Current prevalence and preferences for immediate loading of fixed complete-arch implant-supported prostheses: A survey among South African Prosthodontists.

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A mini-thesis submitted in partial fulfilment of the requirements for the degree of Master of Dental Surgery in the speciality of Prosthodontics in the Department of Restorative Dentistry, Faculty of Dentistry, University of the Western Cape.

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KEYWORDS

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Immediate loading

Implant-supported prosthesis

Complete-arch rehabilitation

Implant preference

Restorative material preference

Primary stability

ABSTRACT

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MChD (Prosthodontics) Mini-Thesis, Department of Restorative Dentistry, Faculty of Dentistry, University of the Western Cape.

Introduction:

Edentulism negatively impacts patients' quality of life. A fixed complete-arch implant-supported prosthesis is proven to restore function and aesthetics and is associated with high patient satisfaction. An immediate loading protocol can provide patient satisfaction in a shorter period, as the time between surgical implant placement and connection of a prosthesis is lessened. The many considerations involved in this type of treatment are either based on available evidence or the preferences of the clinicians themselves.

Aims and objectives:

To determine the current prevalence and preferences of the immediate loading protocol for a fixed complete-arch implant-supported prosthesis, utilized amongst South African Prosthodontists.

Methodology:

From July to August 2021, survey invitations were sent out to Prosthodontists registered with the Health Professions Council of South Africa (HPCSA). The survey was hosted on the online REDCap platform and consisted of a total of 23 questions related to the diagnostic/planning aids, implant number and design, impression techniques, materials and design preferences for fixed complete-arch implant-supported provisional prostheses. It was suggested that answers be based on preferences for

ideal treatment assuming sufficient native bone and an opposing complete-arch fixed tooth- or implant-supported prosthesis. A mixed-method research approach was followed as the survey included both closed and open-ended questions.

Results:

Of 83 invitations sent via email, 74 (89.16%) surveys were started and 70 (84.34%) were completed. A total of 50 respondents reported providing the investigated treatment modality. Relevant results were summarized in stacked bar charts including colour coding of each variable to indicate the estimated number of arches the respondent had treated (an indication of the respondent's experience). Most respondents were in private practice (58%) and had completed more than 30 arches of fixed implant-supported prostheses (54%). The majority of the respondents preferred 6 implants in the maxilla (76%) and the mandible (46%). 84% of respondents preferred bone-level implant designs, while the connection type was shared between external connection (60%) and internal connection (40%). Two-thirds (64%) regarded an insertion torque of between 30-40 Ncm as being critical, and the majority (56%) reported using intermediary abutments on all implants. There was a broad variety in the impression techniques employed, while the ideal material for the provisional prosthesis was clearly screw-retained (100%) acrylic resin with denture teeth and reinforcement (42%) delivered within 48hr (58%). Patient satisfaction (44%) and immediate function (38%) were identified as the two main advantages of following an immediate loading protocol. Pre-operative diagnosis and planning (58%) and primary stability (28%) were identified as being the most important aspects to ensure the success of this treatment modality.

Conclusion:

While a wide range of implant/prosthesis designs and materials exist in the use of the fixed complete-arch implant-supported prosthesis, these results provide a snapshot of the current clinical preferences among the Prosthodontists in South Africa.

Date:

11 November 2021

DECLARATION:

I declare that *Current prevalence and preferences for immediate loading of fixed complete-arch implant-supported prostheses: A survey among South African Prosthodontists i*s my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Full Name: Jennifer Julyan **Date:** 11 November 2021

Signed: ……

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

DEFINITION OF TERMS

The following definitions are all taken from "The Glossary of Prosthodontic Terms: Ninth Edition", 2017.

"Edentulism": \"e-dĕn´cha-lĭz-um\ (1998): "the state of being edentulous; without natural teeth".

"Dental implant": \dĕn´tl ĭm-plānt\: "a prosthetic device made of alloplastic material(s) implanted into the oral tissues beneath the mucosal and/or periosteal layer and on or within the bone to provide retention and support for a fixed or removable dental prosthesis; a substance that is placed into and/or on the jawbone to support a fixed or removable dental prosthesis".

"Dental implant abutment": \ĭm´plānt´ a-būt´ment\: the supplemental component of a dental implant that is used to support and/or retain any fixed or removable dental prosthesis; dental implant abutments are frequently described by their form (i.e., cylindrical, with diameter and height specifications), material (i.e., ceramic, titanium, zirconia ceramic), or special design factors (i.e., internal hex lock, external hex lock, spline)".

"Prosthesis": \prŏs-th"e´sĭs\ (1900): "an artificial replacement of part of the human anatomy restoring form, function, and esthetics; -ses".

“Implant-supported”: \ĭm′plānt′ prŏs-thē′sĭs\: “dental prosthesis, such as artificial crown, fixed complete denture, fixed partial denture, removable complete overdenture, removable partial overdenture, as well as maxillofacial prothesis, which are supported and retained in part or whole by dental implants”.

“Complete mouth rehabilitation”: “this term applies to the restoration of teeth, with or without dental implants, with fixed dental protheses in the maxillae and mandible”.

“Dental implant loading”: “the process of placing axial or tangential force on a dental implant usually associated with the intentional exposure of the dental implant either at the time of initial surgical placement of the dental implant or subsequent to surgical exposure; such forces may come from any of a variety of sources including intentional and/or unintentional occlusal loading, unintentional forces from the tongue or other oral tissues, food bolus, as well as alveolar/osseous deformation”.

“Dental impression”: \dĕn′tl ĭm-prĕsh′en\: “a negative imprint or a positive digital image display of intraoral anatomy; used to cast or print a 3D replica of the anatomic structure that is to be used as a permanent record or in the production of a dental restoration or prosthesis; syn IMPRESSION”.

CHAPTER 1 - INTRODUCTION

Implant dentistry has become a daily practice in many dental clinics/practices and it represents a major part of the prosthodontic specialty. The rapidly evolving diagnostic and therapeutic procedures involved in implant dentistry, as well as the demand to achieve predictable long-term results, is even more important because of the uncertainty surrounding the vast amount of methods and materials available to clinicians (Harel *et al.*, 2017).

When rehabilitating an edentulous patient, there are several treatment options available to replace the missing teeth. Although many clinicians do still provide edentulous patients with conventional removable dentures in an attempt to restore their aesthetics and function, this treatment does not predictably ensure patient satisfaction and never quite restores the functioning to ideal satisfaction.

According to Peñarrocha-Oltra *et al.* (2014), fixed complete-arch implant-supported prostheses are, at present, the treatment alternative which best rehabilitates oral functions in edentulous patients. Where financially and clinically possible, implant-supported rehabilitation is sought. There has been a rapid evolution of materials, designs and protocols associated with the treatment of the completely edentulous patient utilizing a fixed complete-arch implant-supported prosthesis (Schoenbaum *et al.*, 2020). Many clinical trials and *in-vitro* testing have been published but have trouble keeping pace with the continuous development and evolution of this specific treatment modality.

When assessing and planning for a fixed complete-arch implant-supported prosthesis, many factors need to be taken into consideration. Relevant clinician factors include the experience and skill of the operator, and the willingness to work as part of a team. Patient factors include expectations, prosthetic space available, the bone volume available, position of transition line and presence of parafunctional habits, to name only a few.

The clinician also needs to consider the number of implants to be placed, the implant macro and micro design, the impression technique to be used, the loading protocol followed, and the design and material of the prosthesis. Unfortunately, the current data concerning all of these considerations are varied and divergent (Schoenbaum *et al.*, 2020). The dental industry also continues to innovate and bring new materials to market, resulting in clinicians being faced with the challenge of providing treatments that have little objective evidence to support their use (Schoenbaum *et al.*, 2020). This presents a challenge in making informed decisions and providing the best available evidence-based treatments.

According to Jiang *et al.* (2021), dental implant therapy is evolving toward a tendency to reduce the overall treatment time and streamline procedures to guarantee improvement in the patient's acceptance and satisfaction of the treatment received. This can be achieved by shortening the time between implant placement and the delivery of a fixed complete-arch implant-supported prosthesis, by applying what is known as an immediate-loading protocol. Immediate loading has been proven to achieve the immediate rehabilitation of both function and aesthetics, which proves to be of great benefit to edentulous patients seeking a fixed solution (Jiang *et al.*, 2021).

There are several international studies, such as the one by Schoenbaum *et al.* (2020), that report on the prevalence and preferences of the immediate loading protocol for fixed complete-arch rehabilitations among their local Prosthodontists. At the time of commencement of this research, no such study had been performed in South Africa. There is, therefore, no literature available regarding whether or not South African Prosthodontists are performing immediate-loading of fixed complete-arch implant-supported prostheses, and if they are, what specific preferences they have to successfully execute this treatment modality.

This motivated this study to determine both the prevalence of immediate-loading, as well as the preferences of Prosthodontists for the immediate loading of fixed complete-arch implant-supported prostheses in South Africa.

This research question was answered through a series of strategic questions combined in an online survey sent only to Prosthodontists registered with the Health Professions Council of South Africa (HPCSA). A mixed methodology was applied to provide in-depth information to supplement the closed-ended questions. In doing this it allowed the researcher an understanding of the clinicians' reasoning regarding their results/answers given.

This mini-thesis consists of a total of 6 chapters. Chapter 2 is the "Literature Review" and aims to give an overview of the currently available literature on immediate-loading of fixed complete-arch implant-supported prostheses. Chapter 3 is the "Research Design and Methodology", providing clarity on the specific design of this research as well as detail regarding the mixed methodology applied.

In Chapter 4, "Results", the findings of the research will be presented and illustrated by means of relevant tables/graphs. Chapter 5 is the "Discussion" which aims to correlate the results of the study and discuss the relevance thereof. The final chapter summarizes the conclusions and limitations and presents recommendations based upon the findings of this study.

CHAPTER 2 - LITERATURE REVIEW

Introduction

The literature that covers fixed complete-arch implant-supported prostheses in the rehabilitation of edentulous patients is vast and it is impossible to include all of the available literature in this mini-thesis.

This literature review aimed to provide a broad overview of all relevant literature, including relevant information from original implant research published by the "father of implantology", Professor PI Brånemark in the 1980s, and more recent literature published in peer-reviewed journals. The sub-topics covered include implant loading protocols, more specifically the immediate-loading protocol, primary stability and the ideal characteristics related to the implant design, as well as the features of the provisional prosthesis design.

It is fundamental to clarify key terms before embarking on the literature available. All relevant terminology has been defined on the "Contents" page preceding Chapter 1.

Implant loading protocols

When referring to "implant loading" or "loading" protocols, it refers to the connection of a prosthesis to the implants. With regards to dental implant loading protocols, the literature refers to either the immediate, early or conventional loading of implants and it is important to clarify the terminology used to refer to these different implant loading protocols. According to Jokstad & Carr (2007), immediate loading represents a prosthesis that is connected to the implants within the first 48 hours of implant placement, early loading requires the connection of the prosthesis after 48 hours but before 3 months after implant placement and delayed/conventional loading is the connection of the prosthesis after 3 months of healing.

The first scientifically established clinical protocol was described by Brånemark (1983). This clinical protocol recommended a "non-disturbed" healing period of 3-6 months to prevent the development of fibrous tissue at the junction between the implant and the surrounding bone (Brånemark, 1983). Only after this healing period could the surgeon perform the second surgery to connect the abutments and the restorative dentist could fabricate the prosthesis to be screw-retained to the implant (Zarb & Jansson, 1985). One of the disadvantages or limitations of this classic protocol is that edentulous patients receiving implants are typically required to function either without a prosthesis or at the most function with removable dentures during this healing period, which they have often reported to be uncomfortable (Peñarrocha-Oltra *et al.*, 2014).

Regardless of this limitation, over the years many authors have published data using this original Brånemark protocol, and have illustrated its high predictability (Adell *et al.*, 1990; Lindquist *et al*, 1996). This "classic Brånemark" protocol is what we now refer to as 'conventional/delayed loading' of dental implants.

Over the years, the use of dental implants as part of prosthetic rehabilitations have had successful outcomes and have resulted in the modification of certain aspects of the original protocols, including the timing of implant loading (Penarrocha-Oltra *et al.*, 2015). Several authors began to experiment with earlier loading protocols and also reported high success and positive implant and prosthesis survival rates (Becker *et al*., 2003; Payne *et al.*, 2002; Tawse-Smith *et al.*, 2002).

According to Jiang *et al.* (2021), dental implant therapy is currently evolving toward a tendency to reduce the overall treatment time and streamline procedures to guarantee improvement in the patients' acceptance and satisfaction of the treatment received. This can be achieved by shortening the time between implant placement and the delivery of an implant-supported fixed prosthesis. Immediate loading has been proven to achieve the immediate rehabilitation of both function and aesthetics, which proves to be of great benefit to completely edentulous patients seeking a fixed solution (Jiang *et al.*, 2021).

Immediate implant loading

The specific definition of the "immediate implant loading" protocol has evolved over the past years.

Back in 2003, it was agreed that immediate loading was the connection of the restoration to the implants on the same day of implant placement (Aparicio *et al*., 2003). A year later in a review by Cochran *et al.*, (2004), immediate loading was then defined as the restoration being in occlusion with the opposing dentition, within 48 hours of placement of the implants. Immediate loading is currently defined as implants being loaded within 1 week of implant placement (Gallucci *et al.*, 2014; Weber *et al.*, 2009).

According to Penarrocha-Oltra *et al.* (2015), edentulism, which can be disabling, has a definite negative impact on the patient's quality of life. In order to address this concern, the dental profession has specifically popularized the immediate loading protocol, as it aims to achieve speedier restoration of oral function and improved aesthetics, it decreases morbidity by circumventing the need for a second surgical procedure, and it avoids the need for an interim removable conventional denture to be worn during the period of osseointegration (Crespi *et al.*, 2007). The avoidance of interim removable denture wearing is particularly relevant in the mandible, where the reported patient satisfaction for conventional dentures is low (Penarrocha-Oltra *et al.*, 2015).

General contraindications for immediate loading include uncompliant patients, as recall visits are of utmost importance and patients with parafunctional habits (bruxism). Bruxism is a contra-indication because the literature shows that occlusal overloading may alter the bone-to-implant interface and lead to failure (Jokstad, 2009).

The first clinical trial on immediately loaded Brånemark System (Nobel-pharma) implants was conducted by Schnitman *et al.* (1990). The 10-year results of this clinical trial reported that the failure rate for the immediately loaded implants was significantly higher than that of the implants placed with the conventionally submerged technique (Schnitman *et al.*, 1990).

Over the years, there have been advancements in the clinical techniques as well as implant surface modifications, resulting in several high-quality randomized controlled trials (RCTs) reporting high survival rates for immediately loaded implants (Jokstad & Alkumru, 2014; Vercruyssen *et al.*, 2016). Some RCTs have even shown no implant failures (Chen *et al.*, 2019).

Presently, there is, however, literature both supporting and refuting the predictable success of immediately loaded implants in a fixed complete-arch implant-supported prosthesis. The paragraphs below aim to report this contradictory literature in more detail.

According to a 2009 study by Gallucci *et al*., implants immediately loaded with fixed complete-arch prostheses achieved very high success rates after several years of follow-up. This applied to both post-extraction and healed bone sites, and both in the maxilla and the mandible (Gallucci *et al.*, 2009).

However, in the same year Esposito *et al.*, (2009) published a Cochrane systematic review and concluded that in selected patients immediate loading can be successfully performed, but that tendencies do indicate that immediately loaded implants fail more frequently than those loaded conventionally. In addition to this, it was concluded that while immediate loading in edentulous mandibles is well documented, there is less evidence available for immediate loading in the maxilla (Esposito *et al.*, 2009).

Immediate loading in the edentulous Mandible versus Maxilla

The recent systematic review by Jiang *et al.* (2021) echoed the conclusion by Esposito *et al.* (2009) stating that ample evidence indicates that immediate loading of implants in the edentulous mandible can be considered as a predictable treatment modality with confirmed high implant and prosthesis survival rates, while in the edentulous Maxilla, the bone quality/quantity and axial loading conditions result in less-favourable conditions for immediate loading compared with the mandible.

The conclusion of a 10-year follow-up report, by Pera *et al.* (2019), on the application of the immediate implant-supported rehabilitation of the edentulous maxilla was that it led to "similar implant and prosthodontic clinical outcomes and less bone loss when compared to the traditional two-stage protocol". Although this sounds promising, the extreme heterogeneity among the published studies still leads to considerable controversy: the inclusion/exclusion criteria applied, the implant number and distribution chosen, tilted vs. axial implant use, and survival or success criteria applied (Maló, *et al.*, 2019).

A prospective controlled trial reported that overall, the literature on immediate loading with fixed complete-arch prostheses in the maxilla shows that "a successful outcome can be expected if adequate criteria are used to evaluate the patient, choose the implant and perform the surgical and prosthetic treatment" (Peñarrocha-Oltra *et al.*, 2014).

Jiang *et al.* (2021) emphasized that selecting the most appropriate protocol for the rehabilitation of the edentulous jaw, especially the maxilla, may present a challenge and that the clinicians should continue to base their decision on the available evidence. As there is limited evidence regarding this in the South African (SA) context, there is a need for this specific study, as it would provide some evidence about the protocols followed by prosthodontists in SA.

Regarding the preferences for immediate loading, Schoenbaum *et al.* (2020) highlighted certain aspects that need to be considered when opting for an immediately loaded fixed complete-arch implant-supported rehabilitation. These considerations, which will be expanded upon, are:

I. Ideal number of implants
II. Implant design characteristics
III. Primary stability
IV. Implant survival rates
V. Prosthesis design factors
VI. Impression techniques
VII. Use of intermediary abutments
VIII. Diagnostic/planning aids
IX. Degree of surgical guidance

I. Ideal number of implants

According to Sadowsky *et al.* (2015), neither comparative trials nor randomized controlled trials (RCTs), are available to assess and suggest the optimal number and position of implants for a fixed complete-arch implant-supported prosthesis in the maxilla. Other risk factors that require consideration when deciding on the number of implants to place include the presence of compromised quality and quantity of bone as well as high occlusal forces (Sadowsky *et al.*, 2015).

A descriptive study that reviewed long-term evidence on both implant and prosthodontic survival rates of fixed rehabilitations reported higher survival rates when >/= 6 implants were placed in the Maxilla (Lambert *et al.*, 2009) and >/= 4 implants were placed in the Mandible (Sadowsky & Hansen, 2014).

The "All-on-4" protocol has gained popularity in recent years and consists of two axial implants in the anterior region and two tilted implants in the posterior region. This protocol not only takes advantage of tilted implants but also decreases the number of implants needed to four. According to Jiang *et al.* (2021), several studies have applied this protocol and have proven that these four implants are indeed sufficient to support a fixed complete-arch implant-supported prosthesis and bear the occlusal forces applied clinically. Lopes *et al.* (2017), even reported an "All-on-4" case which experienced a single implant failure and the prosthesis survived on three remaining implants. This, however, is one successful case and cannot be used as a suggested treatment protocol.

Although the "All-on-4" protocol is often applied, several authors such as Shigehara *et al.* (2015) and Martens *et al.* (2014) still prefer >4 implants per arch, as a reported concern is that a decrease in implant number may result in a higher prosthesis failure rate due to occlusal loads which are distributed unevenly. Additionally, Jiang *et al.* (2021) found that although the "All-on-4" protocol has reported predictable clinical outcomes, the clinician should apply caution as the failure of the distal implants can lead to a complete failure of the prosthesis. To over-compensate for this potential failure, the clinician may opt to submerge one or two additional distal implants to be available as emergency implants should they be necessary.

The available literature regarding the ideal number of implants to support a fixed complete-arch implant-supported prosthesis varies from a minimum of 3 implants to >/= 6 implants. It might, therefore, be possible that the choice of implant number may be subjective according to the experience of the Prosthodontist.

II. Implant design characteristics

When rehabilitating a patient with a fixed complete-arch implant-supported prosthesis there are several factors regarding the implant design that are relevant. These factors include whether the implant platform is situated at the level of the bone or the level of the soft tissue, and the implant-abutment connection type.

A. Bone-level versus tissue-level

The long-term health of the peri-implant tissue is of extreme importance as this relates to the ultimate success or failure of the treatment. It has been reported that the implant type (bone level vs. tissue level) is associated with the soft tissue bleeding response after probing, possibly due to the presence of a chronic infiltrate and the related micro-gap at the implant-abutment interface of two-piece (bone-level) implants (Broggini *et al.*, 2003).

A 2012 systematic assessment concluded that at both 1 and 3 years following functional loading, there was no statistically significant increase in the risk of implant loss in bone-level compared to tissue-level implants (Vouros *et al.*, 2012). The authors also performed a meta-analysis which confirmed that there was not a statistically significant difference in terms of the mean marginal bone loss, after 1 year of functional loading, when comparing these two implant types (Vouros *et al.*, 2012).

A more recent systematic review by Cosola *et al.* (2020) also compared the radiological outcomes of bone-level and tissue-level implants with the results reporting no differences between bone-level and tissue-level implants according to bone loss, survival/success rate, or clinical outcomes. It is accepted that bone loss will inevitably occur around dental implants, however, Palacios-Garzón *et al.* (2019) stated that the extent of bone loss reported is similar for both types of implants.

In addition, Tallarico *et al.* (2018a), was in agreement and highlighted that no significant evidence is available to support the theory that the position/orientation and design of the implant shoulder offer any significant improvement in the clinical and radiological outcomes.

According to the available literature, the choice of bone-level versus tissue-level implant use may be subjectively linked to whichever type allows for easier prosthetic workflow.

B. Prosthetic connection type

The type of implant-abutment connection is currently widely investigated as the literature has shown a direct association with reported clinical outcomes. Implants are available with many different

implant-abutment connection designs, however, the specific clinical advantages and indications thereof are not clear (Pera *et al.*, 2021).

The first connection introduced was the external hexagonal connection (EHC) which demonstrated several advantages, specifically in full-arch rehabilitations, namely: the simplification of the prosthetic phase, improved passivity between the prosthesis and implants, and the uncomplicated management of multiple implants (Pera *et al.*, 2021).

However, the reported downfall of the EHC is the possibility of micro-movement occurring, which may result in abutment screw loosening or possibly even fatigue fracture of the screw (Almeida *et al.*, 2013). In addition, Caricasulo *et al.* (2018) stated that implants with an EHC have been proven to be associated with an unsatisfactory force distribution at the peri-implant bone with increased force concentration in some areas affecting bone metabolism and resulting in peri-implant bone resorption. Furthermore, EHC is also associated with higher bacterial leakage and contamination when compared to other connection types (Canullo *et al.*, 2015).

Corvino *et al.* (2020) mentioned in their randomised controlled trial that it is due to these mentioned shortcomings of EHC that different implant-abutment connections were introduced. Among them, internal hexagonal connections (IHC) are said to present a more even distribution of the load and less bacterial microleakage. However, in the case of implant divergence IHC present a more unfavourable outcome in terms of the accuracy of the impression and prove challenging in cases of full-arch rehabilitations (Gracis *et al.*, 2012). IHC achieve optimal results in cases of partial implant rehabilitations (Vetromilla *et al.*, 2019); however, less information is available regarding their use in full arch implant rehabilitations.

Pera *et al.* (2021), published a randomized split-mouth controlled trial with a 3-year follow-up and found no statistically significant differences between the different connection types. This finding corroborated the findings of both a recent systematic review and meta-analysis by Lemos *et al.* (2018) and a 5-year randomized controlled trial on internal versus external connection by Esposito *et al.* (2016) who also reportedly found no significant difference in the complication rates of the different implant-abutment connections.

In the publication by Pera *et al.* (2021), which showed similar outcomes irrespective of whether EHC or IHC were utilized, it must be pointed out that either straight or angled intermediary (multi-unit) abutments were attached to each implant, meaning that the prostheses were, therefore, not directly connected to the implants. The principle of the “one-abutment-one-time” technique which entails the

abutment being connected at the time of surgery, claims to protect the attachment of the soft tissue (Canullo *et al.*, 2018).

The conclusion made by Pera *et al.* (2021) was that clinical outcomes of complete-arch immediate loading rehabilitations are not significantly affected by different implant-abutment connections and that the clinician's preference will mostly drive the choice of prosthetic connection.

III. Primary stability

According to the Glossary of Prosthodontic Terms (2017), primary implant stability is defined as the "contributing factors of mechanical stabilization of a dental implant during the healing phase" (Ferro *et al.*, 2017). Primary stability is directly related to the insertion torque of the dental implant as an increased insertion torque reduces implant micromotion, which then relates to increased primary stability.

The insertion torque (measured in Ncm) reflects "the consumed electric current during tapping or implant insertion by a motor unit-connected computer" (Lekholm & Zarb, 1985). The value of the insertion torque is a result of the texture of the host jawbone, the drilling protocol followed and the design (macro and micro) of the implant inserted.

A skilled surgeon should be able to "manipulate" this insertion torque value by employing an adapted surgery technique. The surgeon may either make use of the standard drilling protocol in combination with choosing an implant design (varied implant diameters and/or tapered implant designs) that suits the site in question or instead he/she may adapt the actual drilling protocol (under preparation of the site, for example) in combination with the use of standard-sized /shaped implants (Lekholm & Zarb, 1985).

Primary stability is considered a key requirement for immediate loading and most studies agree that a minimum implant insertion torque between 30 and 45 Ncm is required to predictably immediate load dental implants (Mozzati *et al.*, 2013).

These findings were echoed in the recent systematic review by Jiang *et al.* (2021), where the authors summarized the insertion torque values applied in the different clinical studies. To ensure sufficient primary stability, the insertion torque values applied, ranged broadly from 15 Ncm (Marchesi *et al.*,

2015) to 50 Ncm (Cannizzaro *et al.*, 2018). Nineteen included studies, such as those by Shigehara *et al.* (2015) and Maló *et al.* (2019) specified that the insertion torque needed to be at a minimum of 30 Ncm. It was also stated that when not all individual implants have an insertion torque of >30 Ncm, the clinician can apply the principle of cumulative torque values of >120 Ncm across all the dental implants (Maló *et al.*, 2019).

Several factors affect primary stability and these factors can either be biological (related to bone density, quantity and quality) or geometric (regarding the implant design, length, diameter and surface modifications) (Vollmer *et al.*, 2020).

IV. Implant survival rates

Regardless of the loading protocol followed, one of the most important factors is the success/survival of the implants themselves, as in many cases implant failure may lead to prosthetic failure and an unsuccessful outcome.

In the 2021 systematic review by Jiang *et al*., a total of four publications specifically compared the implant survival rates (ISRs) between an immediately loaded group and a conventionally loaded group, with the unanimous outcome being that no significant difference between the groups was found.

Additionally, a high cumulative survival rate (up to 95.53%) of immediately loaded implants was achieved in 33 of the included studies (Jiang *et al.*, 2021). It should be noted that 9 of these studies represent a medium- to long-term result, of a total of 5,564 implants, as the mean follow-up period was 60 months (Jiang *et al.*, 2021). Furthermore, 6 studies involving a total of 839 implants achieved a 100% survival rate.

It is important to note that most published literature reports on the implant “survival” rate and not the implant “success” rate. According to Negm (2016), implant “survival” is a generalized term referring to implants that are still in the oral cavity at the time of the examination, while implant “success” is when the implants are not only in the mouth, but they are also satisfactory from both an aesthetic and functional viewpoint.

V. Prosthesis design factors

Traditionally, once the dental implants had been placed, the patient was required to wear a conventional removable denture as a provisional prosthesis. In the study by Penarrocha-Oltra *et al.* (2015), the entire control group of patients, receiving conventionally loaded implant-supported prostheses, reported some level of discomfort with the interim removable denture they were provided with. Six patients developed ulcers and five reported that they only rarely used their dentures, illustrating the poor patient-related outcomes regarding provisional removable denture wearing (Penarrocha-Oltra *et al.*, 2015).

The immediate loading protocol aims to overcome this issue, as the provisional prosthesis that is provided, is one that is fixed to the newly-placed implants. There are, however, several design features which need to be taken into consideration, such as the rigidity of the prosthesis (material choice), the use of reinforcement for strength, whether the prosthesis is connected to intermediary abutments or the implant directly, and the method of retention (screw-retained, cement-retained or telescopic).

It is known that micromotion of the implants, after placement and during the healing phase, may prevent osseointegration. According to Haïat *et al*. (2014), micromotion is defined as "the temporary localised relative movement that occurs between an implant surface and adjacent bone when functional loading is applied". These movements are not large enough to be seen by the naked eye, hence "micro" (Kohli *et al.*, 2021).

According to Jokstad (2009), in the provisional phase, rigid splinting and minimal force application have been confirmed as critical factors for immediate loading as the rigidity of the provisional prosthesis helps to minimize the transfer of micromotions down to the bone-implant interface. Therefore, the use of a fixed, cross-arch prosthesis is well-documented to control micromovements.

It is of utmost importance that the provisional prosthesis does not hinder soft-tissue healing and that the occlusion of the prosthesis with the opposing arch (natural teeth/removable denture/implant-supported prosthesis) is in balance, to ensure equally distributed loading on all the implants (De Bruyn *et al.*, 2014).

In terms of the retention of the prosthesis, a screw-retained solution is unquestionably preferable over a cemented one as it is more tissue friendly and allows for easy retrieval for maintenance (De Bruyn *et al.*, 2014).

The provisional prosthesis may be fabricated using many different materials, such as poured tooth-coloured acrylic resin, acrylic resin with resin denture teeth or milled polymethylmethacrylate (PMMA). These materials can be used either on their own or reinforced with metal to ensure strength and rigidity.

VI. Impression techniques

The establishment of a passive fit of an implant-supported prosthesis is critically dependent on the accuracy of the implant impressions to ensure the long-term success of the implant rehabilitation (Baig, 2014). However, evidence regarding the techniques and materials used for making multi-unit implant impressions is inconclusive (Baig, 2014).

Several aspects of the impression-making need to be considered, such as: should the impression copings be rigidly splinted on not; should the impression copings be "picked up" (open-tray technique) or "transferred" (closed-tray technique); and should conventional or digital impression techniques be used (Baig, 2014).

Based on the publication by Baig (2014), no significant differences were found between splinted and non-splinted impression copings. The results regarding the impression technique agreed with Lee *et al.* (2008) that overall, it seemed that neither of the techniques ("pick-up" or "transfer") was more effective than the other, although "pick-up" was the preferred technique when recording a greater number of implants (Baig, 2014).

In terms of conventional versus digital impressions, scientific research is still at a preliminary stage regarding the use of digital impression techniques for the fabrication of multi-unit implant restorations (Baig, 2014). There are limited accuracy studies, such as the study by Eliasson & Örtorp (2012), that have reported on the use of digital methods to record the 3D dental implant positions by using scan bodies and/or digital coded healing abutments. According to Baig (2014), there is currently no scientific literature to support digital impressions as being superior in accuracy for complete-arch implant impressions.

VII. Use of intermediary abutments

In the literature, intermediary abutments are also referred to as 'conical' or 'multi-unit' abutments.

Healthy peri-implant soft tissues are critical for creating a barrier between the oral environment and the peri-implant bone (Canullo *et al.*, 2018). According to Canullo *et al.* (2018), using a platform-switched conical abutment provides a double positive effect. Firstly, the application of the platform switching concept allows the establishment of the biologic width more coronal to the implant-abutment interface (Farronato *et al.*, 2012). Secondly, the literature suggests that platform-switching provides the soft tissues with a space wherein they can mature and this may improve the stability of the tissues and create an aesthetic result (Canullo *et al.*, 2018). A recently published systematic review by Testori *et al.* (2018) confirmed the positive outcomes of conical abutment use, in terms of the behaviour of the associated soft tissue.

During the fabrication of the implant-supported prosthesis, the clinician is required to disconnect certain components to gain access to the implant platform, etc. The repeated connection/disconnection of the implant-abutment may disturb the peri-implant mucosal barrier and result in micro damages of the connective tissue which may lead to its apical repositioning and possible bone resorption (Tallarico *et al.*, 2018b).

The literature regarding the use of intermediary abutments is controversial, with some studies, such as that by Alves *et al.* (2015), reporting significant differences between the groups which underwent dis/reconnection of implant components and those that did not, and other studies that reported no significant differences (Becker *et al.*, 2012). Despite the controversy, the connection of the implant-abutment early on may have additional benefits, such as enhancing peri-implant soft tissue dimension stability (Canullo *et al.*, 2018).

A 2018 systematic review and meta-analysis of randomised controlled trials concluded that the one-abutment one-time (OAOT) protocol provides stabilization of the supracrestal soft tissue at the early stage of the healing phase, which is a key for soft tissue maturation (Tallarico *et al.*, 2018b).

It is important to remember that from a clinical point of view, prosthetic success is determined by both the stability of the implant/abutment complex as well as the soft tissue thickness (Canullo *et al.*, 2018).

VIII. Diagnostic/planning aids

When planning to restore an edentulous patient by means of dental implants, there are several factors, both prosthetic and surgical, that need to be considered. There are several guidelines applicable to the surgical placement of the implants, to ultimately secure a prosthodontically-driven implant placement. According to Sharma *et al.* (2016), a prosthodontically-driven implant placement means that the ideal final restoration/prosthesis should first be planned, and thereafter used as a guide to ensure the accurate 3-D positioning of the supporting dental implants.

Ideally, the positioning of the dental implant should be such that the occlusal forces are directed along the long axis of the implant (especially in the posterior regions) because it is well-known that bone resists compressive forces better than tensile or shear stresses (Tözüm *et al.*, 2021). Therefore, placement of the implant in an ideal "prosthodontically-driven" position is of extreme importance in terms of achieving ideal function and ensuring long-term implant stability (Tözüm *et al.*, 2021).

The presence of anatomic structures may influence the desired implant position. For example, in the posterior region, Watanabe *et al.* (2010) found that a lingual concavity is prevalent in 36-39% of patients. Ignorance of the possible presence of this anatomical structure may result in the perforation of the lingual plate during surgery (Gallucci *et al.*, 2017). When treatment is planned for dental implant placement, radiographic methods are traditionally used to assess bone quantity and quality. Two-dimensional panoramic images provide a basic overview of the jaws and are usually considered adequate in the initial evaluation of the implant site. The goal is not only to improve the accuracy and predictability of surgical implant placement but it assists the surgeon in evaluating the surgical complexity of the specific case and to assess the possibility of immediate loading when indicated (Tözüm *et al.*, 2021).

Sun *et al.* (2015) agree with Correa *et al.* (2014) that when planning to place a dental implant, a two-dimensional panoramic radiograph is insufficient as it does not provide information regarding the buccal-lingual dimension of the bone available. The bucco-lingual aspect of the alveolar bone can only be obtained utilizing either conventional cross-sectional tomography, computed tomography (CT), or cone-beam computed tomography (CBCT). Ganz (2015) went along to say that if clinicians are not utilizing either CT or the lower radiation dosage CBCT, they are not accurately determining the three-dimensional anatomic reality and this may potentially increase the surgical and restorative complications.

Recently, cone-beam computed tomography (CBCT) scanners have become more widely used in dental clinics due to their high image resolution, reduced scanning time and lower levels of radiation compared with CT scans (Sun *et al.*, 2015; Suomalainen *et al.*, 2008). The CBCT scan is favoured for the preoperative planning of dental implants and the fabrication of the surgical template (Sun *et al.*, 2015).

Correa *et al.* (2014) stated that, in general, the clinical examination should provide sufficient information to enable the selection of the implant width, and then information from the panoramic radiograph will allow selection of the implant length. This statement agreed with Frei *et al.* (2004) who concluded that in standard implant cases, a cross-sectional image seems unnecessary for the evaluation of the available bone volume. It is worth noting that this study by Frei *et al.* (2004) excluded patients with narrow ridges, which would reduce the complexity of dental implant planning.

On the other hand, back in 2000, The American Academy of Oral and Maxillofacial Radiology (AAOMR) recommended that the evaluation of any potential implant site should include cross-sectional imaging of the region of interest (Tyndall & Brooks, 2000).

Interestingly, in the study by Correa *et al.* (2014), they found that when implant planning was initially done using a panoramic radiograph in combination with a clinical examination, and later confirmed using a CBCT scan, the majority of the planned implants were subsequently changed to be smaller and shorter to avoid important anatomical structures and to respect the bucco-lingual bone width. This study concluded that the preoperative selection of implant size will be influenced by the type of radiographic method and that implant size should not only be determined on two-dimensional images displaying only the mesial-distal plane (panoramic radiographs) (Correa *et al.*, 2014).

It is known that the incidence of serious complications such as haemorrhage, nerve injury and implant migration into anatomic spaces is highest during the actual surgical phase of treatment. However, by utilizing a combination of CBCT imaging and thorough digital planning before performing any invasive procedure, it is possible to accurately assess the morphology of the ridge and predict the level of difficulty of the implant surgery, and even possibly bone augmentation that may be required (Tözüm *et al.*, 2021).

According to Ganz (2015), there are several available pre-surgical prosthetic planning pathways. The first pathway involves acquiring a CT/CBCT scan directly, without any prior planning having been done. The data can then be processed and viewed on the relevant software. Evaluation of the potential implant sites can then be done, followed by the surgical procedure, or the scan can be incorporated

into a “third party interactive treatment planning software” which may allow a digital wax-up to be done (Ganz, 2015).

A second pathway requires the prior fabrication of a radiopaque “scannographic” template (see Fig. 1 and Fig. 2), incorporating the crucial restorative information, that is then worn by the patient during the process of scan acquisition (Ganz, 2015). By following this pathway, the desired tooth position can be evaluated in relation to the underlying bone (unlike the CBCT acquisition seen in Fig. 3) as well as other important anatomical structures such as the incisive canal, maxillary sinus, submandibular fossa or the inferior alveolar nerve (Ganz, 2015).

Figure 1: A radiopaque scanning appliance fabricated from a duplicate of a patient’s existing well-fitting denture (Ganz 2015)

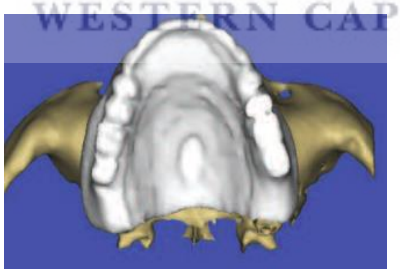

Figure 2: The scanning appliance is worn at the time of the CBCT acquisition (Ganz 2015).

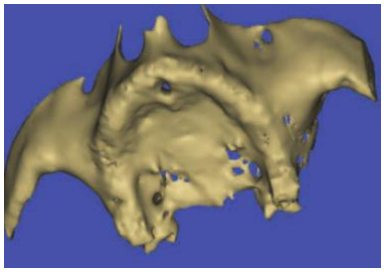

Figure 3: The volumetric rendering aids in the inspection of the bone, but does not offer information on the desired restorative position (Ganz 2015)

After a thorough assessment of the available bone volume, the key implant positions are then identified and simulated as seen in Fig. 4.

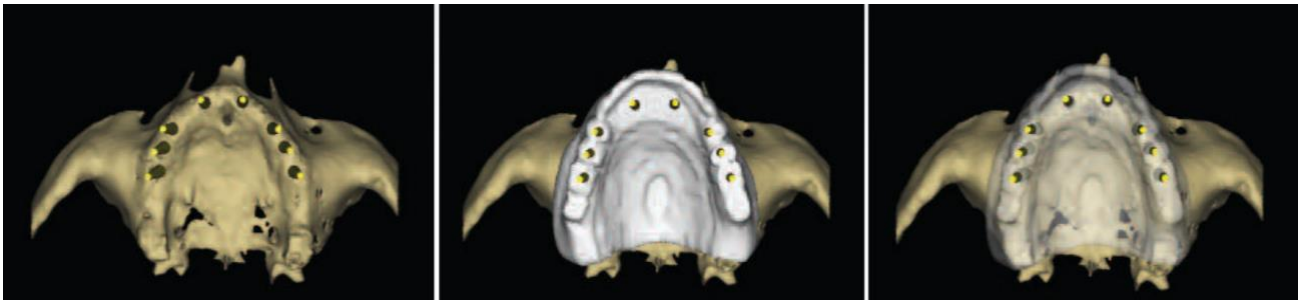

Figure 4: Eight implants positioned to support a fixed restoration to fit within the framework of the desired tooth position. Selective transparency allows visualization of the underlying bone (Ganz 2015).

The frontal view allows the assessment of the implant parallelism by visualizing the implant abutment projections (Fig. 5). Ganz (2015) mentioned that the "Selective Transparency" feature which can be applied to multiple structures, assists with the visualization of the entire complex of the implant, abutment projection, radiopaque template, and the underlying bone. This encompasses the true intention of "prosthodontically-driven treatment planning".

Once the final implant positions have been confirmed, a mucosa-supported surgical template can be designed and thereafter fabricated through either 3-D printing, stereolithography, or a CAD/CAM process (Ganz, 2015).

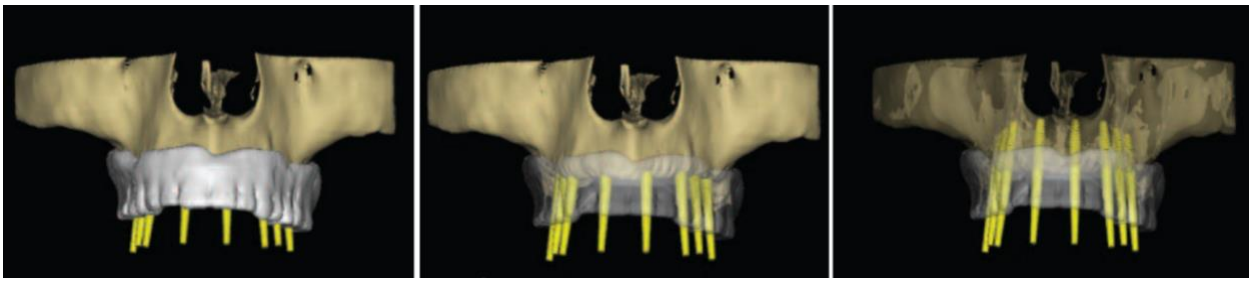

Figure 5: Frontal view of the scanning template with yellow abutment projections can be visualized as they relate to both the tooth positions and the underlying bone from a frontal view (Ganz 2015)

IX. Degree of surgical guidance

It is well known that a surgical procedure is required to place dental implants. During this surgical procedure, the accurate positioning of the implant is the main goal, especially in relation to critical anatomical structures such as the nasal cavity, maxillary sinus, mandibular canal, and adjacent teeth (Sun *et al.*, 2015).

When the surgical implant placement is performed the surgeon can either perform the surgery freehand (without any form of guidance), using an analogue guide or duplicate of a denture set-up, using a printed/milled surgical guide with pilot hole guidance or a printed/milled surgical guide that is fully-guided. According to Sun *et al.* (2015), implant surgery can be challenging, especially in edentulous jaws, where some form of guidance is helpful.

Ganz (2015) stated that once a "virtual" plan has been determined, based on a 3-D scan diagnosis, guided surgery can be divided into three distinct categories according to the "Ganz-Rinaldi Classification of Guided Implant Surgery Protocols".

The first category allows the information gathered to be assessed, relaying important information to the clinician, who will then perform the surgical procedure freehand but based upon the virtual plan (Ganz, 2015). This category is termed "Diagnostic-Freehand" as no surgical guide is utilized.

The second category involves the fabrication of a surgical guide, constructed from the digital plan (See Fig. 6), usually through either rapid prototyping/stereolithography, CAD/CAM or laboratory fabricated and termed "Template-Assisted" (Ganz, 2015). The pilot drill is used through the guide, but thereafter the rest of the surgery is performed without the guide.

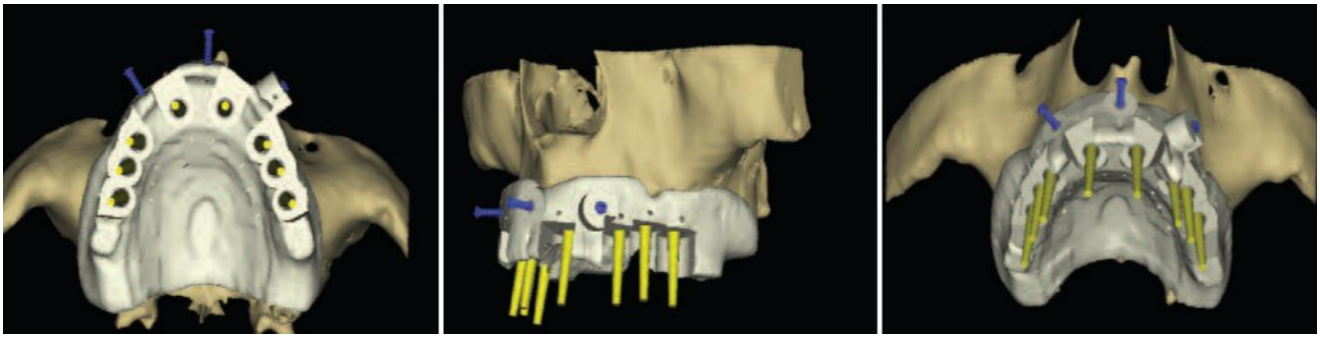

Figure 6: The template design revealing the guide tubes and three blue fixation pins (Ganz 2015)

The third category is termed "Full Template Guidance" and it consists of a specific template design that allows for accurate drilling and preparation of the osteotomy by making use of the proper manufacturer-specific carriers for the implants (Ganz, 2015). According to Tan *et al*. (2018), the drill position, angle and depth are precisely controlled, and the implant insertion is also performed through the template to precisely control the surgical process.

Ganz (2015) emphasized that the use of advanced imaging modalities is essential for any type of implant surgery and restorative intervention, whether it be for a single/multiple tooth restoration, complete arch fixed or a removable overdenture reconstruction. What is important to note is that these three-dimensional tools need to be used correctly to truly provide the clinicians with the highest degree of insight and accuracy to diagnose and formulate a treatment plan for dental implant placement (Ganz, 2015).

In addition, the use of surgical guides can significantly improve the accuracy of the osteotomy compared with freehand drilling, for both experienced and inexperienced clinicians (Nickenig *et al.*, 2010). With regards to the accuracy of the different guides, there are fewer deviations from the planned implant position when using stereolithographic surgical guides compared with conventional ones (Tan *et al.*, 2018). There was an improved accuracy in implant placement when using a guide, in general, compared with freehand placement (Tan *et al.*, 2018).

However, it is important to note that surgical guides do not always perfectly translate the virtual implant position into reality, and deviations from the planned implant position do still occur (Tan *et al.*, 2018).

According to Jiang *et al.* (2021), some specific aspects of guided surgery should be valued, such as the improvement of accuracy, the decrease in technical sensitivity, and the option to combine surgical guides with real-time navigation to expose more details of surgical sites.

Summary of the literature review

According to Penarrocha-Oltra *et al.* (2015), implant-supported fixed complete-arch prostheses are the "therapeutic alternative that best rehabilitates the lost anatomy and function of edentulous patients and provides the highest patient satisfaction". When planning for a fixed complete-arch implant-supported prosthesis in the edentulous jaw many factors need to be considered. Proper planning/diagnosis is

achieved by means of advanced imaging technologies such as CT/CBCT which allow visualization of the patient's bony anatomy.

Prior prosthodontic work-up of the patient aids in the successful implementation of prosthodontically-driven implant placement which then simplifies the restorative process as any shortcomings or complications have been identified and planned for.

In order to immediately load dental implants with a fixed complete-arch provisional prosthesis, certain factors need to be present, such as primary stability, which according to the literature is an absolute pre-requisite for immediate loading.

Several other factors, such as the ideal number of implants, implant design characteristics, degree of surgical guidance, impression technique and material for the provisional prosthesis, can be governed by the available literature, but the final choice is often determined by the clinician's preferences and experiences.

The fact that the literature lacks clear evidence-based guidelines regarding these crucial factors, was the main motivation to undertake this specific research, aiming to determine the actual preferences of Prosthodontists, specifically in South Africa, with regards to this treatment modality.

The next chapter will focus on the research design and methodology employed in this study.

CHAPTER 3 - RESEARCH DESIGN AND METHODOLOGY

Introduction

The previous chapter provided an overview of the relevant literature on immediate loading of fixed complete-arch implant-supported prostheses. This chapter provides information regarding the aim, objectives and research hypothesis of this study. The study design, along with the sampling technique and sample size are explained, and the inclusion/exclusion criteria are identified.

The ethics approval and consent are provided and the specific research instruments used are identified. Information is given regarding data collection, analysis, and disposal and finally, any limitations in the data is mentioned.

3.1 Aim

To determine the current prevalence and preferences of the immediate loading protocol for a fixed complete-arch implant-supported prosthesis, utilized amongst South African Prosthodontists.

3.2. Objectives:

1. To determine the socio-demographic factors of the registered Prosthodontists in South Africa, namely their age, gender, years of experience and location of their practice.
2. To determine the **prevalence** of immediate loading of complete-arch implant-supported prostheses among South African Prosthodontists.
3. To determine the **preferences** of South African Prosthodontists when approaching an immediate loading complete-arch case, with reference to implant-, abutment-, and material-choice.

3.3. Research Hypothesis

The research hypothesis was that more recently qualified Prosthodontists would be more likely to perform an immediate loading protocol and would have set preferences based on both their clinical experience and the available literature (evidence-based).

3.4. Study Design

A cross-sectional descriptive study with a mixed method research approach was used. According to Shorten & Smith (2017), mixed method research draws on the potential strengths of both qualitative and quantitative methods and requires intentional mixing of the two methods concerning the collection of the data, the analysis thereof and how the evidence is interpreted. The mixed-method approach was followed since the data collection involved gathering quantitative and qualitative information. The combination of both qualitative and quantitative approaches in the mixed methods approach facilitated deeper insight, compared with either method performed alone (Creswell, 2003).

It is well-known that surveys/questionnaires do not provide clarity as to why people think or act the way they do, hence the need to incorporate qualitative questions to clarify the reasoning behind some of the answers given. Mixed methods, provided a clearer understanding of the links or contradictions between the qualitative and quantitative data, as by incorporating different avenues of data collection, the evidence was enriched by more in-depth answering of certain questions (Wisdom & Creswell, 2013).

According to Creswell & Plano Clark (2017), mixed methods research can consist of multiple categories, namely: explanatory, exploratory, parallel and nested (embedded) designs. The table below, taken from Shorten & Smith (2017), explains the characteristics of each category. This research followed the "parallel" design as the qualitative and quantitative data was collected and analysed concurrently.

Table 1: Types of mixed methods designs (Shorten & Smith 2017)

Mixed method type	Research processes	Examples
Explanatory sequential	Quantitative data are collected and analysed first, then qualitative data are collected and analysed to help explain quantitative data QUAN → QUAL	AIM: Identify levels of stress among new graduate registered nurses (RNs) working in emergency room (ER) settings QUAN: National survey of new RNs working in ER settings measuring levels of workplace stress QUAL: Personal interviews with 15–20 new RNs working in ER settings to discuss their experiences with stressful workplace situations SYNTHESIS: Sequential QUAL data help explain QUAN data
Exploratory sequential	Qualitative data are collected and analysed first, then quantitative data are collected and used to test findings empirically QUAL → QUAN	AIM: Identify highest sources of workplace stress for new RNs working in hospital ERs QUAL: Focus group data collected from newly registered RNs working in hospital ERs within a local area health service to discuss workplace stress QUAN: QUAL data used to create a national survey administered to all RNs working in ERs about sources of workplace stress experienced within their first year of practice SYNTHESIS: Sequential QUAL data inform collection of QUAN data, which verify QUAL data
Parallel	Qualitative and quantitative data collected and analysed concurrently QUAL + QUAN	AIM: Identify sources of stress for RNs working in ER settings, personal coping strategies used and types of programmes or support systems provided by hospitals QUAN: National survey of all RNs working in ER departments, based on the literature, to identify common sources of stress and methods of support used by employers to reduce RN stress QUAL: Focus groups and interviews with a random selection of RNs working in ERs to broaden understanding of different sources of stress and personal coping strategies used SYNTHESIS: Data integration during interpretation phase after QUAN and QUAL data analyses
Nested	Can be either QUAL or QUAN main design with the alternative paradigm embedded within the study to answer a complementary question QUAL + quan or QUAN + qual	AIM: Test an online peer support programme designed to reduce workplace stress for new RNs working in ERs QUAN: RCT to test online programme effect on stress levels and intention to remain working in the ER qual: Interview nested in the RCT, focused on user experiences of the online programme SYNTHESIS: qual analysis embedded within the main QUAN study

*Table adapted from Halcomb and Hickman.[7]
QUAN, quantitative; QUAL, qualitative.

An anonymous online questionnaire (see Appendix 1) using Research Electronic Data Capture (REDCap), a browser-based application developed by Vanderbilt University to capture data for clinical research and create databases and projects, was utilized as the data collection tool. The questionnaire included both closed and open-ended questions.

The questionnaire developed by Schoenbaum *et al.* (2020) was further modified to include additional clinicians' preferences with regard to diagnostic aids used to plan treatment, the degree of surgical guidance provided and preferred insertion torque. The qualitative open-ended questions aimed to determine the clinicians' opinions regarding the advantage of this treatment modality, as well as what they deemed most critical to ensure a successful outcome.

3.5. Sampling Technique

According to Jager *et al.* (2017), sampling strategies can be classified into two broad categories, namely: non-probability sampling and probability sampling. For this study, a non-random (non-probability) sampling technique, more specifically convenience sampling, was utilized, since the targeted population was a small group of specialist dentists (Prosthodontists) who were readily and easily available.

Non-probability sampling strategies refer to any methods of sampling in which random selection is not used (Jager *et al.*, 2017). A review by Bornstein *et al*., (2013) stated that among the non-probability sampling strategies, convenience sampling is by far the most commonly used. This sampling strategy involves the selection of participants in an ad hoc or specific fashion based on their accessibility and/or proximity to the research (Bornstein *et al.*, 2013). The noteworthy advantages of utilizing convenience sampling include cost-effectiveness, efficiency and simplicity, while the disadvantage thereof is the lack of clear generalizability (Bornstein *et al.*, 2013). This lack of generalizability means that the results of the study cannot be broadly applied to many different types of people or situations.

Taherdoost (2018) agreed that although convenience sampling is the least expensive and the most convenient, it may be subject to selection bias and the sample is not representative of the whole population. However, in this specific research the researcher intended for the sample to be a specific group of participants, namely; the entire population of registered Prosthodontists in South Africa. The chosen sample did not need to be representative or random but instead required a clear rationale regarding the inclusion or exclusion of some participants within this sample. The results also need not be generalized as the findings should apply to the registered Prosthodontists only, and not the generalized population.

3.6. Sample Size

The convenience sample used in this study consisted of Prosthodontists registered with the Health Professions Council of South Africa (HPCSA). Permission was obtained (via the "Research Form", "Form A" and "Data Request". See Appendix 2) to access the demographic details of Prosthodontists

registered with the HPCSA. A quotation (see Appendix 2) and a tax invoice (see Appendix 2) were provided. These demographic details were charged for.

The Protection of Personal Information Act (POPI Act), implemented on July the 1st 2021, prevented the release of the direct contact details of these Prosthodontists, and therefore the HPCSA could only provide their names and area of practice. The participants' email addresses were obtained through either contacting their practices directly or accessing the websites of tertiary institutions where they are employed.

The sample size for the calculation of proportions in surveys for a finite population was used.

$$m = \frac{(Z\alpha/2)\ 2\ p(1-p)}{d^2}$$

$$n = \frac{m}{1 + \frac{m-1}{N}}$$

Where n=sample size, Z=statistical level of confidence, P=expected proportion, and d=precision. If Z=1.96 (95% confidence), and using a prevalence of 50% (guestimate) P=0.5 and d=0.05, N=83, n is 68.

With a predicted prevalence of 50% of prosthodontists who will perform immediate loading of complete-arch implant-supported prostheses and a finite sample size of approximately 83 prosthodontists in the country, with a power of 80% and a 5% level of significance, a sample size of 68 participants was recommended (https://select-statistics.co.uk/calculators/sample-size-calculator-population-proportion/).

3.7. Inclusion Criteria

1. Must be a qualified Prosthodontist.
2. Must be registered with the HPCSA.
3. Must be practicing in South Africa.
4. Must be able to read and understand English.

5. Must practice clinically.
6. Must have access to the internet.

3.8. Exclusion Criteria

1. Not a qualified Prosthodontist.
2. Not registered with the HPCSA.
3. Practicing abroad (not in South Africa).
4. Not able to read and understand English.
5. Not practicing clinically; for example, only in teaching (academics), with no clinical work being done.
6. Participants that do not have access to the internet.

3.9. Ethics Approval and Consent

Ethics approval (reference number BM21/03/08) was granted by the Biomedical Research Ethics Committee (BMREC) at the University of the Western Cape (Appendix 3).

An information sheet (see Appendix 4), that included the title and relevant details of this research, was emailed to all the participants in a courtesy email, before launching the survey on 29/6/2021. A digital consent form was also incorporated into the online survey informing participants that their participation was voluntary and anonymous. The participants could, at any point, opt to withdraw from the study, with no repercussions.

Each participant was allocated a number, for example: "1". The names of the participants were not captured, to maintain anonymity, and all information was safely stored on the password-protected computer of the primary researcher. The primary researcher was also the only one with the login details to the REDCap survey and can confirm that extreme care was taken to ensure that all information collected was handled with strict confidentiality.

3.10. Research Instruments

An anonymous online questionnaire using the REDCap platform (see Appendix 1) was used. REDCap is known to be a secure web application and is readily available to students registered at the University of the Western Cape.

Excel documents were created for purposes of recording responses and scheduling reminder emails.

3.11. Data Collection

The online questionnaire, using REDCap was used to capture the data. Questionnaires are the most common means of obtaining information from a sample of individuals, and due to the specific format of a questionnaire, the data obtained is standardized and well structured.

According to Phillips *et al.* (2013), questionnaires may consist of open-ended questions (allowing unlimited answers), checklists (applicable items are then selected), multiple-choice questions (the participant then chooses the most applicable answer), and ranking scales (the items are then ranked in a specific order depending on the nature of the question). The selection of the type(s) of questions used is dependent on the specific data needed, as well as the planned data analysis to be used.

In this study, the questionnaire consisted of three separate sections (see Appendix 1). The first section was the digital consent form which reiterated the information sent to the participants in the courtesy email (sent on 2021/06/29) and required them to digitally accept and sign the informed consent form. Thereafter, the second section consisted of 5 multiple choice questions and covered the demographic information of the participants. The final question in the second section was “Do you provide fixed complete-arch implant-supported prosthetic treatment to your patients?”. Only if the participants answered “Yes”, were they able to continue with the rest of the survey. If they answered “No”, the participants were thanked for their contribution and not allowed to continue the survey.

The final section consisted of 16 multiple-choice questions, as well as 2 additional multiple-choice questions with mandatory open fields in which the participants needed to elaborate on their answers. These two open-ended questions aimed to obtain the participants’ personal opinions and thereby provide qualitative information regarding this treatment modality.

Prior to launching this survey, a pilot study was completed with 10 individuals to test the efficiency of the survey invitations, as well as the follow-up reminders that would be automatically generated by REDCap. Following this pilot study, necessary changes were incorporated as it was noted that the survey invitations sent to participants directly from the REDCap platform ended up in their spam folders. This would have impacted the response rate negatively. The findings of this pilot study were excluded from the present study.

Therefore, it was decided to manually generate each participant's personal survey link and send the email invitation directly. Although this was more time-consuming, it guaranteed that the survey invitations would not be marked as spam.

The survey was launched on 2021/06/30 and was sent to a total of 83 participants. Of the 97 registered prosthodontists, 6 had since passed away and 8 were practicing abroad, hence the 83 participants included. Weekly reminder emails were sent to the participants that had not yet responded. These reminder emails were sent on different days of the week, as well as at different times of the day to ensure the best chance of being acknowledged and completed by the participants.

The survey was terminated on 2021/08/31, after being active for 8 weeks. See Table 2 below for a summary of the data collection.

Table 2: Summary of Data Collection

2021/06/29	Courtesy email, containing information leaflet, sent to 97 participants.	Information gained – 6 participants had passed away, 8 are practicing abroad.
2021/06/30	Survey launched. Invitations sent to 83 participants.	31 responded
2021/07/08	Reminder email sent to 52 participants.	8 responded
2021/07/15	Reminder email sent to 44 participants.	15 responded
2021/07/25	Reminder email sent to 29 participants.	3 responded
2021/07/30	Reminder email sent to 26 participants.	6 responded
2021/08/15	Reminder email sent to 20 participants.	1 responded
2021/08/24	Reminder email sent to 19 participants.	10 responded
2021/08/31	Survey terminated	74 responses in total, 9 participants did not respond.

Challenges encountered during data collection:

1. Email invitations sent directly from REDCap were marked as spam and therefore ended up in the participants' spam folders. This meant that manually sending the invitations from the primary researcher's email address was the most reliable, however, it was also time-consuming and required the use of an Excel document to keep accurate records of responses to the survey and reminders to be sent, etc.

2. Prosthodontists in private practice are very busy and often would respond to the email stating that they would complete the survey later that day, but then they would forget. This required multiple reminders.

3. The survey settings did not allow the participants to leave the survey and return at a later date to complete it. This meant that several responses were seen as being "incomplete" unless the participant erased all responses and started the survey again.

4. On REDCap, the green icon indicating a "completed" survey was inaccurate, as when this data was exported several "completed" surveys were, in fact, incomplete and were subsequently disregarded.

3.12. Data Disposal/Storage

Data collected on REDCap was stored on the electronic platform. In addition, any data exported into statistical programmes (such as Excel or Stata) was stored on the UWC institutional research data repository, Kikapu.

3.13. Data Analysis

The data analysis of the quantitative data (closed-ended questions), using basic descriptive statistics, was done by a statistician affiliated with the University of the Western Cape. The quantitative data was imported into Stata version 16.0 (Stata, College Station, Texas, USA) for analysis. 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.

Pearson Chi^2 and Fischer's Exact test were applied to determine associations between the variables. Both the Chi^2 and the Fischer's Exact test are statistical tests used to determine if there are non-random associations between two categorical variables. The Fischer's Exact test is used when the sample size is small.

The qualitative data (open-ended questions) was thematically analysed. The answers given to the open-ended questions were read a few times before common themes were identified. The answers were then grouped according to these identified themes, guided by literature. A second researcher independently analysed the qualitative data. Consensus regarding the themes was reached between the researchers. This ensured trustworthiness of the qualitative analysis.

This data was displayed in tables with some direct quotes of the participants. In addition, an in-depth description of the data followed.

3.13. Possible Limitations and Gaps in the Data

The data collected is specific to South African Prosthodontists (small sample size) and cannot be used to make generalized deductions about the prevalence and preferences towards this treatment modality. However, this data would provide evidence of the current trends in the South African context.

CHAPTER 4 - RESULTS AND STATISTICS

Introduction

The previous chapter explained the methodology used to collect the data, the research instruments used and the application thereof. This chapter presents the actual sample characteristics, the results obtained and identifies the main trends and associations that emerged.

Following the characteristics of the sample, the results are reported in two main sections. In the first section, which is subdivided into Part 1 and Part 2, the descriptive quantitative results of the survey are reported and illustrated utilizing tables and graphs. In the second section, the descriptive qualitative results of the open-ended questions are reported together with the themes identified and the relevant respondent quotes, which are illustrated in tables. In Chapter 5 these results will be discussed and compared with the relevant literature.

Characteristics of the sample

The total number of registered Prosthodontists at the HPCSA is 97, which included 8 prosthodontists practicing abroad (not in South Africa), and 6 that have since passed away. Therefore, the sample size available was 83 prosthodontists. A total of 70 prosthodontists consented to be part of the study and completed the survey, relating to a response rate of 84.34% (see Fig. 7).

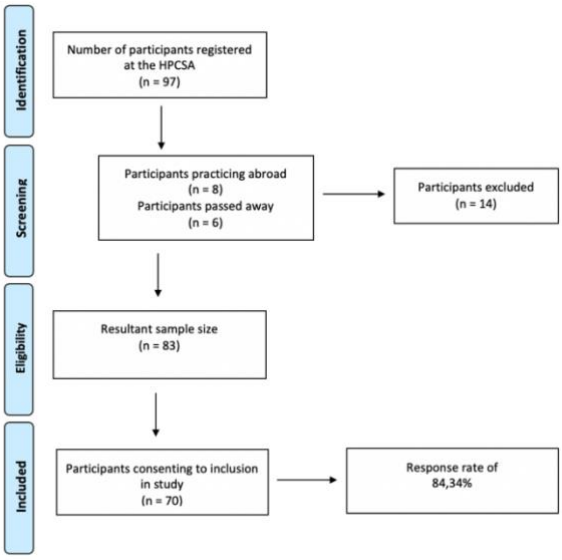

Figure 7: Prism chart indicating characteristics of the sample

Main results of the study (descriptive, quantitative)

Part 1

All of the tables presented contain the complete data counts and answers in the order in which they appeared in the survey. From here onwards the participants that completed the survey will be referred to as the "respondents". The demographic data of the respondents is presented in Table 3 below.

Table 3: Demographics of the 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

Firstly, regarding the gender of the respondents, 71.43% were male and 28.57% were female. The nature of career type showed most respondents in private practice only (42.86%), followed by a combination of private practice and academics (25.71%), academics only (18.57%), retirees (10.00%) and public health/community clinic/military (2.86%).

The number of years registered as a prosthodontist was fairly well distributed across the year groups, with the highest percentage of respondents (24.29%) in the 20-30 year category, and the lowest percentage (4.29%) in the 40+ year category. A similar distribution was noted between the 10-20 year category (18.57%), the 30-40 year category (17.14%) and the 5-10 year category (15.71%).

Concerning the province in which the respondents practice, the results showed a clear majority practicing in Gauteng (60%), followed by the Western Cape (30%). A smaller percentage of respondents (5.71%) practice in Kwazulu-Natal; and the Eastern Cape, Free State and Limpopo each have only one practicing prosthodontist in the province (1.43%). Northern Cape, Mpumalanga and North-West had no registered prosthodontists that responded to the survey.

For the final question in this first part, 13 respondents (18,57%) indicated that they do not provide fixed complete-arch implant-supported prosthetic treatment to their patients. Therefore, they were excluded from proceeding to the second part of this questionnaire. Even though 57 respondents said they do perform this treatment, only 50 of them completed the entire survey. Thus only the 50 completed responses were used to report further results.

Part 2

A further demographic analysis was performed on these 50 respondents, showing that 39 (78%) were male and 11 (22%) were female. The majority of these respondents were either practicing in private practice only (58%) or both private practice and academics (28%). Regarding the years as a registered prosthodontist, there was once again a similar distribution between the categories less than 5 years (24%), 10-20 years (20%) and 20-30 years (28%).

Table 4 (A-F) presents the data obtained on implant design, treatment planning and execution, and overall protocol preferences for the immediate-loading of fixed complete-arch implant-supported prostheses. The questions and their corresponding answers are listed in the tables in the order in which they were presented to respondents.

Table 4A: Implant design, treatment planning and execution and overall protocol preferences.

Respondent prompt		Frequency	Percentage
What is the total estimated number of arches of fixed complete-arch implant-supported prostheses you have completed?	Less than 20	13	26
	20-30	10	20
	More than 30	27	54
How often do you do immediate-loading of fixed complete-arch implant-supported prostheses?	Always	3	6
	Majority of the cases	25	50
	Minority of the cases	17	34
	Never	5	10
Which diagnostic/planning aids do you make use of when planning for implant rehabilitation of an edentulous jaw?	Panoramic radiograph only	5	10
	Panoramic radiograph with a radiographic denture set-up in situ	4	8
	CBCT only	3	6
	CBCT with a radiographic denture set-up in situ	21	42
	CBCT with a radiographic denture set-up in situ and an intra-oral scan	17	34

The total estimated number of fixed complete-arch implant-supported prostheses completed indicated that the majority of respondents have completed more than 30 arches (54%). The categories for less than 20 arches (26%) and between 20-30 arches (20%) were similar (See Table 4A and Fig. 8). This variable described the respondents' estimated experience regarding the number of fixed complete-arch implant-supported prostheses placed. This specific variable will be used in combination with the majority of variables displayed in the form of coloured grading of the stacked bars, graphs and figures.

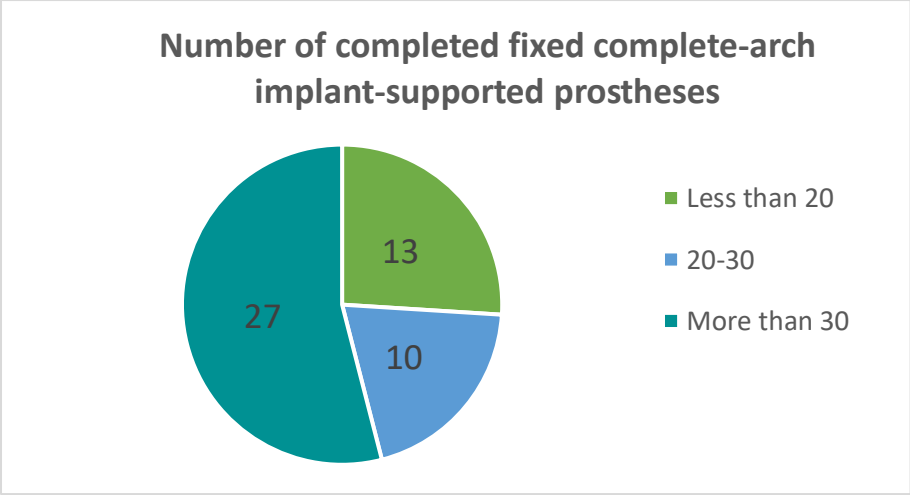

Figure 8: Number of completed fixed complete-arch implant-supported prostheses.

When prompted to indicate how often they perform immediate-loading of fixed complete-arch implant-supported prostheses, the majority of respondents stated that they perform this modality for the majority of their cases (50%), while 34% stated that they immediate-load for the minority of their cases. Three respondents indicated that they always immediate-load, while 10% (5 respondents) claimed to never immediate-load.

For the treatment planning for these cases, the majority of the respondents (42%) stated that the diagnostic/planning aid that they make use of is a CBCT with a radiographic denture set-up, while 34% of the respondents indicated that they use a CBCT with a radiographic denture set-up in combination with an intra-oral scan. Interestingly, 10% of the respondents still make use of a 2D panoramic radiograph only (see Fig. 9).

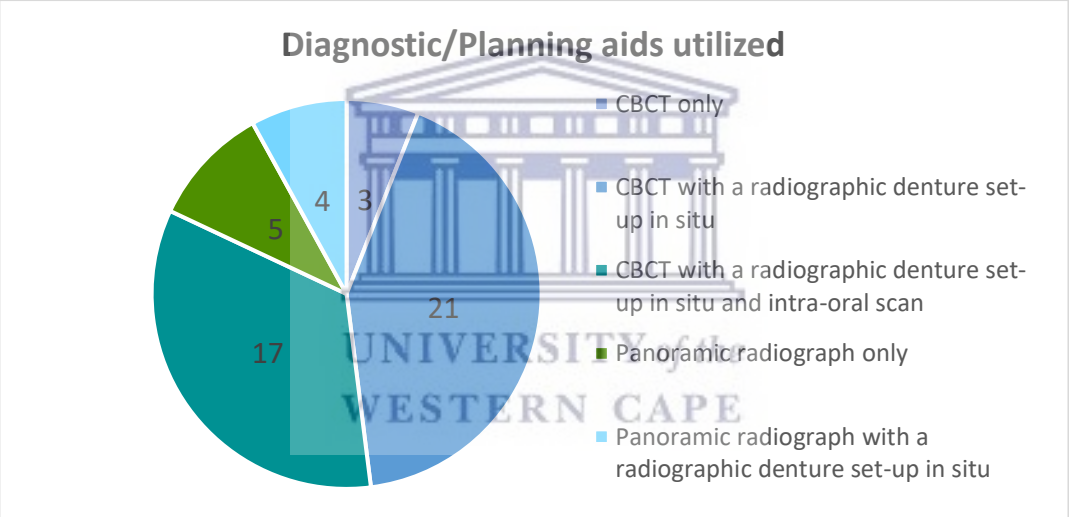

Figure 9: Preferences regarding diagnostic and planning aids used for ideal treatment using a fixed complete-arch implant-supported prosthesis.

Table 4B: Implant design, treatment planning and execution and overall protocol preferences.

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	4
	Surgeon only	1	2
	Prosthodontist and surgeon in combination	47	94

Preferences for the number of implants in the Maxilla and Mandible are presented in Table 4B, Fig. 10 and 11 below. In the Maxilla, there was a clear preference for the use of 6 implants (76%), followed by the much lower 12.00% of the respondents preferring 8 implants. In the Mandible, the preferences regarding implant number were largely spread between 4 (26% of respondents), 5 (24% of respondents), and 6 (46% of respondents) implants.

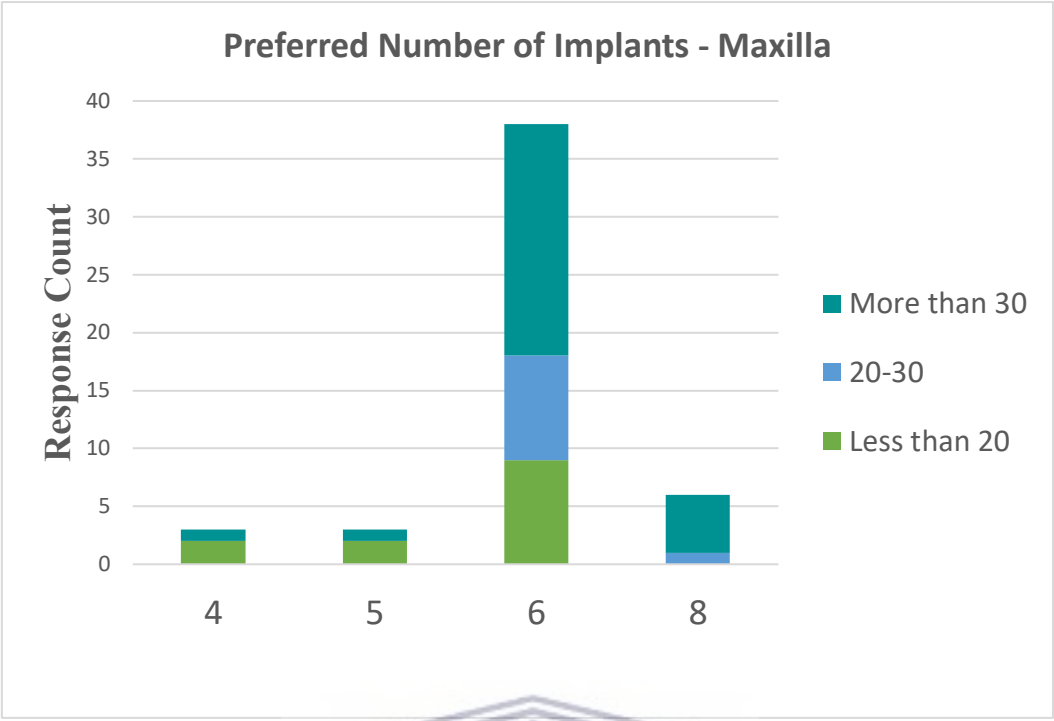

Figure 10: Preferences regarding number of implants in maxilla for ideal treatment using fixed complete-arch implant-supported prosthesis.

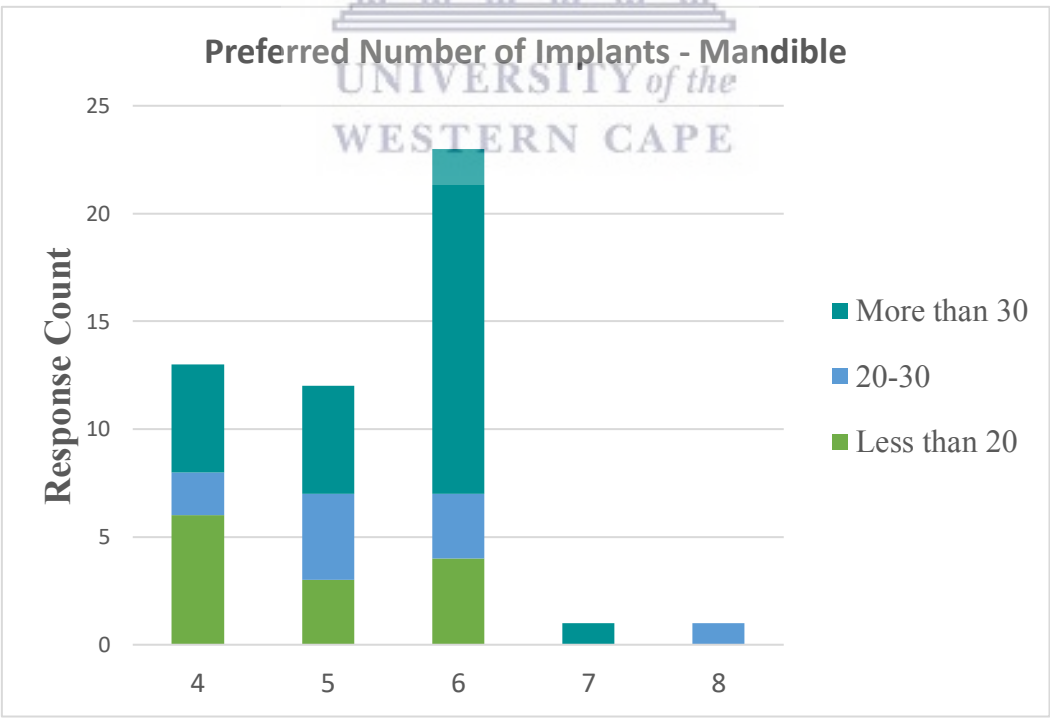

Figure 11: Preferences regarding number of implants in mandible for ideal treatment using fixed complete-arch implant-supported prosthesis.

When asked "Who makes the decision regarding the implant used?" 94% (47 respondents) said that this decision is shared between both the prosthodontist and the surgeon.

Table 4C: Implant design, treatment planning and execution and overall protocol preferences.

Respondent prompt		Frequency	Percentage
Which implant type do you use for an immediate-load fixed complete-arch implant-supported prosthesis?	Bone-level design	42	84
	Tissue-level design	8	16
Which connection type do you use for an immediate-load fixed complete-arch implant-supported prosthesis?	External connection	30	60
	Internal connection	20	40
How do you have the surgeon place the implant for the majority of your cases?	Fully-guided with printed/milled surgical template	8	16
	Pilot-hole guided with printed/milled surgical guide	15	30
	Analogue guide or duplicate denture	20	40
	Freehand	7	14

Table 4C shows the results for preferences regarding implant design for use with fixed complete-arch implant-supported prostheses. Respondents showed the highest level of support for implants with bone-level designs (84%) as compared with tissue-level implants (16%) (See Fig. 12). The preferred connection type was a 60/40 result with 30 of the respondents (60%) preferring the external connection over the internal connection (preferred by 40% of the respondents) (See Fig. 13).

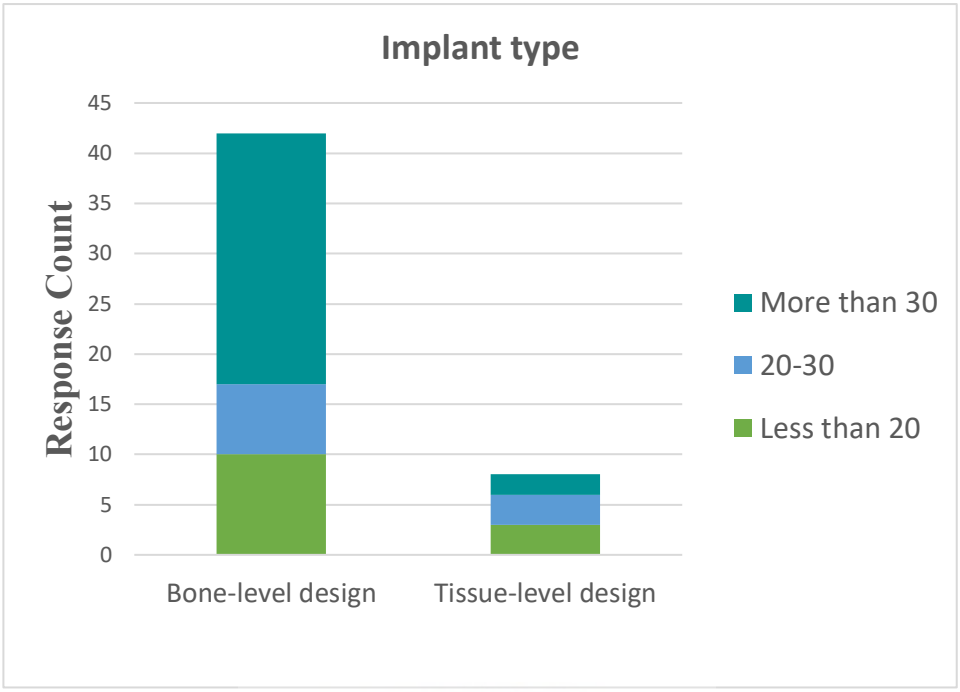

Figure 12: Preferences regarding implant type for ideal treatment using fixed complete-arch implant-supported prosthesis.

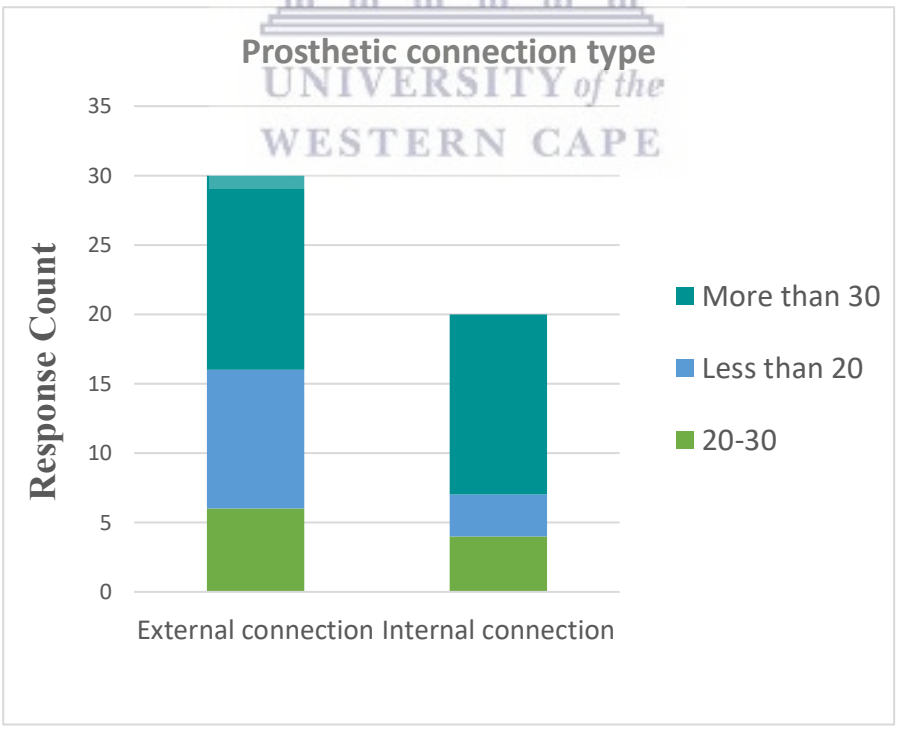

Figure 13: Preferences regarding prosthetic connection for ideal treatment using fixed complete-arch implant-supported prosthesis.

The question "How do you have the surgeon place the implants for the majority of your cases?" had two prominent answers. The highest preference was for the use of an analogue guide or duplicate of the denture (40% of the respondents), and thereafter the use of a pilot hole printed/milled surgical guide (30% of the respondents). See Fig. 14.

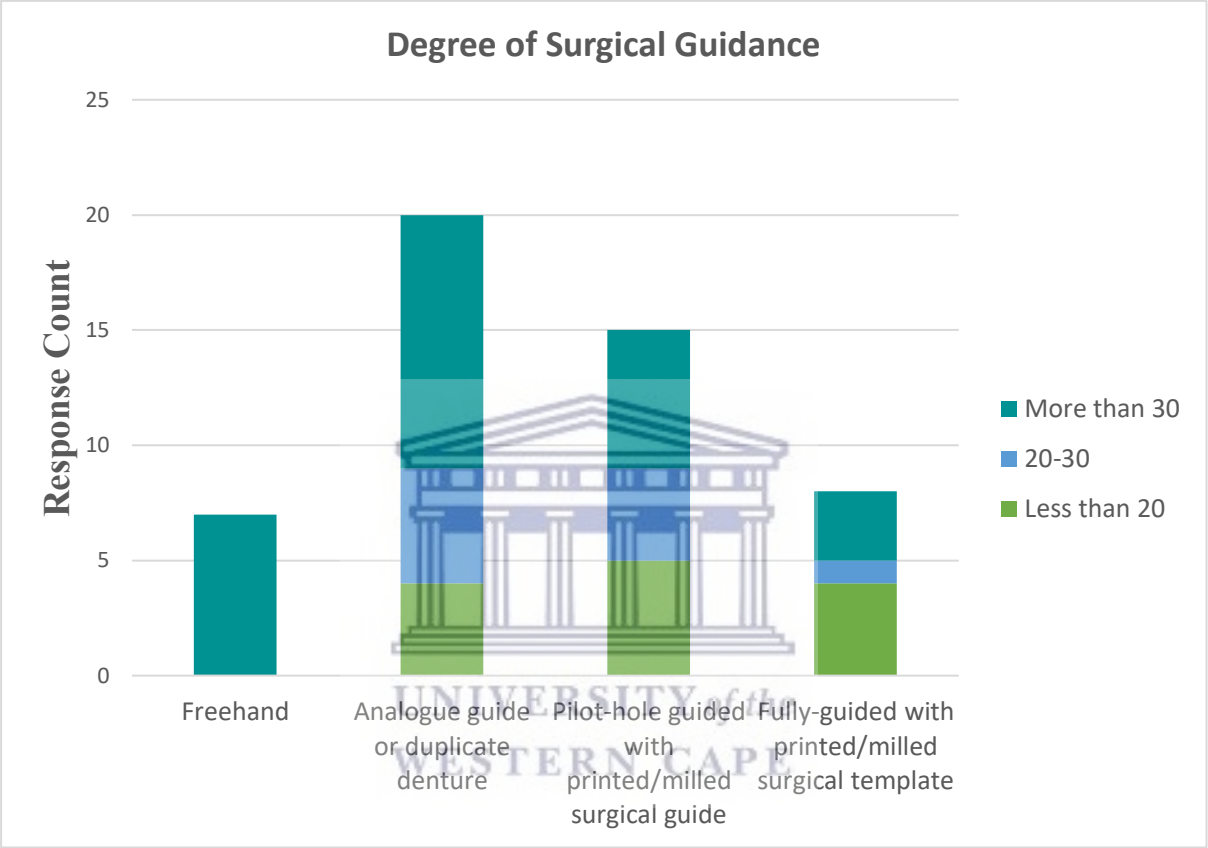

Figure 14: Preferences regarding degree of surgical guidance for ideal treatment using fixed complete-arch implant-supported prosthesis.

In terms of the consensus regarding the critical insertion torque required to predictably immediate-load the implants, 32 of the 50 respondents (64%) stated that they prefer an insertion torque of 30-40 Ncm per implant. 8 respondents (16%) would accept an insertion torque of 20-30 Ncm per implant, while 9 respondents (18%) prefer to be guided by a cumulative insertion torque of >120 Ncm over all implants (Table 4D).

Table 4D: Implant design, treatment planning and execution and overall protocol preferences.

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

When asked about the use of multi-unit/conical intermediary abutments 56% of the respondents (28 of 50) indicated that they use these intermediary abutments on all the implants, while 13 respondents (26%) stated that they do not use these intermediary abutments and instead connect the prosthesis directly to the implants. A group of 9 respondents (18%) reported using these intermediary abutments on some implants when necessary. See Fig. 15.

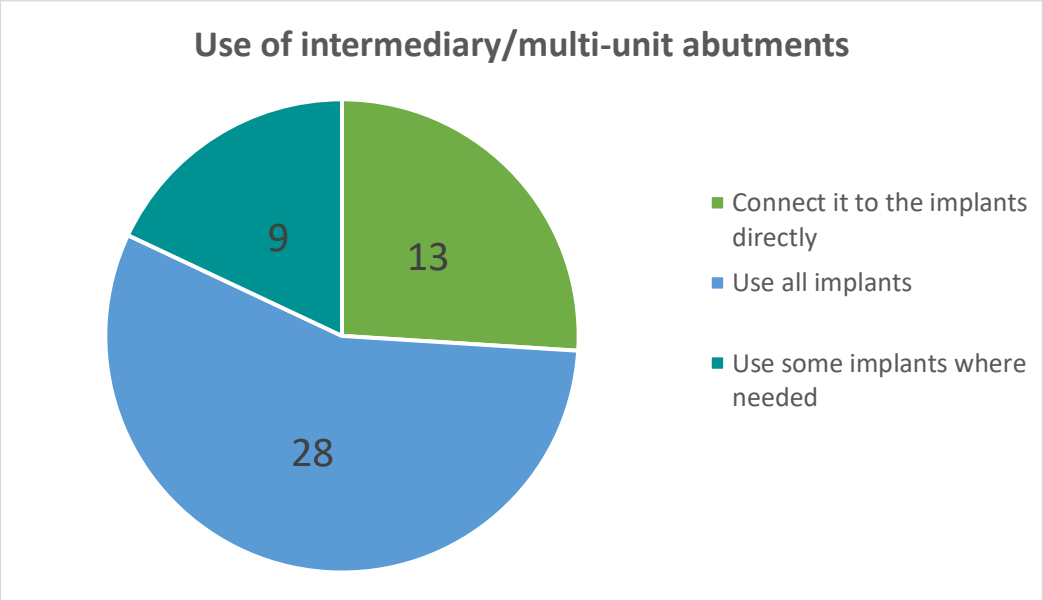

Figure 15: The use of intermediary abutments for the provisional prosthesis

In Table 4E and Fig. 16, the results of the impression technique applied to immediate-loading cases did not clearly divide the respondents. 17 respondents (34%) make use of an open-tray abutment-level impression without rigid splinting of the impression copings. The next most prevalent option selected was that of an open-tray abutment level impression with rigid splinting of the impression copings (13 respondents, 26%), followed by the 11 respondents (22%) that selected the option of an open-tray implant-level impression without rigid splinting of the impression copings.

Table 4E: Implant design, treatment planning and execution and overall protocol preferences.

Respondent prompt		Frequency	Percentage
If immediate loading which of the following best describes your impression?	Open-tray impression with rigidly splinted copings at implant-level	7	14
	Open-tray impression with rigidly splinted copings at abutment-level	13	26
	Open-tray impression without rigidly splinted copings at implant-level	11	22
	Open-tray impression without rigidly splinted copings at abutment-level	17	34
	Closed tray impression	0	0
	Intra-oral pick-up with prosthesis	0	0
	Intra-oral digital scan	2	4
Ideal material for the provisional restoration?	Poured tooth-coloured acrylic resin with reinforcement	7	14
	Poured tooth-coloured acrylic resin without reinforcement	3	6
	Acrylic resin with denture teeth with reinforcement	21	42
	Acrylic resin with denture teeth without reinforcement	5	10
	Milled PMMA with reinforcement	7	14
	Milled PMMA without reinforcement	7	14

The majority of the respondents (42%) preferred an acrylic resin prosthesis with denture teeth and reinforcement for the provisional prosthesis (Fig. 17). Equal numbers of respondents (7 of 50) selected either the option of a poured tooth-coloured acrylic resin with reinforcement (14%), milled PMMA with reinforcement (14%) or milled PMMA without reinforcement (14%).

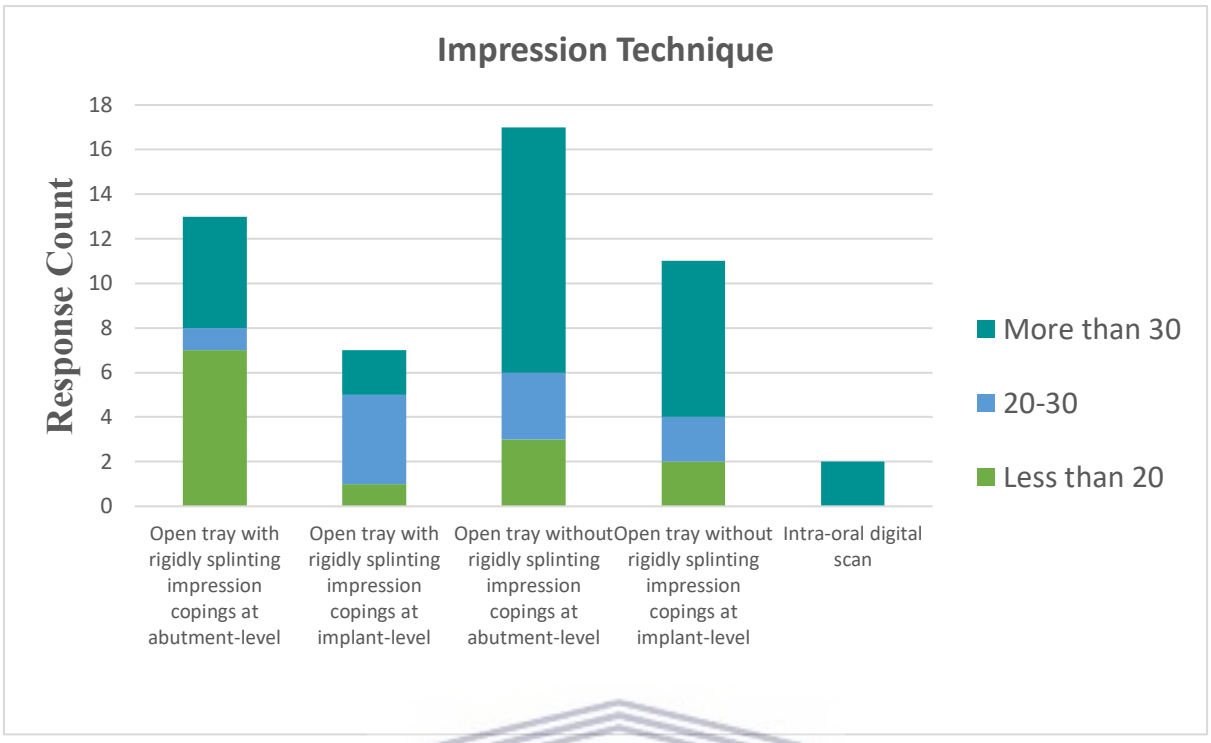

Figure 16: Preferences regarding impression technique for ideal treatment using fixed complete-arch implant-supported prosthesis.

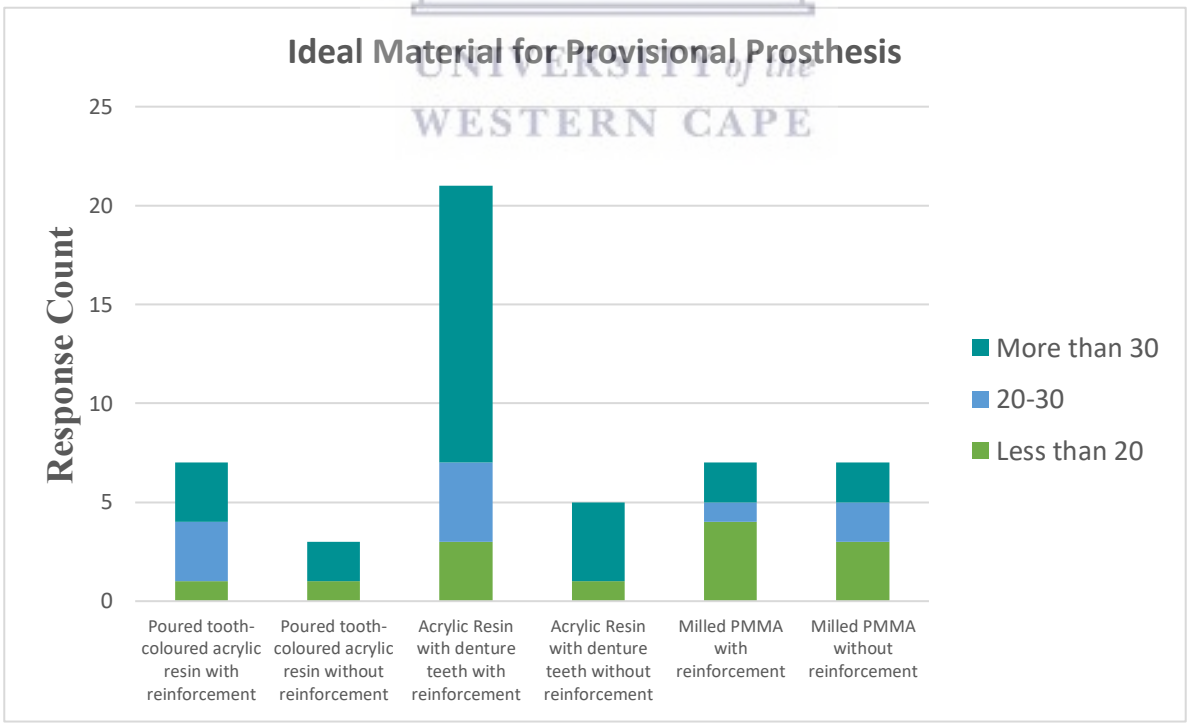

Figure 17: Preferences regarding material for provisional prosthesis for ideal treatment using fixed complete-arch implant-supported prosthesis.

Table 4F: Implant design, treatment planning and execution and overall protocol preferences.

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

There was 100% consensus that the chosen method of retention of the provisional prosthesis should be screw-retained, and not cement-retained or telescopic (See Table 4F).

The majority of respondents (58%) preferred to deliver a fixed, immediately loaded, provisional restoration within 48hrs of the implants being placed, while 16 respondents (32%) preferred to deliver the prosthesis between 48hrs and a week following implant placement. A smaller percentage (10%) stated that they preferred to deliver the provisional prosthesis either immediately after, or at the time of implant surgery.

Preferences for proactive retorquing of abutment screws at a follow-up appointment were mixed (38% never, 38% minority of the cases, 12% majority of the cases, and 12% always).

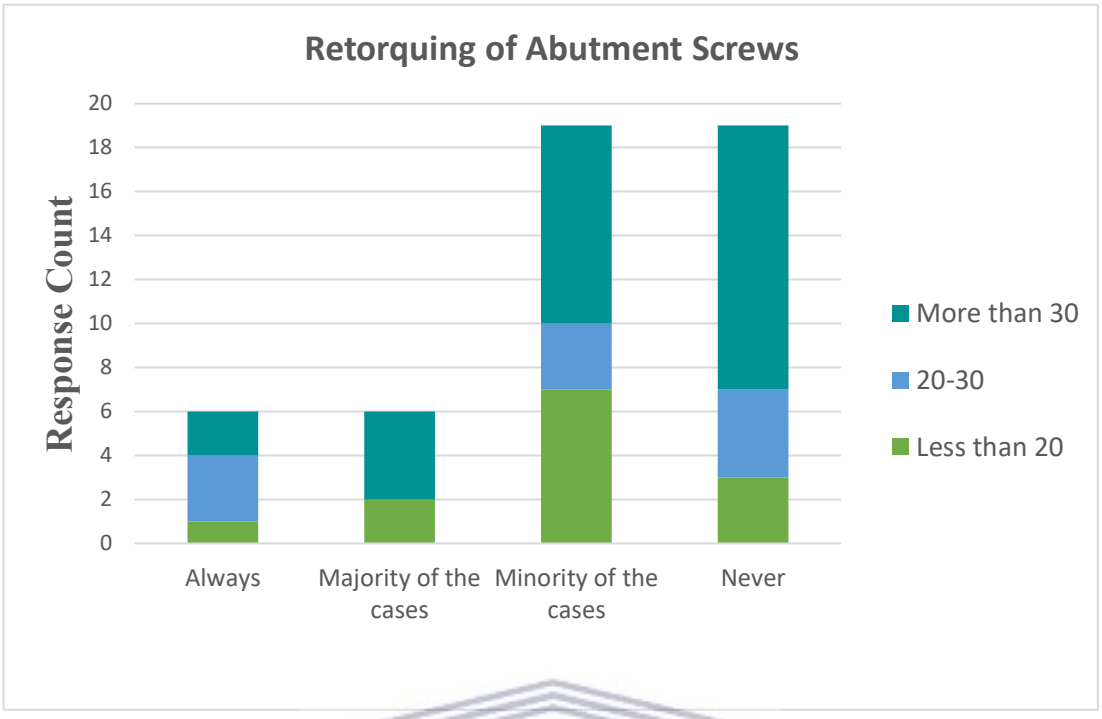

Figure 18: Preferences regarding retorquing of abutment screws for ideal treatment using fixed complete-arch implant-supported prosthesis.

Open-ended questions (descriptive, qualitative)

This section will describe the qualitative analysis of the final two questions in this questionnaire (Question 22 and 23). The respondents were required to select the most applicable option and then further elaborate as to why they selected those options. The aim hereof was to obtain further insight as to the respondents' reasoning behind their choice and to determine the more subjective opinion regarding immediate loading for fixed complete-arch implant-supported prostheses.

Raw data were collected, organized according to the option selected and further assessed. The elaborations given by the participants were then read through multiple times.

Question 22: "In your opinion, what is the biggest advantage of following an immediate-load protocol?"

The participants were required to select one of the following options, and elaborate further:

- "Immediate function possible",
- "Immediate prototyping of aesthetics",
- "Patient satisfaction",
- "Immediate gauge of phonetics",
- "Immediate development of occlusion",
- "Maintenance of vertical dimension",
- "Reduced implant complications"
- "Other".

The two most common options selected were "patient satisfaction" (22 respondents, 44%) and "immediate function possible" (19 respondents, 38%). These were followed by "immediate prototyping of aesthetics" (4 respondents, 8%), "reduced implant complications" (3 respondents, 6%) and "other" (2 respondents, 4%).

Most respondents stated that the biggest advantage of following an immediate-load protocol was patient satisfaction with the treatment. Table 5A, below, illustrates the common themes identified as well as the most relevant quotes provided by the respondents.

Table 5A: Common themes identified for patient satisfaction

Themes identified	Quotes from participants
A: No need to use a removable interim prosthesis	*"To have fixed teeth for a patient is the ultimate goal following removal of teeth.*" (Respondent 62)
	"Avoids the use of loose irritating dentures that may lead to trauma of the tissues and unwanted negative pressure on the implants. Patient is given instant satisfaction and confidence." (Respondent 71)
B: No need to be without teeth	*"Patients happier as they are never without teeth or dentures."* (Respondent 26)
	"Transition from a dentate or partially dentate state to an edentulous state is a major functional and psychological hurdle for most patients. This hurdle is avoided and the transition made acceptable by immediate load protocol." (Respondent 39)
C: Promotes treatment through positive word-of-mouth	*"The high patient acceptance and satisfaction of the immediate load protocol is the most satisfying to the clinician and builds confidence in the patient who will share their positive experience with others."* (Respondent 29)
	"This is a very attractive option to the patients and helps to 'sell the treatment'." (Respondent 65)
D: High expectations/demands of patients	*"Patients demand this."* (Respondent 48)
	"Immediate load protocols are often done after the removal of a failing dentition. Those patients that can afford this treatment modality mostly fall in a high-income group, with high expectations regarding social integration and function." (Respondent 57)

The second biggest advantage selected was that immediate function is possible. Table 5B, below, illustrates the common themes identified as well as the most relevant quotes provided by the respondents.

Table 5B: Common themes identified for immediate function possible

Themes identified	Quotes from participants
A: Reduced chairside time	*"Reduces chairside time and complications."* (Respondent 1)
	"Less number of procedures. Reduced treatment time." (Respondent 28)
B: Patient satisfaction as a result of having a fixed provisional prosthesis	*"Patients have been able to carry on with their daily work/ social activities with minimal disturbance."* (Respondent 8)
	"Pt wants teeth immediately which are fixed" (Respondent 72)
C: Restores function as close to ideal as soon as possible	*"Main objective for rehabilitation is restoration of function and it is made possible with the immediate loading protocol as opposed to waiting for the delayed loading Overall patient function can be achieved sooner."* (Respondent 13)
	"Allows patient to function as close to ideal as possible." (Respondent 20)

8% of the respondents felt that immediate prototyping of aesthetics was the biggest advantage of following an immediate load protocol. Two themes were identified and the relevant quotes are tabulated below in Table 5C.

Table 5C: Common themes identified for immediate prototyping of aesthetics

Themes identified	Quotes from participants
A: Assessing and developing soft tissue emergence	*"To assist in definitive restoration and scalloping soft tissue and training facial muscles."* (Respondent 3)
	"Immediate formation of emergence profile of the soft tissues." (Respondent 4)
B: Aesthetics is the main outcome of rehabilitation	*"Aesthetics forms the basis of rehabilitation for my patients."* (Respondent 7)

The elaborations by the 3 respondents that selected "reduced implant complications" could all be grouped under one common theme, namely "Interim denture is harmful to implants". The relevant quotes included:

"Better osseous response and eliminated the risk of the interim denture affecting the implants, any augmentation and patients' quality of life." (Respondent 16)

"Splinted implants provide a better outcome than if a denture is resting or riding on the implants." (Respondent 67)

Question 23: "In your opinion what is the most important aspect to ensure the success of an immediate-load protocol?"

According to the respondents, the most important aspects to ensure the success of an immediate-load protocol, in descending order of importance, can be seen in Fig. 19 below.

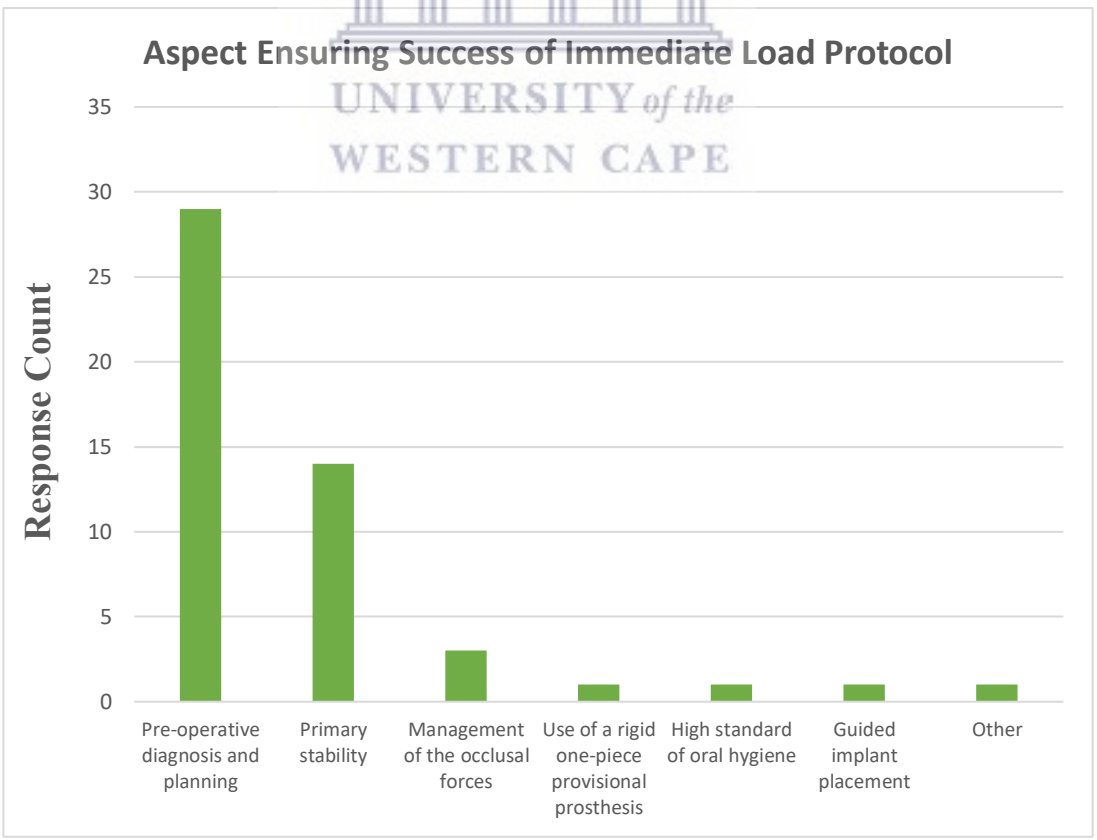

Figure 19: Aspect ensuring success of an immediate-load protocol

A large majority of the respondents (29 respondents, 58%), felt that pre-operative diagnosis and planning was the most important aspect to ensure the success of an immediate loading protocol. Table 6 illustrates the common themes, as well as the relevant quotes from the respondents.

Table 6: Common themes identified for pre-operative diagnosis and planning

Themes identified	Quotes from participants
A: Case selection	*"The basis of the success of an oral rehabilitation hinges on good case selection which is achieved by doing careful diagnoses and case selection."* (Respondent 13)
	"Case selection is very important. Factors that need consideration include prosthetic space, aesthetic and functional needs (incl. speech), parafunctional habits, and oral hygiene/patient compliance." (Respondent 57)
B: Prosthetically-driven planning	*"Prosthetically driven planning is essential in getting a good outcome."* (Respondent 4)
	"A prosthetically driven plan results in a more predictable outcome, which in turn decreases complications and increases the prognosis of the outcome." (Respondent 16)
C: Automatically all relevant aspects are considered	*"Good planning covers most of the important aspects in achieving success."* (Respondent 29)
	"Pre-operative diagnosis and planning impacts on all aspects that pertain to patient factors, implant factors as well as technical factors. Possible complications can predictably be envisaged and managed." (Respondent 43)
D: Team approach	*"Multidisciplinary planning is vital."* (Respondent 1)
E: Planning = Successful outcome	*"Poor planning = poor outcome."* (Respondent 3)
	If the planning is done properly, then everything will fall into place." (Respondent 51)

The second most common option selected was primary stability. 14 respondents (28%) selected this option and the common theme identified was that "Primary stability is non-negotiable". The relevant quotes are noted below:

"Primary stability forms the basis of implant rehabilitation, without it your prosthesis is as good as failed." (Respondent 7)

"Without primary stability, you cannot even consider immediate loading. Initial stability ensures that there's sufficient bone-implant contact that will eventually lead to secondary stability." (Respondent 37)

"No implant stability, then no immediate loading." (Respondent 72)

Three respondents selected the management of occlusal forces as being the most important aspect. The relevant quotes are listed below:

"Patients will need to adapt to functioning on an implant-borne prosthesis. Managing of the occlusal forces will aid in this adaptation." (Respondent 34)

"Heavy occlusal load will lead to osseo-disintegration." (Respondent 55)

One respondent felt that guided implant placement was the most critical aspect and elaborated by saying:

"It is controlled." (Respondent 48)

One respondent selected the use of a rigid one-piece provisional prosthesis as being the most important aspect ensuring success, as they felt that:

"This helps to distribute the occlusal forces post-implant loading." (Respondent 65)

Trends, patterns, associations.

The Fisher's Exact test was utilized to determine associations between different questions answered. The findings are summarized below.

1. There was a statistically significant association (p-value < 0.001) between the number of years that the participant has been registered as a Prosthodontist and the estimated total number of full-arch implant-supported rehabilitations performed.

2. There was a statistically significant association (p-value < 0.001) between the estimated total number of full-arch implant-supported rehabilitations performed and how often the participant would do immediate-loading of fixed complete-arch implant-supported prostheses.

3. There was a statistically significant association (p-value = 0.014) between the number of years that the participants had been registered as Prosthodontists and the diagnostic/planning aids that they make use of when planning an implant rehabilitation of an edentulous jaw.

4. There was not a statistically significant association (p-value = 0.579) between the implant connection type used and whether or not the participant makes use of intermediary abutments on some, all or none of the implants.

5. There was not a statistically significant association (p-value = 0.058) between the number of years that the participant has been registered as a Prosthodontist and the degree of surgical guidance involved in the implant placement.

6. There was not a statistically significant association (p-value = 0.515) between the number of years that the participant has been registered as a Prosthodontist and the impression technique that the participant makes use of.

In summary, the statistically significant associations were between the number of years that the participant has been registered as a Prosthodontist and the estimated total number of full-arch implant-supported rehabilitations performed (p-value < 0.001); the estimated total number of full-arch implant-supported rehabilitations performed and how often the participant would do immediate-loading of fixed complete-arch implant-supported prostheses (p-value < 0.001); and the number of years that the participants had been registered as Prosthodontists and the diagnostic/planning aids that they make use of when planning an implant rehabilitation of an edentulous jaw (p-value = 0.014).

Interestingly, of the 29 participants that stated that they felt "pre-operative diagnosis and planning" was the most critical aspect to ensuring a successful immediate loading protocol, the largest majority made use of a CBCT with a radiographic denture set-up, alone (13 participants, 44.8%) or in combination with an intra-oral scan (9 participants, 30%).

Of the 14 participants that felt that "primary stability" was the most critical aspect, 8 participants (57.14%) stated that the critical insertion torque needs to be between 30-40 Ncm per implant.

Summary of the results

Regarding the quantitative results, some of the questions had clear majority answers; such as diagnostic planning aids used (majority using CBCT), the number of implants in the Maxilla (6), the decision regarding implant type being shared by both the prosthodontist and the surgeon, implant type used (majority using bone-level), insertion torque required (30-40 Ncm), provisional prosthesis material used (denture teeth with reinforced acrylic resin), and ideal retention mechanism (100% answering "screw-retained").

Other results were more evenly spread among the answers available.

Regarding the qualitative results, the most frequent answers (in descending order) given to the question regarding the biggest advantage of immediate loading were "patient satisfaction", "immediate function possible", "immediate prototyping of aesthetics", and "reduced implant complications".

The results of the last question about the most important aspect to ensure the success of the treatment modality showed that a clear majority of respondents felt that the "pre-operative diagnosis and planning" was the most critical, followed by "primary stability".

CHAPTER 5 - DISCUSSION

5.1 Overview

In the previous chapter, both the quantitative and the qualitative results were analysed and presented. These findings were illustrated by means of tables and figures, which often included an association between the specific finding being reported and the experience of the Prosthodontist (determined by the estimated number of completed treatments).

In this chapter, the results will be discussed under the headings: "Findings from the study & significance", "Comparison with other studies", "Limitations" and "Summary".

5.2 Findings from the study & significance

Participants were asked to complete an online survey consisting of both closed and open-ended questions on the REDCap platform.

Eighty-three Prosthodontists met the inclusion criteria and were included in this study. A total of 70 prosthodontists consented to be part of the study and completed the survey, relating to a response rate of 84.34%. The included sample was diverse as it included Prosthodontists in private practice, academics and/or Military/community clinics, as well as a broad range concerning both the years of experience and the number of completed complete-arch implant-supported rehabilitations.

Interestingly, but not surprisingly, the demographics regarding the sex of the participants showed a majority of male Prosthodontists (71.43%). Traditionally, dentistry, in general, has been viewed as a "male career", however, I do believe that if this study were to be repeated in 15-20 years, we would see a more even spread between male and female Prosthodontists.

The results suggest a significant range in implant design chosen, material selection for the provisional prosthesis and planning aids used in the treatment of the edentulous patient with fixed complete-arch implant-supported prostheses even among the group of HPCSA registered Prosthodontists. This ties in with Pera *et al.* (2021) who mentioned that these factors are often chosen based on the clinician's experience and preferences.

Regarding the degree of surgical guidance, 14% of the respondents stated that they prefer freehand implant placement, not making use of any form of a surgical guide. This is in contrast to the available literature which states that implant surgery can be challenging, especially in edentulous jaws, where some form of guidance is helpful (Sun *et al.*, 2015) and that surgical guides significantly improve the accuracy of the osteotomy compared with freehand drilling for both experienced and inexperienced clinicians (Nickenig *et al.*, 2010). It is also worth mentioning that this 14% of respondents fell into the more experienced group, having restored more than 30 cases, therefore they may have grown to trust the expertise of their surgeon over the years, assuring them to proceed with freehand surgical implant placement.

The respondents unanimously agreed that a screw-retained provisional prosthesis should be fabricated where possible. It is assumed that this is due to the ease of retrievability of a screw-retained prosthesis for modification/repair at follow-up visits.

In terms of the material most often used for the fabrication of the provisional prosthesis, 42% of the respondents reported that they prefer acrylic resin with denture teeth and reinforcement. This was not a surprise as according to Holtzclaw (2016), the most commonly reported complication with non-reinforced acrylic provisional prostheses is bulk fracture, with an expected 40% fracture rate during the provisional phase. Several studies have suggested that reinforcement of the provisional restorations with materials such as braided wire (Yamaguchi *et al.* 2014) or various fibers (Li *et al.* 2016) will improve the rigidity of the prosthesis and minimize the fracture rates.

The technique employed for impression taking varied among the respondents, with a total of 40% splinting the impression copings and 56% not splinting the impression copings. There was also no clear preference for implant-level or abutment-level impressions. This is in keeping with the available literature that shows inconclusive evidence with regard to the techniques and materials required for making multi-unit implant impressions (Baig, 2014).

Only 4% of the respondents used the digital workflow and performed an intra-oral scan at the time of impression-taking. This small group's methods may be driven by the advanced equipment in their practices or a dental laboratory that is digitally-driven, and not necessarily by the evidence available. Baig (2014) stated that scientific research is still at a preliminary stage regarding the use of digital impression techniques for the fabrication of multi-unit implant restorations and that there is currently no scientific literature to support digital impressions as being superior in accuracy for complete-arch implant impressions.

When such a broad variety of opinions exists, it is clear that there is a significant lack in the availability of high-quality information, leading the Prosthodontists to formulate their decisions by relying on other methods. As mentioned by Schoenbaum *et al.* (2020), the significant lack of appropriate, long-term, multi-centre trials for comparing the various modalities may partly be responsible for the broad variety of opinions. It may also be due to variations in the experience, expertise and equipment of the Prosthodontists, surgeons and their dental laboratories/technicians (Schoenbaum *et al.*, 2020).

In terms of the qualitative analysis, the fact that "patient satisfaction" was the number one advantage, indicated by 22 of the respondents, is not surprising as we practice in a time where this is deemed crucial. Prosthodontists tend to measure the success of their treatments based on the satisfaction of their patients and rely on positive feedback and word-of-mouth for referrals. This ties in with the study by Jiang *et al.* (2021), which stated that immediate loading protocols reduce the overall treatment time and streamline the procedures to guarantee improvement in the patients' acceptance and satisfaction of the treatment received.

"Pre-operative diagnosis and planning" was considered the most important aspect to ensure the success of an immediate load fixed complete-arch implant-supported prosthesis. This aspect encompasses all the relevant considerations, and since this treatment modality is complex, it requires thorough planning and anticipation of possible complications. As stated by Tözüm *et al.* (2021), the goal of diagnosis and planning is not only to improve the accuracy and predictability of the surgical implant placement but it assists the surgeon and the prosthodontists in evaluating the complexity of the specific case and in assessing the possibility of immediate loading when indicated.

5.3 Comparison with other studies

A similar study by Schoenbaum *et al.* (2020) asked several of the same questions. Only a few comparisons will be mentioned in this section.

Firstly, regarding the response rate achieved, the present study achieved an 84.34% response rate, while that of Schoenbaum *et al.* (2020) only achieved a 36% response rate. When evaluating the ideal number of implants in the Maxilla, both studies reported 6 implants as being the most prevalent answer. Similar results were also noted between the studies regarding the ideal number of implants in the Mandible, with a consistent spread of responses between either 4, 5 or 6 implants.

Bone-level implants were preferred over tissue-level implants, with this study reporting 84% of respondents and Schoenbaum *et al.* (2020) reporting 75% choosing this implant type. There were also similar results regarding the use of intermediary (multi-unit) abutments with the majority (52% in Schoenbaum *et al.* (2020) and 56% in this study) selecting to use these abutments on all of the implants.

In the study by Schoenbaum *et al.* (2020), there was a clear preference (67 %) for rigidly splinting the impression copings, whereas this study reported a lower preference for splinting (40%).

5.4 Limitations

The results of this study should be interpreted with caution. These preferences are exclusive to treatments using fixed complete-arch implant-supported prostheses and should not be generalized to removable prostheses or partially edentulous treatments.

These data do not address patient-specific needs and desires and do not address the fact that each patient has a unique set of clinical conditions that also need to be taken into consideration.
As such, the observations made intend to report on the trends and not to draw clear conclusions on how these treatments should be planned and completed. High-quality research, future innovations and experience will shift these results over time.

The respondent sample size is limited and includes challenges that are possibly due to selection biases. The respondents are limited to a single organization (the HPCSA) from one country (South Africa). The resultant responses provide a narrow view in time and the interpretation and use of this data may decrease in usefulness over time.

5.5 Conflict of interest

None of the authors had any conflicts of interest to disclose.

5.6 Source of funding

All possible expenses were funded by the primary researcher.

5.7. Summary

This chapter covered the discussion of the results, compared them with another study and identified limitations regarding the data collected and the deductions possible. In Chapter 6 conclusions will be drawn and clinical recommendations will be made.

CHAPTER 6 - CONCLUSIONS AND RECOMMENDATIONS

The research hypothesis that more recently qualified Prosthodontists would be more likely to perform an immediate loading protocol, was rejected as it was found that the more experienced Prosthodontists performed immediate loading protocols more often. The second part of the research hypothesis, that the prosthodontists would have set preferences based on both their clinical experience and the available literature (evidence-based), was proven.

The negative impact of edentulism on the patient's quality of life can be avoided by fixed implant-supported rehabilitations, where financial, clinical and patient-specific factors allow. In these cases, following an immediate-loading protocol achieves a speedier restoration of both the oral function and the aesthetics, when compared to the early or conventional loading protocols.

Based on the findings of this survey completed by clinically-practicing Prosthodontists in South Africa, the following conclusions suggested:

1) The majority of the Prosthodontists (82%) utilize CBCT in the implant planning for edentulous cases, with 42% using it in conjunction with a radiographic denture set-up and 34% with both a radiographic denture set-up and an intra-oral scan.

2) The preferred number of implants is 6 in both the Maxilla (76%) and the Mandible (46%).

3) The majority of the Prosthodontists felt that the type of implant used should be decided by both the Prosthodontist and the surgeon (94%).

4) Bone-level implant design was preferred (84%), whereas the preferred connection-type varied – 60% preferred external connection and 40% preferred internal connection.

5) 14% of the Prosthodontists still preferred a freehand implant placement, all of whom fell into the more experienced category having restored more than 30 cases. The remaining 86% preferred to provide the surgeon with some form of surgical guidance.

6) The preferred insertion torque required for immediate loading was between 30-40 Ncm per implant (64% of Prosthodontists).

7) The majority of the Prosthodontists, 56%, make use of intermediary (multi-unit/conical) abutments on all of the implants.

8) There was unanimous consensus that screw-retained prostheses are favoured over cement-retained or telescopic prostheses.

9) The technique for impression taking varied among the Prosthodontists, regarding whether to rigidly splint the impression copings (40%) or not (56%), and whether to take the impression from implant-level (36%) or abutment-level (60%). Not surprisingly, only 4% opted for digital intra-oral scans, which is the technique associated with the least reliable long-term evidence to support its accuracy.

10) 42% of Prosthodontists stated that acrylic resin with denture teeth and reinforcement was the ideal material for the provisional restoration.

11) The two biggest advantages of following an immediate loading protocol are "patient satisfaction" (44% of Prosthodontists) and "immediate function possible" (38% of Prosthodontists).

12) The two most important aspects to ensure the success of an immediate loading protocol are the "pre-operative diagnosis and planning" (58% of Prosthodontists) and "primary stability" at the time of implant insertion (28% of Prosthodontists).

Limitations of study

It is important to note that although these conclusions have been suggested from the results of this study, the small sample size means that these conclusions cannot be generalized to a larger population. However, this study reports on the trends/preferences of the clinical practicing Prosthodontists in South Africa.

Recommendation

In order to provide more reliable and generalizable conclusions, future studies aimed at survey data from larger groups of expert clinicians, spanning broader geographic areas, need to be performed.

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APPENDICES

APPENDIX 1:
Questionnaire

Consent and project information

Please complete the survey below.

Thank you!

I hereby confirm that I have been informed by the researcher, Jennifer Julyan, about the nature, conduct, benefits and risks of the proposed research. I have also received, read and understood the above written information (informed consent) regarding the study.

- ◯ Yes
- ◯ No

I am aware that the results of the study, including personal details regarding sex, age and research results of myself will be anonymously processed into the research report. (See in particular the definition of "personal information" in the Promotion of Access to Information Act 2 of 2000.)

I may, at any stage, without prejudice, withdraw my consent and participation in the study. I have had sufficient opportunity to ask questions and declare myself prepared to participate in the study.

Basic Demography Form

Please complete the survey below.

Thank you!

2) Gender
- ◯ Male
- ◯ Female

3) What is your current primary career?
- ◯ Private practice only
- ◯ Academics only
- ◯ Private practice and academics
- ◯ Public health/community clinic/military
- ◯ Retired

4) For how many years have you been registered as a Prosthodontist?
- ◯ Less than 5y
- ◯ 5-10y
- ◯ 10-20y
- ◯ 20-30y
- ◯ 30-40y
- ◯ 40+y

5) Which province do you practice in?
- ◯ Eastern Cape
- ◯ Free State
- ◯ Gauteng
- ◯ Kwazulu-Natal
- ◯ Limpopo
- ◯ Mpumalanga
- ◯ Northern Cape
- ◯ North West
- ◯ Western Cape

6) Do you provide fixed complete-arch implant-supported prosthetic treatment to your patients?
- ◯ Yes
- ◯ No

Immediate loading of fixed full-arch prostheses

Please complete the survey below.

Thank you!

6. What is the total estimated number of arches of fixed complete-arch implant-supported prostheses you have completed?	◯ Less than 20 ◯ 20-30 ◯ More than 30
7. How often do you do immediate-loading of fixed complete-arch implant-supported prostheses?	◯ Always ◯ Majority of the cases ◯ Minority of the cases ◯ Never
8. Which diagnostic/planning aids do you make use of when planning for implant rehabilitation of an edentulous jaw?	◯ Panoramic radiograph only ◯ Panoramic radiograph with a radiographic denture set-up in situ ◯ CBCT only ◯ CBCT with a radiographic denture set-up in situ ◯ CBCT with a radiographic denture set-up in situ and intra-oral scan
9. 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 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 8+
10. 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 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 8+
11. Who makes the decision regarding implant used?	◯ Prosthodontist only ◯ Surgeon only ◯ Prosthodontist and Surgeon in combination
12. Which implant type do you use for an immediate-load fixed complete-arch implant-supported prosthesis?	◯ Bone-level design ◯ Tissue-level design
13. Which connection type do you use for an immediate-load fixed complete-arch implant-supported prosthesis?	◯ External connection ◯ Internal connection
14. How do you have the surgeon place the implant for the majority of your cases?	◯ Fully-guided with printed/milled surgical template ◯ Pilot-hole guided with printed/milled surgical guide ◯ Analogue guide or duplicate denture ◯ Freehand

15. In order to predictably immediate-load, which of the following is most critical regarding insertion torque:

- ◯ 15-20 Ncm per implant
- ◯ 20-30 Ncm per implant
- ◯ 30-40 Ncm per implant
- ◯ Cumulative insertion torque of >120Ncm over all implants

16. For the provisional fixed prosthesis, do you mostly?

- ◯ Use intermediary abutments (multi-unit/conical abutments) on all implants
- ◯ Use intermediary abutments (multi-unit/conical abutments) on some implants where needed
- ◯ Connect it to the implants directly

17. If immediate loading which of the following best describes your impression?

- ◯ Open-tray impression with rigidly splinted copings at implant-level
- ◯ Open-tray impression with rigidly splinted copings at abutment-level
- ◯ Open-tray without rigidly splinted copings at implant-level
- ◯ Open-tray without rigidly splinted copings at abutment-level
- ◯ Closed tray impression
- ◯ Intra-oral pick-up with prosthesis
- ◯ Intra-oral digital scan

18. Ideal material for the provisional restoration?

- ◯ Poured tooth-coloured acrylic resin with reinforcement
- ◯ Poured tooth-coloured acrylic resin without reinforcement
- ◯ Acrylic resin with denture teeth with reinforcement
- ◯ Acrylic resin with denture teeth without reinforcement
- ◯ Milled PMMA with reinforcement
- ◯ Milled PMMA without reinforcement

19. Which method of retention do you favour?

- ◯ Screw-retained
- ◯ Cement-retained
- ◯ Teloscopic
- ◯ Other

20. What is your preferred time to deliver the immediate-load fixed implant-supported provisional restoration?

- ◯ Immediately after (or at time of) the surgery
- ◯ Within 48hr
- ◯ Between 48hr and a week after implant placement

21. After delivery of the provisional full-arch prosthesis, do you proactively retorque the abutment screws at a follow-up visit?

- ◯ Always
- ◯ Majority of the cases
- ◯ Minority of the cases
- ◯ Never

22. In your opinion what is the biggest advantage of following an immediate-load protocol?

- ◯ Immediate function possible
- ◯ Immediate prototyping of aesthetics
- ◯ Patient satisfaction
- ◯ Immediate gauge of phonetics
- ◯ Immediate development of occlusion
- ◯ Maintenance of vertical dimension
- ◯ Reduced implant complications
- ◯ Other

22a Please elaborate

_____

22 b Please elaborate

22 b Please elaborate

22 d Please elaborate

22 e Please elaborate

22 f Please elaborate

22 g Please elaborate

22 h Please elaborate

23. In your opinion what is the most important aspect to ensure the success of an immediate-load protocol?

- ◯ Pre-operative diagnosis and planning
- ◯ Implant choice
- ◯ Number of implants
- ◯ Guided implant placement
- ◯ Primary stability
- ◯ Choice of impression technique
- ◯ Use of a rigid one-piece provisional prosthesis
- ◯ Material used for the provisional prosthesis
- ◯ Management of the occlusal forces
- ◯ High standard of oral hygiene
- ◯ A compliant patient
- ◯ Other

23 a Please elaborate

23 b Please elaborate

23 c Please elaborate

23 d Please elaborate

23 e Please elaborate

23 f Please elaborate

23 g Please elaborate

23 h Please elaborate

23 i Please elaborate

23 j Please elaborate

23 k Please elaborate

23 k Please elaborate

APPENDIX 2:

HPCSA documentation requesting particulars of the registered Prosthodontists

FORM A

REQUEST FOR ACCESS TO RECORD OF PUBLIC BODY
(Section 14 (1) of the Promotion of Access to Information Act, 2000 (Act No. 2 of 2000)

[Regulation 6]

A. Particulars of Public Body

Health Professions Council of South Africa (HPCSA)

B. Particulars of person requesting access to the record

(a)	The particulars of the person who requests access to the record must be given below.
(b)	The address and/or fax number in the Republic to which the information is to be sent must be given.
(c)	Proof of the capacity in which the request is made, if applicable, must be attached.

Full names and surname: Jennifer Julyan
Identity number: 8909250119082
Postal address: PO Box 1591, Durbanville, Cape Town, 7551
Fax number:
Telephone number: 0824469410 E-mail address: drjenniferjulyan@gmail.com
Capacity in which request is made, when made on behalf of another person: N/A

C. Particulars of person on whose behalf request is made

This section must be completed *ONLY if* a request *for information is* made on behalf of *another* person.

Full names and surname: N/A
Identity number: N/A

D. Particulars of record

(a)	Provide full particulars of the record to which access is requested, including the reference number if that is known to you, to enable the record to be located.
(b)	If the provided space is inadequate, please continue on a separate folio and attach it to this form. The requester must sign all the additional folios.

1 Description of record or relevant part of the record: Contact details of registered Prosthodontists in South Africa

2 Reference number, if available: Not available

3 Any further particulars of record:

1. Number of registered Prosthodontists in South Africa, the Western Cape and Cape Town.
2. Email addresses of the registered Prosthodontists in South Africa.

E. Fees

(a)	A request for access to a record, other *than* a record containing personal information about yourself, will be processed only after a request fee has been paid.
(b)	You will be *notified of* the amount required to be paid as the request fee.
(c)	The fee payable for access to a record depends *on* the form *in which* access is required and the reasonable time *required* to search for and prepare a record.
(d)	If you qualify for exemption *of* the payment *of* any fee, please state the reason for exemption.

Reason for exemption from payment of fees:

F. Form of access to record

If you are prevented by a disability to read, view or listen to the record in the form of access provided for in 1 to 4 hereunder, state your disability and indicate in which form the record is required.

Disability: No disability Form in which record is required:	Form in which record is required
Mark the appropriate box with an X. NOTES: (a) Compliance with your request in the specified form may depend on the form in which the record is available. (b) Access in the form requested may be refused in certain circumstances. In such a case you will be informed if access will be granted in another form. (c) The fee payable for access for the record, if any, will be determined partly by the form in which access is requested.	

1. If the record is in written or printed form:					
	copy of record*		inspection of record		
2. If record consists of visual images this includes photographs, slides, video recordings, computer-generated images, sketches, etc)					
	view the images		copy of the images"		transcription of the images*
3. If record consists of recorded words or information which can be reproduced in sound:					
	listen to the soundtrack audio cassette		transcription of soundtrack* written or printed document		
4. If record is held on computer or in an electronic or machine-readable form:					
	printed copy of record*		printed copy of information derived from the record"	X	copy in computer readable form* (stiffy or compact disc)

'If you requested a copy or transcription of a record (above), do you wish the copy or transcription to be posted to you? Postage is payable.	YES	NO X

G Particulars of right to be exercised or protected

If the provided space is inadequate, please continue on a separate folio and attach it to this form. The requester must sign all the additional folios.

1. Indicate which right is to be exercised or protected:

2. Explain why the record requested is required for the exercise or protection of the aforementioned right:

H. Notice of decision regarding request for access

You will be notified in writing whether your request has been approved/denied. If you wish to be informed in another manner, please specify the manner and provide the necessary particulars to enable compliance with your request.

How would you prefer to be informed of the decision regarding your request for access to the record?

I would prefer to be emailed on drjenniferjulyan@gmail.com please.

Signed at Tygerberg, Cape Town This 6th day of May, 2021 20

SIGNATURE OF REQUESTER / PERSON ON WHOSE BEHALF REQUEST IS MADE

553 Madiba Street
Arcadia
Pretoria

PO Box 205
0001 PRETORIA

Tel: +27 (12) 338 9476
Fax: +27 (12) 338 9476
Email: SadickaB@hpcsa.co.za
Website: www.hpcsa.co.za

PERMISSION TO CONDUCT RESEARCH AT HEALTH PROFESSIONS COUNCIL OF SOUTH AFRICA

PRINCIPAL RESEARCHER

FULL NAME Jennifer Julyan

DESIGNATION Registrar in Prosthodontics

CONTACT NUMBER 0824469410 E-MAIL ADDRESS drjenniferjulyan@gmail.com

DEPARTMENT Department of Restorative Dentistry, Dental Faculty, University of the Western Cape.

HEAD/S OF DEPARTMENT/S Dr Carol-Ann Cloete

TITLE OF RESEARCH Current prevalence and preferences for immediate loading of fixed complete-arch implant-supported prostheses: A survey among South African Prosthodontists.

OBJECTIVES OF RESEARCH

To determine the socio-demographic factors, such as age, gender and years of experience, of the registered Prosthodontists in South Africa; the prevalence of immediate loading of complete-arch implant-supported prostheses among South African Prosthodontists; and the preferences of South African Prosthodontists when approaching an immediate loading case, with reference to implant-, abutment-, and material-choice.

STUDY SITE/S Dental Faculty, University of the Western Cape

BRIEF OUTLINE OF METHODOLOGY Online questionnaire containing both closed and open-ended questions will be sent to the registered Prosthodontists. The online questionnaire platform "REDCap" will be used for data collection and the data will then be imported into Stata version 16.0 for data anaylsis.

EXPECTED START DATE 17/5/2021		**EXPECTED DURATION** 2 calendar months	
ETHICS CLEARANCE	YES X	NO	PENDING
CONFLICTS OF INTEREST	YES	NO X	DETAILS:
COSTS TO HOSPITAL AND/OR OTHERS	YES	NO X	
SOURCE OF FUNDING Primary researcher will fund study			
SIGNATURE OF RESEARCHER & DATE			
PERMISSION GRANTED	YES	NO	
SIGNATURE (REGISTRAR /CEO)	**NAME IN PRINT & DESIGNATION**		**OFFICIAL STAMP & DATE**

UNIVERSITY of the WESTERN CAPE

60 YEARS of hope, action & knowledge

Data Supply Request

1) Full contact and invoicing details:

Name: Dr Jennifer Julyan (DP0104361)

Contact number: 0824469410

Email address: drjenniferjulyan@gmail.com

Postal address: PO Box 1591

Durbanville

Cape town

7551

2) Register/Category List of Students or Professionals for which the information is required

Names and postal addresses of registered Prosthodontists.

3) The Geographical area/s or Postal Code range/s to be included in the Dataset

Whole country (South Africa).

4) Details concerning any other criteria required (eg: Age, Registration Year, Category etc)

None.

5) The purpose for which the information is to be utilized

Research purposes. I need this information for my mini-thesis as part of my MChD (Prosthodontics) degree.

6) Preferred Format in which the Data is required:

MS Excel Workbook

Signed on 12th May 2021

Health Professions Council of South Africa

553 Vermeulen Street
Arcadia, Pretoria

PO Box 205
Pretoria, 0001

Email: yvetted@hpcsa.co.za
Website: www.hpcsa.co.za

Electronically Transmitted Document

DEPT: INFORMATION TECHNOLOGY
HELPDESK & STATISTICS: MRS Y DAFFUE

QUOTATION

Att: Dr Jennifer Julyan

For: Research
Prosthodontic Registrar
University of the Western Cape

eMail: drjenniferjulyan@gmail.com

Date	Quote No
2021/05/13	DQ 2021-002

VAT Reg No 4550104923

NB: Please DO NOT pay on Quotation. An Invoice will be issued on receipt of the Signed Quotation Acceptance

Data Description	Format	No of Records	Price (ea)	Amount	VAT (15 %)	Total
Postal Addresses MP Specialists Prosthedontics	Excel File	91	0.45	R 40.95	R 6.14	R 47.09

Quotation Accepted in accordance with the Conditions of Purchase

Signed : _____ **Date :** _13_/05__/2021__

Name : _Jennifer Julyan__

Payment Terms

No Cash Payments accepted
Strictly with Order or Collection
EFT & Credit Card Payments Accepted

Conditions of Purchase:

1. The requested Data may contain privileged or confidential information and may accordingly only be used for the purpose as declared in the Data Request.
2. No part of the requested information may be reproduced/transmitted/redistributed in any form or by any electronic/mechanical means, including photocopying/telefaxing/recording/any storage or retrieval system, without written permission from the HPCSA.
3. Courier Service/Postage costs for Printed Formats to be for the Purchaser's account. The Purchaser is responsible for Courier Service arrangements.
4. All Quotations are valid for 28 Days from Quotation Date only.

E&OE

HPCSA
Health Professions Council of South Africa

553 Vermeulen Street
Arcadia, Pretoria

PO Box 205
Pretoria, 0001

Tel No: +27 (12) 338 9300
Email: yvetted@hpcsa.co.za
Website: www.hpcsa.co.za

Electronically Transmitted Document

DEPT: INFORMATION TECHNOLOGY
STATISTICS & DATA ANALYSIS: MRS Y DAFFUE

TAX INVOICE

Att: Dr Jennifer Julyan

For: Research
Prosthodontic Registrar
University of the Western Cape

eMail: drjenniferjulyan@gmail.com

Date	Invoice No
2021/05/20	INV 21/001

VAT Reg No 4550104923

NB: The Data will be released on receipt of Proof of Payment & signed Order Confirmation.

Data Description	No of Records	Price (ea)	Amount	VAT (15%)	Total
Postal Addresses DP Specialists Prosthedontics	91	0.45	R 40.95	R 6.14	R 47.09
			R 40.95	R 6.14	R 47.09

Order Confirmed in accordance with the Conditions of Purchase

Signed : _ _ **Date :** _21_/_5_/20_21_

Name : _Jennifer Julyan_

Format: MS Excel File

Payment Details

Electronic Payments

Bank: ABSA Branch: Arcadia
Branch Code: 334945 Account No: 0610000169

Swift Code: ABSA ZAJJ (International Payments)

Credit Card Payments

Processed On Site at Cashiers Office ONLY

Payment Terms

No Cash Payments accepted
Payment strictly with Order or Collection
EFT & Credit Card Payments Accepted

Kindly Forward Copy of Deposit Slip or Proof of EFT Payment to: Mrs Y Daffue
eMail: YvetteD@hpcsa.co.za

Conditions of Purchase:

1. The requested Data may contain privileged or confidential information, and may accordingly only be used for the purpose as declared in the request therefor.
2. No part of the requested information may be reproduced/transmitted/redistributed in any form or by any electronic/mechanical means, including photocopying/telefaxing/recording/any storage or retrieval system, without written permission from the HPCSA.
3. Courier Service/Postage costs to be for the Purchaser's account.
   The Purchaser is responsible for Courier Service arrangements.
4. All Invoices are valid for 28 Days from Invoice Date only.

For Internal Office Use:

Payment Date: _____ **Cashier:** _____

Receipt No: _____ **Amount:** _____

Collected / Delivered By

Name: _____

Signature: _____

Date: _____

E&OE

APPENDIX 3:
BMREC Approval letter

UNIVERSITY of the WESTERN CAPE

60 YEARS of hope, action & knowledge

11 May 2021

Dr J Julyan
Restorative Dentistry
Faculty of Dentistry

Ethics Reference Number: BM21/03/08

Project Title: Current prevalence and preferences for immediate loading of fixed completearch implant-supported prostheses: A survey among South African Prosthodontists.

Approval Period: 07 May 2021 – 07 May 2024

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report annually by 30 November for the duration of the project.

Permission to conduct the study must be submitted to BMREC for record-keeping.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

NHREC Registration Number: BMREC-130416-050

APPENDIX 4:

Patient information sheet and informed consent clause

UNIVERSITY of the WESTERN CAPE

60 YEARS of hope, action & knowledge

PARTICIPANT INFORMATION LEAFLET AND INFORMED CONSENT

Dear Participant…

Title of project:

Current prevalence and preferences for immediate loading of fixed complete-arch implant-supported prostheses: A survey among South African Prosthodontists.

Introduction:

You are invited to voluntarily participate in this research study. This information leaflet aims to assist your decision to participate. Before you agree to take part in this study you should fully understand what is involved. If you have any questions, which are not fully explained in this leaflet, do not hesitate to ask the researcher directly. You should not agree to take part unless you are completely satisfied with all the procedures involved.

What is the purpose of the study?

To determine the current prevalence and preferences of the immediate loading protocols of implants with a complete-arch prosthesis utilized amongst South African Prosthodontists.

How will the study be conducted?

The invitation to participate in the study includes a link to an online questionnaire which you can complete at a convenient time.

What is the duration of the study?

The link will only be valid for 2 months from date sent.

Has the study received ethical approval?

This research protocol was submitted to the Biomedical Research Ethics Committee (BMREC) at the University of the Western Cape, for registration as an approved research project. Ethical approval was obtained for the period 07 May 2021 – 07 May 2024. Reference number: BM21/03/08.

The study has been structured in accordance with ethical considerations such as the protection of the identity of all participants.

What are my rights as a research participant in this study?

Your participation in this research is entirely voluntary and you can refuse to participate or stop at any time without stating any reason. The investigator retains the right to withdraw you from the study if considered to be in your best interest.

What are the benefits involved in the study?

I believe that by participating in this study, you will contribute to the overall body of knowledge and ensure that a broad scope of Prosthodontists' prevalence and preferences are included in the results.

Are there any restrictions concerning my participation in this study?

Only HPCSA registered Prosthodontists are permitted to participate in this study.

Insurance and financial arrangements:

Participants will not receive any compensation for participating in the study.

Source of additional information:

The study will be conducted by Dr Jennifer Julyan. Should you have any questions, please do not hesitate to contact me. My contact telephone number is 082 446 9410 and email address is drjenniferjulyan@gmail.com.

Confidentiality

All information obtained during the course of this research is strictly confidential. Data that may be reported in law or scientific journals will not include any information which identifies you as a participant in this study. Data/information will be published anonymously. No information will be disclosed to any third party without your written permission.

UNIVERSITY of the WESTERN CAPE

60 YEARS of hope, action & knowledge

INFORMED CONSENT CLAUSE

I hereby confirm that I have been informed by the researcher, Jennifer Julyan, about the nature, conduct, benefits and risks of the proposed research. I have also received, read and understood the above written information (informed consent) regarding the study.

I am aware that the results of the study, including personal details regarding sex, age and research results of myself will be anonymously processed into the research report. (See in particular the definition of "personal information" in the Promotion of Access to Information Act 2 of 2000.)

I may, at any stage, without prejudice, withdraw my consent and participation in the

study. I have had sufficient opportunity to ask questions and declare myself prepared to participate in the study.

Participant's name: _____ Participant's signature: _____

I, _____ herewith confirm that the above participant has been informed fully about the nature and scope of the above study.

Investigator's name: _____ Investigator's signature: _____

Witness's name: _____ Witness's signature: _____

Date: _____

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