INTERNATIONAL JOURNAL OF HEALTH SCIENCES (IAHS)

Original Research

Open Access

A Nation-wide survey of the selections made by dentists in Pakistan for dental implants and restorations.

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Abstract:

Dental implants have transformed the landscape of dental care, offering a technologically advanced alternative to conventional fixed partial dentures for replacing missing teeth. With an estimated 500,000 dental implants placed annually in the United States alone, the trend towards implant-based prosthetic rehabilitation is on the rise. Titanium remains the most popular implant material, although its aesthetic limitations in the anterior region have prompted exploration into alternative materials.

Objective: This study aims to investigate the selection criteria and preferred restorative approaches among dental professionals in Pakistan.

Methodology: The study, conducted over 9 months, surveyed 380 dental professionals in Pakistan, focusing on implant dentistry practices, training, and preferences. Data collection utilized an online questionnaire covering demographics, training, treatment planning, restorations, and system preferences**.** Dentists' loading techniques and reasons for delayed loading were also investigated.

Results: The study enrolled participants from various regions in Pakistan. Demographic analysis showed 58% male and 42% female participants, with BDS degree holders comprising 44%. Most practiced in Karachi, graduated in the 2010s, received implant training, and had 3 years of experience. Preferences leaned towards software-based implant planning, prefabricated metal abutments, and conventional loading protocols. Patient factors and preparatory surgeries influenced delayed implant loading decisions. Some respondents expressed skepticism or lack of education regarding immediate loading protocols.

Conclusion: The study reveals a preference for Bio-horizon implants and prefabricated metal abutments, alongside conventional loading protocols in Pakistan. Patient factors and preparatory surgeries influence loading decisions, emphasizing ongoing education in implant dentistry.

Keywords: Implants, loading protocol, dentist, Pakistan, surgical techniques, abutments

How to Cite: Aijaz S. A Nationwide survey of the selection made by dentists of Pakistan for implants and restoration. International Annals of Health Sciences. 2024 May 11;1(1).

Introduction:

Dental implants have revolutionized the dental sector by offering a high-tech substitute for conventional fixed partial dentures in the place of missing teeth (1). The clinicians have found implants the best option for replacing missing teeth. The American Academy of Implant Dentistry (AAID) estimates that 500,000 dental implants are implanted annually in the United States (2) This increase is consistent with the rising rates of dental implants that have been seen in different parts of the United States (3).As a result of increased patient awareness, implants are widely utilized in prosthetic rehabilitation. Titanium is the most popular material used for implants, although it is unaesthetic in the anterior region (4). Implant choices among dentists, particularly in Pakistan, are influenced by various factors that have been studied in different regions.

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Date of Receiving: 09-03-2024

Date of Revision: 04-04-2024

Date of Acceptance:15-04-2024

Doi: https://doi.org/10.69491/p7fmjq48

Studies from Iran(5) Nepal (6) Nigeria have emphasized how crucial it is for dentists to be knowledgeable about and conscious of dental implants. A common factor in implant system selection is simplicity of kit (7), as well as, the degree of education and training of dental professionals possess immense influence on how the decisions they make (8). Additionally, evaluations of dentistry student's and general dentist's attitudes and understanding regarding implants have been conducted in a number of countries, including Saudi Arabia and Thailand. Iran, India, and the USA (9-12). The aforementioned research illustrates the need of ongoing education and training in enhancing dentists' comprehension and use of dental implants. Besides this, The kind of implant restoration connection (screw or cement-retained) has an effect on various clinical and technical elements of treatment including aesthetics, occlusion, ease of manufacture, retention, retrievability, cost, and even the passivity of the framework (13). To achieve the best clinical outcomes with implant-retained/supported crowns and overdentures, meticulous assessment and detailed treatment planning are necessary (14). A decision must be taken regarding the type of attachment to allow retention of the prosthesis to the implants in addition to selecting the appropriate number of implants to restore an edentulous patient. Resilient

attachments, such round-shaped bars and clips, balls, magnets, and locators, allow for some rotation and some degree of angulation correction whereas rigid attachments, like telescopic copings and U-shaped bars, restrict rotation (15).

Cardoso et al, surveyed members of the American College of Prosthodontists (ACP) and the American Academy of Maxillofacial Prosthetics (AAMP) in 2013 to identify the most commonly used implants and overall restorative preference, and discovered that prosthodontists' choices were based on training, implant features, and literature support (16). In a Swedish community, general dentistry practitioners are more likely to conduct the prosthetic therapy, which increases the risk of mild to serious peri-implantitis (17). The "gold standard" for implant restores has been regarded as titanium abutments because of their high mortality rates and advantageous mechanical characteristics (18).

The purpose of this study was to identify the selection criteria and preferred restorative and dental implants among dental professionals working in the Pakistan for understanding the decision-making process of dentists regarding dental implant selection, specifically focusing on abutment choice and loading protocols. This understanding can aid in optimizing implant treatment outcomes, improving patient care, and informing dental education and training programs. The types of implants/implant restorations, selection criteria, loading procedures, and use of implant planning software among dentists in Pakistan will be examined, as well as the trends in implant dentistry practice.

A retrospective cohort study that examined the outcome rates of implant-supported crowns and fixed partial prostheses came to the conclusion that general dentists' private practices implant survival and prosthetic success rates were lower than those of specialists working in academic or specialty settings (19). According to a study in a Swedish community, general dentistry practitioners are more likely to conduct the prosthetic therapy, which increases the risk of mild to serious peri-implantitis (20).

Abutments:

The "gold standard" for implant reconstructions has been regarded as titanium abutments because of their incredible survival rates and advantageous mechanical characteristics, nonetheless, they have been linked to the peri-implant tissues' grey discoloration (18).

In order to give superior aesthetics, ceramic abutments have been adopted since they greatly reduce mucosal discoloration compared to metal abutments (21). Additionally, zirconia abutments have considerably lower levels of bacterial colonization than cast or machined titanium abutments do (22).

In single implant-supported prosthesis, a comprehensive study and meta-analysis found no discernible differences in the survival rates or complications of metal and ceramic abutments (23).

Prefabricated abutments can only be partially modified to match clinical specifications since optimal implant fixture placement is necessary (24). Due to its ability to alter the depth and angle of the implant fixture, custom implant abutments are frequently employed (25). The frequency of prosthetic loosening was found to be higher on prefabricated abutments than on custom abutments in a retrospective study analyzing cemented prosthetic reconstructions on prefabricated and custom abutments, and the difference was significant in single crown cases (24).

Type of implant restoration:

Aesthetics, occlusion, ease of manufacture, retention, retrievability, cost, and even the framework's passivity are all clinical and technical elements of therapy that are impacted by the kind of implant restoration connection (screw or cement-retained). There were no statistically significant differences in the survival and failure rates of screw- and cement-retained implant restorations, according to the systematic study by Wittneben et al. Although ceramic chipping was significantly more common in screw-retained restorations, cement-retained restorations showed more biological and technical complications over the course of five years, with a survival rate of 95.6% compared to 96.0% for screw-retained restorations (26).

Implant supported over denture:

To obtain the best clinical outcomes with overdentures that are implant-retained or supported, meticulous examination and detailed treatment planning are necessary(27). A choice must be taken on the kind of attachment to allow retention of the prosthesis to the implants in addition to selecting the appropriate number of implants to restore an edentulous patient. Telescopic copings and U-shaped bars are examples of rigid attachments that limit rotation, whereas round-shaped bars and clips, balls, magnets, and locators are examples of resilient attachments that permit varying degrees of rotation and some degree of angulation correction (15).

In terms of better peri-implant cleanliness, simplicity of denture preparation, decreased frequency of maintenance, and cost, locators have shown superior clinical results over 3 years in maxillary implant-supported overdentures(28). Specifically in the first 1 to 3 years of follow-up, a prospective 5-year clinical trial comparing ball and telescopic attachments in mandibular implant-supported overdentures indicated that ball attachments were linked with higher maintenance demands (29).

Loading protocol:

The loading techniques were categorized as conventional, early, and immediate at the 4th ITI Consensus Conference (30). Several variables, including occlusion, periodontal health, parafunctional behaviors, implant site characteristics, implant size, and attributes, in addition to the time and technique of implant implantation,

might affect how predictable loading regimens are(30). No statistically significant variations in implant success rates were found in a comprehensive evaluation comparing implant success rates with various loading procedures(31). A multicenter randomized controlled research indicated that all loading procedures were effective 4 months after loading, and it was established that establishing a high insertion torque during implant placement (40 Ncm or more) was the most important component in attaining such outcomes (32).

In order to determine the most popular implants and the preferred general restorative approach, Cardoso et al. (2013) surveyed members of the American College of Prosthodontists (ACP) and American Academy of Maxillofacial Prosthetics (AAMP). They discovered that prosthodontists made their decisions based on their education, the characteristics of the implant, and the available research. Additionally, they discovered that the Nobel Biocare implant was the most frequently utilized system across all clinical settings, with 79% of respondents having received training in its use (16).

Material and methods:

The study conducted after the Institutional review board ref DSH/IRB/2022/0045. The study employed a cross-sectional survey design conducted in a multi-center setting over a period of 9 months following the approval of the synopsis. The study population consisted of dental professionals, specifically dentists involved in placing implants in either private or government setups. Inclusion criteria encompassed all dentists engaged in implant placement, while those who declined to participate in the survey were excluded. The sample size of 380 participants was determined using OpenEpi software with a confidence level of 95%. The population under consideration was registered dental practitioners listed on the Pakistan Medical and Dental website, with a total population (P) of 27,428. The sampling technique employed was non-probability, convenience sampling. Data collection was carried out through an online survey as well as visits to dental practices utilizing a 16-item questionnaire based on the work of Cardoso et al. The questionnaire covered topics such as loading techniques for implants, demographic information, implant training and experience, implant treatment planning, implant restorations, and implant system preferences and selection. Dentists were contacted and some were visited in their clinical settings to encourage participation. Demographic details collected included the year of dental school graduation and whether the dentist practiced implant dentistry. Dentist who did not perform implant dentistry were advised to discontinue the questionnaire. Information on implant experience and training, including types and duration of training programs, was gathered. The duration of time spent practicing implant dentistry was also assessed. Implant treatment planning was explored, including the use of planning software

systems and collaboration with other specialties. Various abutment types for single implant-supported crowns and implant-supported fixed dental prosthesis were evaluated. Additionally, attachment types for implant-supported/retained overdentures and the method of retaining the implant superstructure were examined. The study also concluded the selection and preference of implant systems for different oral situations. Respondents were asked to prioritize factors considered when choosing an implant manufacturer or system. Implant loading techniques in different oral scenarios were explored, with respondents selecting preferred loading protocols and reasons for not loading implants immediately.

Results:

We enrolled participants from various regions across Pakistan. Those who did not respond were excluded from the study, and unanswered values were treated as missing data and excluded from the analysis.

The table 3.1 presents the demographic and professional characteristics of participants in the study.

In terms of gender, 222 participants were male, constituting 58% of the total, while 158 participants were female, making up 42%.

Regarding the highest degree achieved, the distribution was as follows: 168 participants held a BDS degree (44%), 70 had an FCPS (Fellowship of College of Physicians and Surgeons) degree (18%), 59 had an MDS degree (16%), 2 had a PhD (1%), 17 had an MSc (4%), 20 had an MPH (Master of Public Health) degree (5%), 25 had an MBA (Master of Business Administration in health care management) degree (7%), and 19 had an MPhil (Master of Philosophy) degree (5%).

Participants practicing implant dentistry were distributed across different settings: 94 in private institutes (25%), 96 in private clinics (25%), 93 in government institutes (24%), and 97 in government hospitals (26%).

Table 3.1 Demographic details:

Item	N	%
Gender		
Male	222	58
Female	158	42
Highest Degree		
achieved.	168	44
BDS	70	18
FCPS	59	16
MDS	2	1
PhD	17	4
MSc	20	5
MPH	25	7
MBA	19	5
M Phil		
Practicing Implant		
Dentistry in	94	25
Private Institute	96	25
Private Clinic	93	24
Government Institute	97	26
Government Hospital		

City of practice		
Karachi	244	64
Faisalabad	15	4
Islamabad	32	8
Lahore	44	12
Peshawar	45	12
Year of Graduation:		
1990s	34	9
2000s	63	17
2010s	192	51
2020s	91	24
Training acquires for		
Implant placement	239	63
Yes	141	37
No		
Experience		
3 years	162	43
5 years	68	18
less than 10 years	84	22
more than 10 years	66	17

The city of practice varied among participants: Karachi had the highest representation with 244 participants (64%), followed by Lahore with 44 participants (12%), Islamabad with 32 participants (8%), Peshawar with 45 participants (12%), and Faisalabad with 15 participants (4%).

Regarding the year of graduation, the distribution was 34 participants graduated in the 1990s (9%), 63 in the 2000s (17%), 192 in the 2010s (51%), and 91 in the 2020s (24%).

Training acquired for implant placement, 239 participants had received training (63%), while 141 had not (37%).

In terms of experience, participants were distributed as follows: 162 had 3 years of experience (43%), 68 had 5 years of experience (18%), 84 had less than 10 years of experience (22%), and 66 had more than 10 years of experience (17%)

3.2 Implant Training:

The table showed the variety of training durations undertaken by the study participants, aiding in understanding the distribution of training timeframes within the sample. The distribution of participants across different durations of the Implant Training course. The highest number of participants were in the 2-6 months duration, followed by 3 hours, 2-5 days, 3 Weeks, 1 year, and finally, 3 years.

Table 3.2: Details of implant training course

Implant Training course	N	%
3 hours	35	9
2-6 months	51	13
2-5 days	42	11
3 Weeks	40	11
1 year	39	10
3 years	32	8

3.3. Implant Treatment Planning

Implant Treatment Planning, the results for dentists utilizing software-based methods such as computerized tomography techniques, interactive software, computer-aided design, or computer-aided manufacturing compared to conventional methods involving manual or radiographic data.

a majority of dentists, 56%, prefer utilizing software-based methods for Implant Treatment Planning, while 44% opt for conventional methods. The study indicates a significant preference for computerized tools and technologies in the planning phase of dental implant procedures among the surveyed dentists.

Table 3.3 Implant Treatment planning protocol

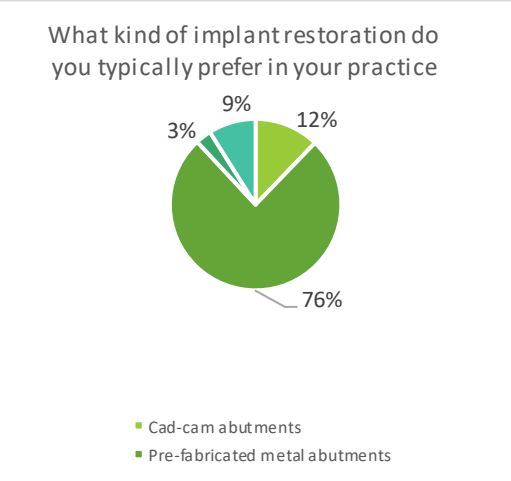
Planning protocol	No	%
Software used for implant planning	212	56
Conventional methods used for planning	168	44

3.4 Implant abutments:

The results Figure 1 indicates a clear preference among practitioners for pre-fabricated metal abutments, with 76% of respondents favoring this type of implant restoration. This high percentage suggests that pre-fabricated metal abutments are widely accepted and commonly used in clinical practice for single implant-supported crowns.

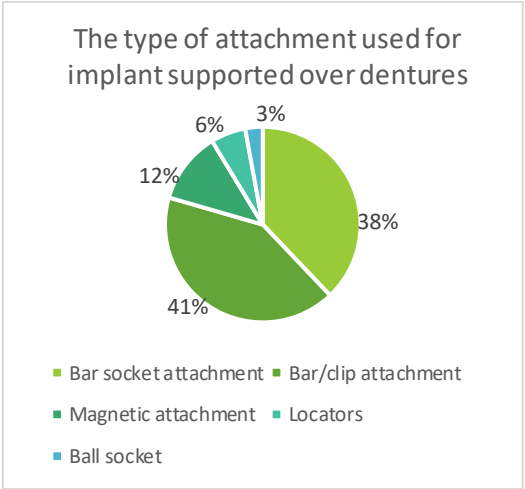
On the other hand, the lower percentages for Cad-cam abutments, ceramic fused metal, and pre-fabricated ceramic abutments (12%, 9%, 3% respectively) indicate that these options are less popular among practitioners for implant-supported restorations.

Fig 1: Implant restoration



The results revealed that the most preferred attachment type for implant-supported overdentures among the surveyed participants is the bar/clip attachment, with 41% of respondents opting for it as shown in figure 2. Following closely behind is the bar socket attachment, chosen by 38% of respondents. Magnetic attachments and locators are selected by 12% and 6% of respondents, respectively, indicating a moderate level of preference for these options. The least favored attachment type is the ball socket, with only 3% of respondents opting for this choice

Figure 2: Type of attachment used



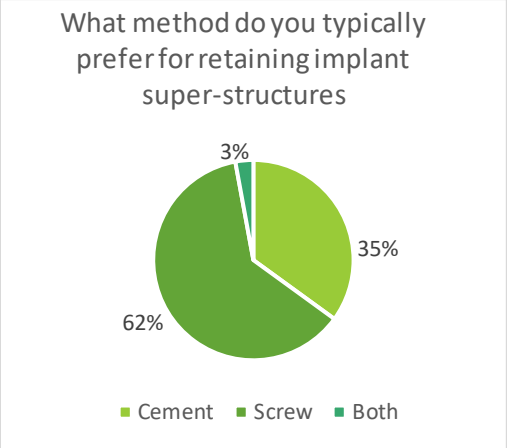
With 62% of participants choosing this strategy, the data clearly showed that respondents clearly prefer to use screws to preserve implant superstructures Figure 3. Benefits of screw retention include easy retrieval, low maintenance requirements, and the ability to handle possible issues without compromising the restoration.

Conversely, cement retention selected by 35% of respondents—offers advantages including aesthetic appeal and passive fit. If issues occur,

retrievability and repair may present difficulties.

Just 3% of respondents said they preferred to keep implant superstructures with a combination of screws and cement.

Figure 3: Retention of implant super structure



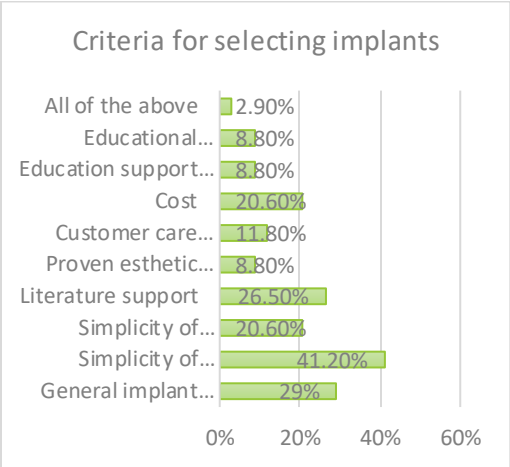
The table 3.6 depicts the distribution of implant systems utilized in different oral regions. Bio-Horizon implants are prevalent across all regions, notably in the anterior (13%), posterior (32%), and edentulous arches (41%). Astra Tech and Implant Swiss are prominent in the anterior and posterior regions, respectively. Neobiotec emerges as notable in edentulous arches. Other systems, such as Ankylose and Nobel Biocare, demonstrate varying degrees of usage across the different oral regions.

Table 3.6 Implant Preferences according to regions

Implant system	Anterior Region %	Posterior region %	Edentulous Arches%
Bio horizon	13	32	41
Ankylose	9	3	9
Astra Tech	8	10	12
Biomet 3i	5	9	0
Nobel Biocare	8	11	6
Strautam Iti	6	1	12
Implant Swiss	12	12	6
Implance	10	8	3
Detec	8	2	2
Neobiotec	10	3	3
Zimmer	11	5	3
Neos	00	4	3

The results highlight the criteria influencing implant selection among respondents in figure 3.7. The most significant factors include the simplicity of the surgical kit (41.20%), followed by general implant features (29%), literature support (26.50%), and cost considerations (20.60%). Other criteria such as the simplicity of restoration kit, customer care service, and proven esthetic outcome also play a role, albeit to a lesser extent. Additionally, some respondents value educational support and their educational background in their selection process. A small percentage considers all criteria equally.

3.7 Reason for selection of implants

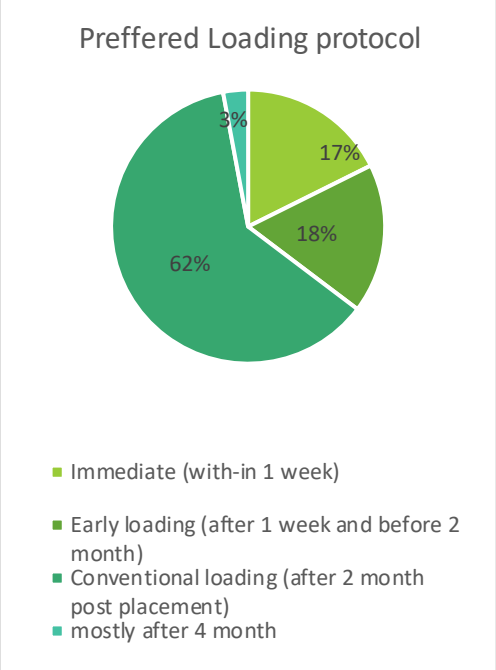


The results in Figure 3.8 indicates that the majority of respondents, 62%, prefer the conventional loading protocol, which involves loading implants after 2 months post-placement. This approach is in line with traditional implant loading protocols that allow for osseointegration to occur before placing functional loads on the implants, ensuring long-term stability and success.

Interestingly, an equal percentage of respondents, 18% each, favor immediate loading (within 1 week) and early loading (after 1 week and before 2 months). Immediate loading protocols are associated with reduced treatment times and immediate restoration of function, while early loading strikes a balance between immediate and conventional loading, offering a compromise between early function and osseointegration.

A small percentage of respondents, 3%, prefer loading implants mostly after 4 months, which may indicate a cautious approach to ensure optimal healing and integration of the implants before loading.

Figure 3.8 Implant loading protocol:



The results in Figure 3.9 indicates that patient factors, such as smoking, uncontrolled diabetes, and bruxism, are the most common reason cited for not loading implants immediately, with 50% of respondents attributing delayed loading to these factors. These patient-related considerations are crucial in determining the appropriate timing for implant loading to ensure successful outcomes and minimize risks.

A significant proportion of respondents, 29.40%, mentioned the need for additional surgeries, such as bone augmentation or sinus lift, as a reason for delaying implant loading. These preparatory procedures are often necessary to create a suitable

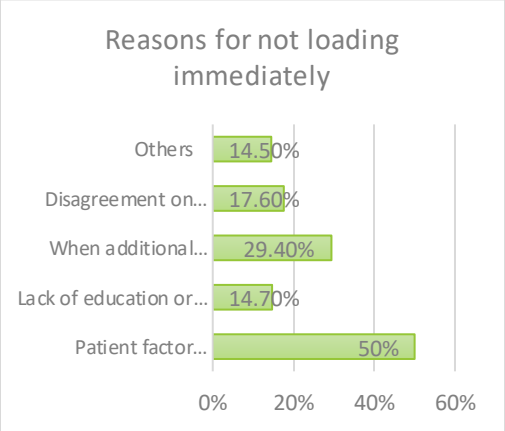
environment for successful implant integration and long-term stability.

Furthermore, 17.60% of respondents expressed disagreement on the concept of immediate loading, indicating varying opinions within the dental community regarding the feasibility and efficacy of immediate loading protocols. This disagreement may stem from differing clinical experiences, training backgrounds, or interpretations of research findings.

Additionally, 14.70% of respondents cited a lack of education or training on immediate loading as a reason for not adopting this approach. Education and training play a crucial role in understanding the complexities of immediate loading protocols and implementing them effectively in clinical practice.

The "Others" category, representing 14.50% of responses, includes perspectives that there is no such thing as absolute immediate loading and concerns from respondents who are unwilling to take risks associated with immediate loading protocols.

Figure 3.9 Reasons for not loading immediately:



4: Discussion:

Current study offers a comprehensive overview of the demographic and professional characteristics of participants, shedding light on the landscape of implant dentistry practice in Pakistan. Enrolling participants from various regions ensures a representative sample, enhancing the generalizability of findings. Exclusion of non-respondents maintains data integrity, minimizing potential biases.

Gender distribution reflects relative parity, with a slight male majority. This aligns with broader trends in dentistry, where male practitioners often outnumber females. However, the near-equivalent representation suggests a growing inclusivity within the field.

Participants exhibit diverse academic achievements, with the Bachelor of Dental Surgery (BDS) being the most common degree. This is expected, as BDS is the standard qualification for practicing dentistry in Pakistan. Notably, a significant proportion hold advanced degrees, including Fellowships, Masters, and even Doctorates. This highlights the commitment to ongoing education and specialization within the dental community.

Practice settings are evenly distributed across private and government sectors, indicating a balanced healthcare landscape. Karachi emerges as the primary city of practice, reflecting its status as a major urban center and hub for healthcare services. Other cities also contribute significantly, showcasing the geographical spread of dental practices.

The distribution of graduation years reveals a shift towards more recent cohorts, with the majority graduating in the 2010s. This suggests a younger demographic of dental professionals, potentially reflecting a recent surge in dental education and training programs in Pakistan.

The prevalence of implant training among participants underscores the importance of continuous professional development in implant dentistry. The majority have received training, indicating a proactive approach towards acquiring specialized skills and knowledge in this field. This aligns with global trends emphasizing the importance of specialized training in implantology.

Experience levels vary among participants, with a notable proportion having less than 10 years of experience. This suggests a relatively young and dynamic workforce, with ample room for career growth and development.

In terms of implant treatment planning, there is a clear preference for computer-based methods over conventional approaches. This reflects the growing reliance on technology and digital tools in modern dental practices. The convenience, accuracy, and efficiency offered by computerized planning systems likely contribute to their popularity among practitioners.

Preferences for implant components such as abutments and retention methods further reflect practical considerations and clinical preferences. The dominance of pre-fabricated metal abutments and screw retention underscores the importance of ease of use, reliability, and long-term maintenance in implant restorations.

Regional variations in implant system preferences highlight the influence of factors such as product efficacy, marketing strategies, and regional preferences. Understanding these variations is crucial for manufacturers and practitioners alike in optimizing product offerings and treatment outcomes.

Criteria for implant selection prioritize practical considerations such as the simplicity of surgical and restoration kits, literature support, and cost-effectiveness. These factors reflect the need for reliable, evidence-based solutions that are accessible and feasible in diverse clinical settings.

Loading protocols for implants predominantly favor conventional approaches, with patient factors and procedural complexity cited as reasons for delayed loading. This cautious approach underscores the importance of patient safety and treatment success in implant dentistry.

Conclusion:

Based on the results, it is shown that there is a preference among dentists in Pakistan for Bio-horizon implants in all regions with pre-fabricated metal abutments and conventional loading protocols in implant dentistry. Additionally, the study highlights the influence of patient factors and preparatory surgeries on loading

decisions. These findings underscore the need for continued education and training in implant dentistry to align with evolving practices and patient needs.

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Conflict of interest: Author declares no conflict of interest.

Funding Disclosure: Nil

Author's Contribution:

Saima Asim: Concept and design of the study
Hassan Khursheed: Drafting the work and final approval of everything.
Urooj Musheer: Concepts, interpretation of data and accountable of all aspects of work.
Muhammad Hassan Chandhio: Revising and proof Reading of study.