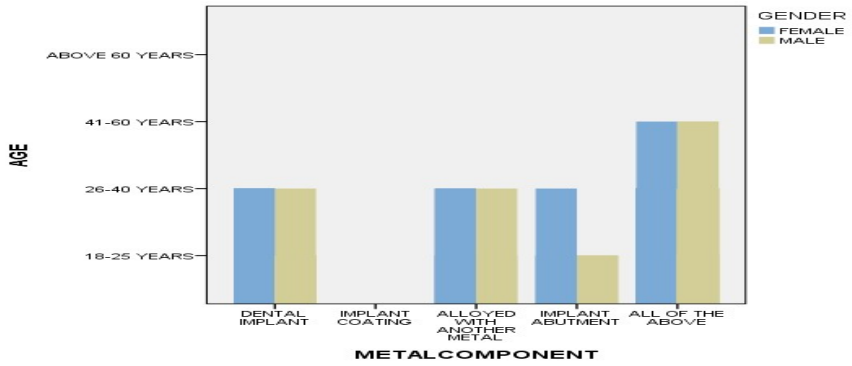

Figure 4: Awareness of participants on the usage of metals as Implant components

The commonly used biomaterials include,

a. Gold standard
b. Non-metal biomaterials
c. Metal biomaterials
d. Metal alloys as biomaterial

Form of Biomaterial The survey also asked participants about their knowledge of studies on the transition metal hafnium and its possible use as a coating for titanium implants. The findings showed that participants' answers varied widely: 38.5% said they were familiar with this type of research, 35.9% said they had no prior experience, and 25.6% said they were unsure (Figure 5). These results highlight how crucial it is to share knowledge about new materials and technology in the dental implant industry. The different answers show how much more information needs to be shared and education has to be provided so that people in all spheres of society are aware of developments that may improve the results of dental implants. As research continues to explore novel materials like Hafnium for coating applications, disseminating knowledge and fostering understanding among the broader population becomes paramount in promoting informed decision-making and advancing dental implant technologies.

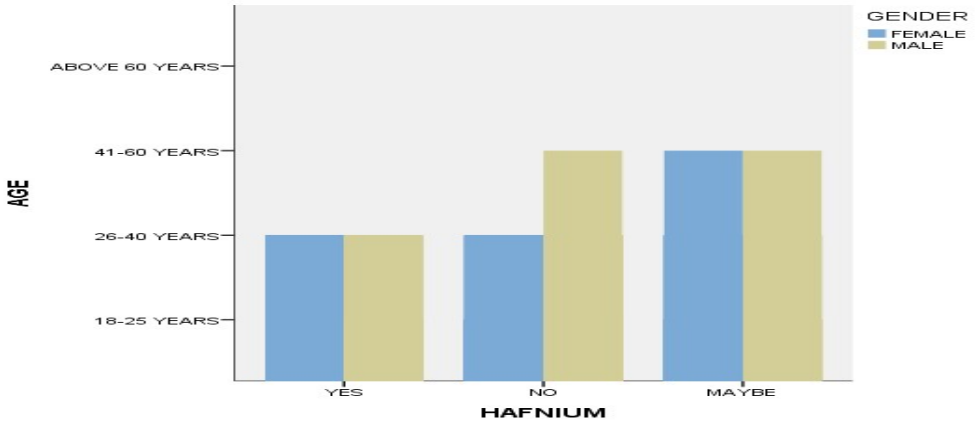

Figure 5: Awareness of participants on Hafnium metal as implant biomaterial

3. DISCUSSION

The multicenter survey on implant biomaterials will be discussed in terms of significant findings, their consequences, study limitations, and prospective future research paths. It will also serve as a backdrop for the findings in the larger field of dental implantology. Summarizes the survey's major findings, emphasizing the prevalence of various dental implant biomaterials throughout the participating sites. It will also highlight the success rates of each biomaterial as well as any major discrepancies found between them. For example, the study could discover that titanium implants outperform zirconia implants in specific regions.

In recent years, dental implant biomaterials have witnessed remarkable advancements that are transforming the landscape of modern dentistry.[11–15] These materials are integral to the success of dental implant procedures, offering patients improved aesthetics, functionality, and oral health. This discussion delves into the key aspects of dental implant biomaterials, their types, benefits, and the impact they have on patients' lives.

Types of Dental Implant Biomaterials

Dental implant biomaterials are carefully selected substances that mimic the properties of natural teeth, ensuring compatibility with the human body. Titanium and its alloys remain the most widely used due to their exceptional strength and biocompatibility. These materials create a strong bond with the jawbone through osseointegration, providing stability and durability. [2,16,17]

Advancements and Benefits

The evolution of dental implant biomaterials has led to groundbreaking innovations. Zirconia, for instance, offers an aesthetically pleasing alternative to metal implants. Its natural color and strength make it a popular choice, especially for visible front teeth replacements. Furthermore, bioactive materials have emerged, stimulating bone growth and enhancing the implant's integration, thereby improving overall success rates. [18–22]

Patient-Centric Approach

Choosing the appropriate dental implant biomaterial involves a comprehensive evaluation of patients' health, preferences, and anatomical factors. Dentists collaborate with patients to select the material that best suits their needs, ensuring long-term satisfaction. [23–26]

Aesthetic and Functional Impact

One of the most significant advantages of modern dental implant biomaterials is their ability to replicate the look and feel of natural teeth. This contributes to a patient's self-esteem and quality of life. Improved chewing efficiency and speech

restoration are additional benefits, making dental implants a comprehensive solution. [27–30]

Hafnium Dental Implants

The investigation of hafnium as a possible covering for dental implants stands out as a crucial area of interest in the discussion section. The special qualities of the transition metal hafnium may improve the functionality and biocompatibility of dental implants. [31] Hafnium coatings may extend the life of dental implants, lessen bacterial adhesion, and increase osseointegration, according to research.[32–35] The results of our poll, which show that different people are aware of different aspects of the research on Hafnium coatings, highlight the necessity of spreading knowledge more widely within the dentistry community. As technology develops, designing dental implants using cutting-edge materials like hafnium may have a major positive impact on patient outcomes and implant success rates.

4. CONCLUSION

In conclusion, the KAP survey's findings provide insight into the disparities in knowledge about dental implant biomaterials among various Indian population segments. The results highlight the need for focused educational programs to address knowledge gaps and advance fair understanding among all members of society. Given that a sizable segment of participants indicated that they were familiar with dental implant biomaterials, specifically base metals, there is a basis on which to construct extensive teaching initiatives. The survey did, however, also identify several areas with low awareness, especially with reference to more recent compounds like hafnium for coating applications. In order to empower people to make educated decisions concerning dental implant operations, these gaps must be filled by widely disseminating knowledge. By fostering a more informed and engaged public, we can strive towards reducing inequalities and advancing dental implant technologies for the benefit of all.

5. LIMITATIONS

Though the research was conducted with a wide range of population as research participants, this survey's limitations may include potential selection bias. Furthermore, the cross-sectional design of the study makes it difficult to establish causal links. To provide context for the results, the discussion will address the survey's shortcomings. These limitations could include the cross-sectional design, potential selection bias, and differences in data collection procedures between sites. Recognizing these limitations aids readers in comprehending the findings and prevents exaggeration of the findings.

The discussion will identify new areas for future research in dental implant biomaterials based on the survey findings. It could point to the necessity for randomized controlled trials evaluating the long-term performance of specific biomaterials or research into novel biomaterials with improved qualities. Researchers are exploring new materials with enhanced biocompatibility and regenerative properties. This may lead to quicker healing times and increased implant success rates.

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