

Immediate loading of fixed complete-arch implant-supported prostheses – Preferences of prosthodontists in South Africa

SADJ FEBRUARY 2025, Vol. 80 No.1 P13-P19

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ABSTRACT

Introduction

Implant dentistry's crucial role demands predictable long-term results, challenging clinicians to adapt to evolving diagnostic and therapeutic methods. Edentulism significantly impacts quality of life, and conventional dentures often fall short in achieving patient satisfaction and functional restoration. Recognising the trend in minimising treatment duration, immediate loading with fixed complete-arch implant-supported prostheses emerges as a possibility for swift restoration. However, South Africa lacks specific insights into prosthodontists' prevalence and preferences with regards to this specific restoration protocol. This study therefore aims to fill this knowledge gap by investigating the perspectives of prosthodontists practicing in South Africa on immediate loading in fixed complete-arch implant-supported prostheses, contributing valuable insights to this evolving field.

Aims and objectives

To determine the current prevalence and preferences among prosthodontists in South Africa regarding the immediate loading protocol for a fixed complete-arch implant-supported prosthesis.

Design and methods

Conducted between July and August 2021, this mixed-methods research study involved a 23-question online survey

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Keywords

Prosthodontists, edentulism, implants, immediate loading, implant-supported prosthesis, complete-arch rehabilitation, restorative material preference

Author's contribution

1. Jennifer Julyan (JJ) – primary author (60%)
2. Ronel Maart (RM) – (25%)
3. Ashen Singh (AS) – (15%)

JJ and AS conceived the study; JJ and RM designed the study and wrote the protocol. JJ obtained funding and ethical approval. JJ collected the data. JJ analysed the data. JJ, RM and AS interpreted the data. JJ wrote the first draft; all authors edited the manuscript and approved the final version of the manuscript.

administered to 83 prosthodontists across South Africa, comprising both a qualitative and a quantitative phase.

Results

Of 83 email invitations sent, an 84.34% response rate was achieved. Among the respondents, 50 administered the treatment modality. Key findings showed 54% having completed more than 30 fixed implant-supported prostheses arches, with preference for bone-level design implants (84%) and external connections (60%).

Conclusion

Although numerous designs and materials are available for fixed complete-arch implant-supported prostheses, these findings offer a glimpse into the current clinical preferences among South African prosthodontists.

Clinical implications

Clinical decision-making when planning fixed, implant-supported treatments can be complicated. Tried and tested protocols may help to simplify and guide this decision-making.

INTRODUCTION

Implant dentistry is now commonplace in dental clinics, playing a crucial role in the field of prosthodontics.¹ The continuous advancements in diagnostic and therapeutic procedures within implant dentistry highlight the need for achieving predictable long-term results, especially given the array of methods and materials available to clinicians.² Edentulism, the state of being “without natural teeth” or missing adult teeth,³ significantly impacts the quality of life of individuals. Edentulous patient rehabilitation offers various treatment options, with conventional removable dentures often falling short in ensuring predictable patient satisfaction and ideal functional restoration.

The restoration of function and aesthetics through a fixed complete-arch implant-supported prosthesis has been shown to result in high patient satisfaction.⁴ Peñarrocha-Oltra *et al* concur that fixed complete-arch implant-supported prostheses currently offer the best oral function rehabilitation for edentulous patients.⁵ Financial and clinical feasibility drives the preference for implant-supported rehabilitations. However, the rapid evolution of materials, designs and protocols in this treatment modality surpasses clinical trials and in-vitro testing, presenting challenges in staying abreast.⁶

Assessing and planning for a fixed complete-arch implant-supported prosthesis involves considering various factors, including clinician expertise, patient expectations, prosthetic

space, bone volume and other clinical aspects. Determining factors such as the number of implants, implant design, impression technique, loading protocol and prosthesis design and material adds complexity. Unfortunately, current data on these considerations are diverse and inconclusive, complicating informed decision-making.⁶

Jiang *et al* observe a growing trend in dental implant therapy focused on minimising overall treatment duration and improving patient acceptance and satisfaction.⁷ Immediate loading, which reduces the time between implant placement and the delivery of a fixed complete-arch implant-supported prosthesis, has proven advantageous in swiftly restoring both function and aesthetics.⁷ Additionally, the immediate connection of the prosthesis after surgery, further enhances patient satisfaction.⁷

While international studies, such as Schoenbaum *et al*, report on the prevalence and preferences of immediate loading, no such study had been conducted in South Africa to date.⁶ To address this knowledge gap, the current study sought to ascertain the prevalence and preferences of South African prosthodontists concerning immediate loading of fixed complete-arch implant-supported prostheses.

To fulfil this aim, the following objectives were established: (1) Assess the sociodemographic factors of registered prosthodontists in South Africa, including age, gender, years of experience and practice geographic location. (2) Determine the prevalence of immediate loading of complete-arch implant-supported prostheses among South African prosthodontists. (3) Explore the preferences of South African prosthodontists in approaching immediate loading complete-arch cases, focusing on choices related to implants, abutments and materials. The central research question guiding this study was: "Do South African prosthodontists engage in immediate-loading of fixed complete-arch implant-supported prostheses and, if they do, what specific preferences do they have for the successful execution of this treatment modality?"

MATERIAL AND METHODS

Methodology

This cross-sectional descriptive study employed a mixed-method research approach for data collection, encompassing both quantitative and qualitative information.

Sampling

A non-random (non-probability) convenience sampling technique was chosen due to the small and readily available population of specialist dentists (prosthodontists). The study focused on 83 prosthodontists meeting specific inclusion criteria, namely: (1) Qualified prosthodontist; (2) Registered with the Health Professions Council of South Africa (HPCSA); (3) Practicing in South Africa; and (4) Proficient in English.

Response rate

Out of the 83 eligible prosthodontists, 70 consented to and completed the survey, resulting in an 84.34% response rate. The diverse sample included prosthodontists in various practice settings, and exhibited a range in years of experience and number of completed fixed complete-arch implant-supported rehabilitations.

Research instruments

Data were collected through an anonymous online questionnaire hosted on the secure REDCap platform. Excel

documents were employed for recording responses and managing reminder emails.

Data collection

Survey invitations were sent from July to August 2021 to prosthodontists registered with the HPCSA. The survey, consisting of 23 questions, covered diagnostic/planning aids, implant number and design, impression techniques, materials and design preferences for fixed complete-arch implant-supported provisional prostheses. Responses were based on ideal treatment scenarios, assuming sufficient native bone and an opposing complete-arch fixed tooth- or implant-supported prosthesis.

Ethical considerations

Ethical approval was granted. Participants received an information sheet before the survey was launched on June 29 2021. A digital consent form ensured voluntary and anonymous participation, allowing withdrawal at any time without repercussions. Participants were assigned numbers to maintain anonymity, and data were securely stored on the primary researcher's password-protected computer.

Data analysis

Data analysis took place in two phases. For the quantitative analysis phase, a statistician affiliated with the University of the Western Cape conducted the analysis of closed-ended questions using basic descriptive statistics. Stata version 16.0 was employed for data processing. Continuous variables that were normally distributed were reported using means and standard deviations, and variables that were not normally distributed were reported using medians and interquartile ranges. Categorical variables were described as frequencies and percentages. Overall, 95% confidence intervals or a 5% level of error was used to determine the statistical significance.

Associations between variables were assessed using Pearson Chi² and Fischer's Exact test. Both tests determine non-random associations between two categorical variables, with Fischer's Exact test being suitable for a small sample size.

Thematic analysis was employed for the qualitative data analysis phase, focusing on responses from the last two open-ended questions. The subsequent section presents the results of both the quantitative and qualitative analyses.

RESULTS

The data derived from the survey are summarised in the tables below. Those who completed the survey are referred to as "respondents". The demographic data of the respondents are presented in Table I.

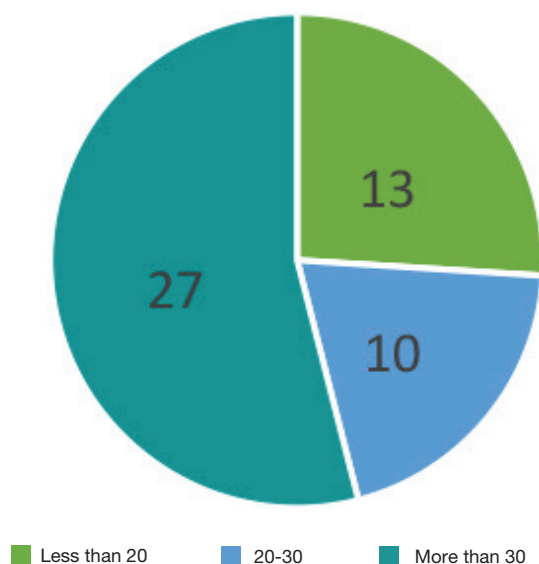
The majority (71.43%) of participants were male prosthodontists. Despite dentistry's historical male dominance, we would expect a more gender-balanced representation in future studies conducted 15 to 20 years from now.

The tables below present some of the noteworthy data obtained from the respondents on frequency, implant design, treatment planning and execution, and overall protocol preferences for the immediate-loading of fixed complete-arch implant-supported prostheses.

Table I. Demographics of respondents

Respondent Prompt		Frequency	Percentage
Gender	Male	50	71.43
	Female	20	28.57
What is your current primary career?	Private practice only	30	42.86
	Academics only	13	18.57
	Private practice and academics	18	25.71
	Public health/community clinic/military	2	2.86
	Retired	7	10.00
For how many years have you been registered as a Prosthodontist?	Less than 5y	14	20.00
	5-10y	11	15.71
	10-20y	13	18.57
	20-30y	17	24.29
	30-40y	12	17.14
	40+y	3	4.29
Which province do you practice in?	Eastern Cape	1	1.43
	Free State	1	1.43
	Gauteng	42	60.00
	KwaZulu-Natal	4	5.71
	Limpopo	1	1.43
	Mpumalanga	0	0.00
	Northern Cape	0	0.00
	North West	0	0.00
	Western Cape	21	30.00
Do you provide fixed complete-arch implant-supported prosthetic treatment to your patients?	Yes	57	81.43
	No	13	18.57

Figure 1. Number of completed fixed complete-arch implant-supported prostheses.



More than half of respondents (54%) have completed more than 30 fixed complete-arch implant-supported prostheses, while 20% managed between 20-30 arches, and 26% handled less than 20 arches (see Fig. 1). This variable reflects the respondents' estimated experience in placing these prostheses and are used to further subdivide the results in the figures.

Most respondents favoured six implants in the maxilla (76%) and the mandible (46%).

Preferences for the number of implants in the maxilla and mandible are presented in Table II.

Respondents strongly favoured bone-level implant designs (84%) over tissue-level implants (16%) (Fig. 2), with connection preferences split: external (60%) and internal (40%) (Fig. 3).

Sixty-four percent (64%) considered an insertion torque of 30-40 Ncm critical. The majority (56%) used intermediary abutments on all implants, as noted in Table III.

Table II. Number of implants preferred and who makes this decision

Respondent prompt		Frequency	Percentage
What is your preferred number of implants in the Maxilla for this treatment? (Assuming native bone, opposing fixed implant- or tooth-supported full-arch prosthesis)	3	0	0
	4	3	6
	5	3	6
	6	38	76
	7	0	0
	8	6	12
	8+	0	0
What is your preferred number of implants in the Mandible for this treatment? (Assuming native bone, opposing fixed implant- or tooth-supported full-arch prosthesis)	3	0	0
	4	13	26
	5	12	24
	6	23	46
	7	1	2
	8	1	2
	8+	0	0
	Who makes the decision regarding implant used?	Prosthodontist only	2
Surgeon only		1	2
Prosthodontist and surgeon in combination		47	94

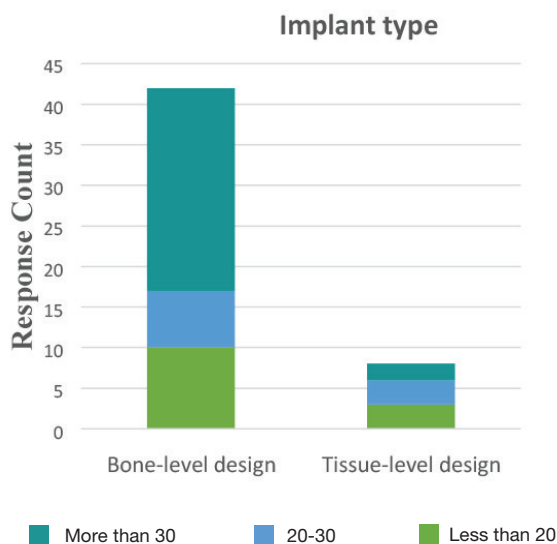


Figure 2. Preferences regarding implant type for ideal treatment using fixed complete-arch implant-supported prosthesis.

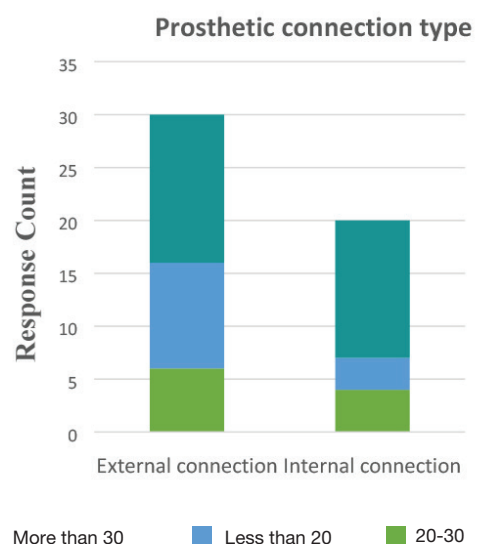


Figure 3. Preferences regarding prosthetic connection for ideal treatment using fixed complete-arch implant-supported prosthesis.

Impression techniques employed varied widely. While 96% employed an open-tray technique, only 40% additionally relied on rigidly splinting the impression copings. The preferred material for provisional prostheses was screw-retained acrylic resin with denture teeth and reinforcement (42%) delivered within 48 hours (58%) (see Fig. 4). All respondents (100%) agreed on the screw-retained method for provisional prosthesis retention, rejecting cement-retained or telescopic options (see Table IV).

In terms of the qualitative analysis, which comprised the final two questions in this questionnaire, patient satisfaction (44%) and immediate function (38%) were identified as the two main advantages of following an immediate loading protocol. Accurate pre-operative diagnosis and planning (58%) and primary stability (28%) were identified as crucial predictors of success for this treatment modality.

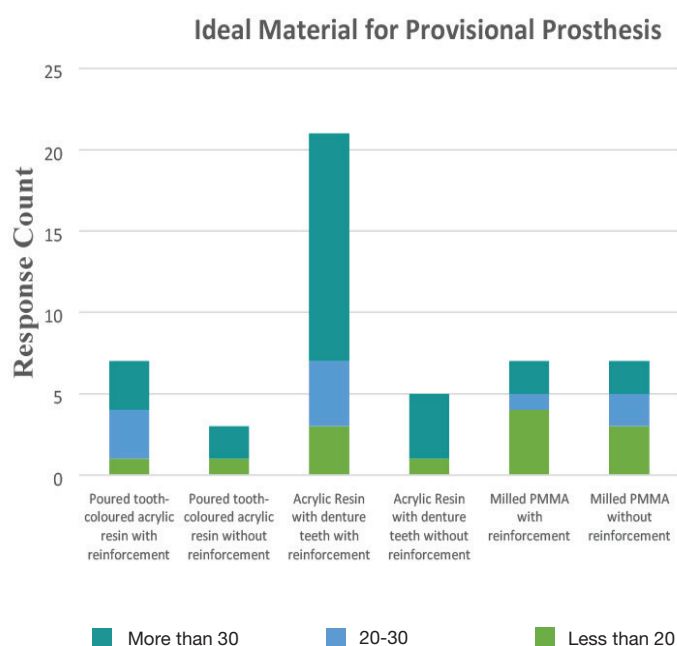
Table III. Insertion torque requirements and use of intermediary abutments

Respondent prompt		Frequency	Percentage
In order to predictably immediate-load, which of the following is most critical regarding insertion torque?	15-20 Ncm per implant	1	2
	20-30 Ncm per implant	8	16
	30-40 Ncm per implant	32	64
	Cumulative insertion torque of >120 Ncm over all implants	9	18
For the provisional fixed prosthesis, do you mostly?	Use intermediary abutments (multi-unit/conical abutments) on all implants	28	56
	Use intermediary abutments (multi-unit/conical abutments) on some implants where needed	9	18
	Connect it to the implants directly	13	26

Table IV. Aspects pertaining to the provisional prosthesis

Respondent prompt		Frequency	Percentage
Which method of retention do you favour?	Screw-retained	50	100
	Cement-retained	0	0
	Telescopic	0	0
	Other	0	0
What is your preferred time to deliver the immediate-load fixed implant-supported provisional restoration?	Immediately after (or at time of) the surgery	5	10
	Within 48hr	29	58
	Between 48hr and a week after implant placement	16	32
After delivery of the provisional complete-arch prosthesis, do you proactively retorque the abutment screws at a follow-up visit?	Always	6	12
	Majority of the cases	6	12
	Minority of the cases	19	38
	Never	19	38

Figure 4: Preferences regarding the ideal material for fixed provisional prosthesis



DISCUSSION

In the preceding section, both quantitative and qualitative results were analysed, revealing a considerable variation in implant design preference, impression techniques employed and treatment planning aids utilised among HPCSA registered prosthodontists. These choices align with Pera *et al's* findings, emphasising clinician experience and preferences as influential factors.⁸

Literature advocates for surgical guidance, as surgical guides notably enhance osteotomy accuracy.^{9,10} Concerning surgical guidance, 14% of the respondents preferred freehand implant placement, in contrast to established literature highlighting challenges in edentulous jaw surgery. It was noted that this 14% comprised the more experienced group having completed more than 30 fixed complete-arch restorations and may reflect trust in their surgeon's expertise and confidence in their freehand surgical implant placement.

Furthermore, the respondents unanimously favoured screw-retained provisional prostheses for easy modification or repair during follow-up visits.

Regarding the material used for provisional prosthesis fabrication, 42% of respondents favoured acrylic resin with denture teeth and reinforcement. This aligns with Holtzclaw's findings on the common complication of non-reinforced acrylic provisional prostheses – an expected 40% bulk fracture rate during the provisional phase.¹¹ Studies, such as Yamaguchi *et al* and Li *et al*, propose that reinforcing provisional restorations with materials such as braided wire or various fibres improves rigidity and minimises fracture rates.^{12,13}

Impression techniques varied among the respondents, with 40% opting to splint the impression copings. Furthermore, no clear preference emerged for either implant-level or abutment-level impressions. This aligns with research by Baig which indicates inconclusive evidence regarding the techniques and materials needed for multi-unit implant impressions.¹⁴

Only 4% of respondents employed the digital workflow, conducting intra-oral scans during impression-taking. This minority's choice may be influenced by advanced equipment or a digitally driven dental laboratory, rather than conclusive evidence. Baig notes that scientific research on digital impression techniques for multi-unit implant restorations is currently still at an early stage, with no current literature supporting digital impressions as superior in accuracy for complete-arch implant impressions.¹⁴

A broad spectrum of opinions reveals a significant lack of high-quality information, prompting prosthodontists to rely on alternative decision-making methods. As emphasised by Schoenbaum *et al*, the absence of adequate long-term, multi-centre trials comparing various modalities may contribute to this diversity of opinions.⁶ Additionally, variations in the experience, expertise and equipment among prosthodontists, surgeons and dental laboratories/technicians could further explain this diversity.⁶

In the qualitative analysis, the prominence of “patient satisfaction” as the top advantage, noted by 22 respondents, aligns with the contemporary emphasis on this aspect of care. Prosthodontists commonly gauge treatment success by patient satisfaction, relying on positive feedback and word-of-mouth for referrals. This resonates with Jiang *et al*'s study, asserting that immediate loading protocols, by reducing overall treatment time and simplifying procedures, enhance patients' acceptance and satisfaction with the treatment.⁷

The pivotal aspect deemed most crucial for ensuring the success of an immediate load fixed complete-arch implant-supported prosthesis is “pre-operative diagnosis and planning”. This encompasses all pertinent considerations and is particularly essential for the complexity of this treatment, requiring thorough planning and anticipation of potential complications. As emphasised by Tözüm *et al*, diagnosis and planning go beyond improving surgical implant placement accuracy; it aids surgeons and prosthodontists in evaluating case complexity and assessing the feasibility of immediate loading when indicated.¹⁵

LIMITATIONS

Caution is advised when interpreting these study results, applicable only to fixed complete-arch implant-supported prostheses, and not generalisable to removable or partially edentulous treatments. The observations highlight trends

rather than providing definitive conclusions for treatment planning, and they do not address patient-specific needs and unique clinical conditions. Moreover, the limited respondent sample size introduces potential selection biases, restricted to the HPCSA in South Africa, offering a time-specific and narrow perspective. Additionally, the applicability and usefulness of this data may diminish over time, necessitating consideration of future research, innovations and experience.

CONCLUSIONS

Fixed complete-arch implant-supported rehabilitations mitigate the negative impact of edentulism on the patient's quality of life, offering expedited restoration of oral function and aesthetics through immediate-loading protocols. Surveying clinically-practicing prosthodontists in South Africa yielded key conclusions:

- a. The majority of prosthodontists (82%) use cone-beam computed tomography (CBCT) for edentulous case planning, often in conjunction with radiographic denture set-ups (42%) and intra-oral scans (34%).
- b. Preferred implant numbers are six for both maxilla (76%) and mandible (46%).
- c. Most prosthodontists (94%) believe implant selection should involve both prosthodontists and surgeons.
- d. Preferred implant design is bone-level (84%), with varied connection-type preferences – 60% external, 40% internal.
- e. Fourteen percent (14%) favour freehand implant placement, mainly among experienced prosthodontists (>30 cases), while 86% prefer surgical guidance.
- f. The favoured insertion torque for immediate loading ranged between 30-40 Ncm per implant, as indicated by 64% of prosthodontists.
- g. More than half of the prosthodontists (56%) make use of intermediary (multi-unit/conical) abutments on all the implants.
- h. There was unanimous consensus that screw-retained prostheses are favoured over cement-retained or telescopic prostheses.
- i. Impression techniques varied among prosthodontists, with differences in rigidly splinting impression copings (40% yes, 56% no) and choosing implant-level (36%) or abutment-level (60%) impressions. Notably, only 4% favoured digital intra-oral scans, a technique with limited reliable long-term evidence supporting its accuracy.

Preferred material for provisional restoration is acrylic resin with denture teeth and reinforcement (42%).

Primary advantages of immediate loading are “patient satisfaction” (44%) and “immediate function” (38%).

Critical aspects for success are “pre-operative diagnosis and planning” (58%) and “primary stability” at implant insertion (28%).

In conclusion, for more reliable and generalisable conclusions, future studies should aim to include larger groups of expert clinicians from diverse geographic areas.

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