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Patients experiences with tooth loss and replacement with single-tooth implants – a qualitative study

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Abstract

Background and objectives: Qualitative research allows us to investigate the "how" and "why" of people's experiences. This study explored the experiences of patients who underwent tooth loss and received single-tooth implants.

Methods: A purposive sample (N=10) of participants who were previously treated at the University of Otago (Faculty of Dentistry) for implant therapy was recruited. Participants were interviewed and the interviews transcribed. Data were analysed through reflexive thematic analysis using NVivo 14 software.

Results: Key themes in the data were: stages of grief; knowledge; the decision; and expectation versus reality. Under the theme stages of grief, participants described their emotions when undergoing tooth loss, and their expressed emotions echoed the stages of grief. Under the theme knowledge, participants expressed their understanding of dental implants, and their understanding was sometimes incorrect. Under the theme decision, participants revealed their thought processes when choosing whether to proceed with dental implants. The theme expectation versus reality was used where participants expressed expectations of their actual experiences with implant therapy differed from their lived reality or clinical expectations.

Conclusions: Patients experience a grief process with tooth loss, and this process may differ between different people. Results highlight the importance of careful and effective practitioner-patient communication about tooth loss and implants, alongside the need for practitioners to understand the participants' lived experiences and their expectations, and how these might differ from clinical expectations. The findings have implications for patient management, particularly communication.

Introduction

Tooth loss is often attributed to disease-related reasons such as periodontal disease and dental caries (Broadbent *et al.* 2006; Haworth *et al.*, 2018; Ong, 1998). Other prevalent reasons for tooth loss include trauma (Caldas, 2000), orthodontic or pre-prosthetic treatment (Ali, 2021; Broadbent *et al.*, 2006; Dardengo *et al.*, 2016), and other socio-cultural reasons such as socially accepted and/or encouraged edentulism (Sussex *et al.*, 2010). In New Zealand (NZ), the 2009 Oral Health Survey reported that 61.8% of the NZ population had lost one or more teeth, with an average of 4.5 teeth missing per person due to dental issues such as decay or periodontal disease (Ministry of Health, 2010). Though the prevalence is likely to be overestimated due to the inclusion of third molars and assumptions regarding lost dentition in certain age groups, it may be clinically significant as it means up to three out of five patients seen in the dental office may require tooth replacement at some point in their life.

When indicated, tooth replacement options include implant-supported fixed dental prostheses, tooth-supported fixed dental prostheses, and removable partial dentures. Dental implants have been increasingly used to manage missing teeth (Gupta *et al.*, 2023). They act as artificial tooth roots that are placed into the jaw to hold a prosthetic tooth or bridge (American Academy of Periodontology, 2024). Typically composed of materials like titanium or titanium alloys, the biocompatible nature of these materials allows for the integration of bone and the implant through the process of osseointegration (Abraham, 2014; Gaviria *et al.*, 2014; Hoque *et al.*, 2022).

The prevalence of modern dental implants has been increasing since their development and presentation by Professor Per-Ingvar Brånemark in 1978 (Abraham, 2014). The National Health and Nutrition Surveys in the United States (U.S.) report that between 1999 and 2016 there was a significant increase in dental implant prevalence, rising from 5.7% to 17%, and projections suggesting potential growth to 23% by 2026 (Elani *et al.*, 2018). In the NZ context, there has also been an increase in the number of dentists providing implant services. The percentage of NZ dentists providing implant services rose from 49.4% in 2004 to 68.0% in 2014 (Murray *et al.*, 2016), which may indicate an increase in demand for such treatment.

Dental implants are considered the gold standard for tooth replacement (Pjetursson *et al.*, 2014; Tomasi *et al.*, 2008). A systematic review of eighteen studies published in 2019 shows dental implants have an estimated 96.4% survival rate at the implant level at 10 years (Howe *et al.*, 2019).

While the clinical success of dental implant therapy has been thoroughly investigated from a quantitative perspective (Busenlechner *et al.*, 2014; Derks and Tomasi, 2015; Howe *et al.*, 2019; Tomasi *et al.*, 2008), there remains a scarcity of qualitative research in the field exploring the "how" and "why" of people's experiences (Cleland, 2017). Qualitative research into implantology prior to 2014 tended to focus on the immediate periods before and after

treatment rather than the treatment itself (Kashbour *et al.*, 2015), and a recent critical review of dental implant-related qualitative research from 2006 to 2020 acknowledged the lack of research regarding patients' and dentists' views on the procedural and managerial aspects of dental implants (Jayachandran *et al.*, 2021). Further, there is little research investigating the qualitative aspects of single-tooth implant therapy (Atieh *et al.*, 2016; Afrashtehfar *et al.*, 2021).

The aim of this study was to answer the question, "what are the experiences of patients who have had tooth loss and replacement with single-tooth implants?"

The study objectives are

1. To understand patients' experiences with tooth loss and how they value their teeth.
2. To understand patients' perceptions and experiences with single-tooth implant therapy.
3. To provide knowledge that can inform the treatment of patients experiencing tooth loss and undergoing implant therapy.

Methods

This study utilised a qualitative design to understand the beliefs, perceptions, and lived experiences of patients who have experienced tooth loss and have undergone tooth replacement with single-tooth implants.

The study was conducted in Dunedin and Auckland NZ at the University of Otago Faculty of Dentistry (henceforth Dental School). Interviews were conducted either in-person in a non-clinical setting at the Dental School, or online over a video conferencing platform such as Zoom®.

Participants were recruited from individuals previously treated at the Dental School for exodontia and/or implant therapy. Eligible participants were identified from patient records (Jan 2018 to Dec 2023 inclusive). Participants from various age groups, ethnicities, and genders were identified for recruitment, aiming to ensure adequate representation of experiences. Dental records were reviewed to recruit a diverse range of participants who had experienced complications during their dental implant therapy. We sought patients who had experienced complications in order to gain an understanding of why and where things go wrong during implant therapy from the patient's perspective Potential participants were initially contacted via email. An information sheet and consent form were provided in person to those attending a physical appointment or sent via email for a video conferencing interview, and all participants provided consent. A $50 grocery voucher was offered to each participant to thank them for their participation.

The inclusion and exclusion criteria for participation were based on several factors including sex, age, capacity to consent, period the implant therapy was received, overall health status, and having a fully restored implant. Detailed criteria are provided in Tables 3 and 4.

A total of 10 patients were purposively selected from those who agreed to participate. The number of participants was in line with previous qualitative studies on dental implantology (Atieh *et al.*, 2016; Grey *et al.*, 2013; Lantto and Wårdh, 2013; Nogueira *et al.*, 2019; Osman *et al.*, 2014). Participants were recruited until data saturation was achieved; meaning sufficient data were collected to provide a 'complete and truthful picture' (Braun and Clarke, 2013) and no new information was being gained from interviews (Morse, 1995; Sandelowski, 1995).

This research was based on a social constructionist lens that recognises that meaning is created through interactions and language (Braun and Clarke 2021), hence the choice of in-person guided interviews. An in-depth, semi-structured, one-to-one open-ended interview style was used (Table 2). Interviews were conducted from May to July 2024 at the Dental School in a meeting room or over Zoom®. Interviews were audio-recorded with the participants' permission and transcribed by the research team. Questions were piloted before the interviews. The range of questions was guided by Oral Health-Related Quality of Life (OHRQoL) items (Figure 1) and encompassed questions around the experiences with tooth loss, complications, expectations before and after, and improvements experienced from implant therapy. Thus, the line of questioning encompassed participants' subjective assessments of their oral health, functional wellness, emotional wellness, treatment satisfaction, and self-perception (Sischo and Broder, 2011) and sought to gain a rich understanding of their lived experiences.

The interview audio recordings were transcribed verbatim, and each participant was invited to review their transcript and make alterations as required. The transcripts were analysed using reflexive thematic analysis (Braun and Clarke, 2021). First, transcripts were read to gain familiarity with the data, then through multiple reflexive readings, the participants' views were organised into categories of similar responses with the assistance of *NVivo14*® qualitative analysis software. Through these multiple readings and interactions with the data and the categories they were organised into, alongside discussion within the research team, the categories were then arranged into a smaller group of themes. Each theme was given a label, for example "grief", and quotes that exemplified each theme were ascribed.

This study was conducted in full conformance with the principles of the "*Declaration of Helsinki*", Good Clinical Practice (GCP), and within the laws and regulations of NZ. Funding for this study was generously provided by the NZ Dental Research Foundation. Māori consultation was undertaken, and ethical approval

1. Social/Emotional:
   Feelings (Anxious, Attractive, Unhappy)
2. Environment:
   School, Job
3. Oral Health:
   Pain, Bleeding gums, spaces between teeth
4. Function:
   Chewing, Talking
5. Treatment expectations

Figure 1. OHRQoL Items (Sischo and Broder 2011)

Table 1. Participant demographics

Variable	Characteristic	N	%
Gender	Male	2	20
	Female	8	80
	Gender diverse	0	0
	Prefer not to say	0	0
Age	18-25	0	0
	25-35	2	20
	35-45	0	0
	45-55	1	10
	55-65	3	30
	65-75	4	40
	75+	0	0
Ethnicity (Select all that apply)	European	9	81.8
	Pacific	0	0
	Māori	1	9.1
	Asian	0	0
	Other (Please specify)	1	9.1
Implant position (if participants mentioned during interviews. some participants had >1 implant)	Anterior	5	45.5
	Posterior	3	27.3
	Unknown	3	27.3

Table 2. Semi-structured interview guide

	Questions	Prompts
Opening	Thinking about when your experience started, what were the things you noticed that led you to go to the dentist?	
Experience and perception of tooth loss	– Tell me about how you felt when you knew you were going to lose the tooth? – What was the experience of losing your tooth like? – In what ways are your teeth important to you? – How would you feel about losing all your teeth and replacing them with dentures?	– What did you think about when you were told that? – Were there any problems you encountered? (during healing, having a missing tooth)
Experience and perception of dental implants	– Tell me what you thought implants were? – What did it turn out to be? – Could you tell me about any complications you experienced, how did you resolve them? – In what ways did having an implant affect you?	Was there anything that concerned or surprised you? Environmentally (school/job), Oral Health (Pain, bleeding, spaces btw teeth), Function (Chewing, Talking, Food enjoyment), Ease of cleaning, Aesthetics
Thoughts post-implant surgery	– What were your expectations of implant therapy? – Were there any parts of your experience have been improved? – In what ways has taking care of your teeth changed compared to before you had the implant placed? – Does it motivate you to take care of your teeth better? (adherence to care, attending appts) – How do you feel about getting implants again?	Did the implant therapy fulfil your expectations? If not or yes, why? Please elaborate What would have made your experience better? Have your expectations changed?
Closing	I think that's basically everything I had to ask you to talk about, have you got anything else to say or any final thoughts or things you'd like to follow up that I haven't asked you?	

Table 3. Inclusion criteria

Inclusion criteria	Rationale
Sex: Male or Female	To obtain the perspectives of both sexes
Age: 20 or older	Most restorative dental implants in healthy patients are placed when skeletal maturity is reached which is at around 20 years or older (Fudalej et al. 2007)
Ethnicity: All ethnicities and cultural backgrounds	To include a wide range of views and perspectives from people of different cultural groups and ethnicities
Capacity to consent: Able to give informed consent	To be able to consent to the requirements of the study
Received treatment for single implant placement and a fully restored single implant crown at the University of Otago (Faculty of Dentistry) within the last 6 years Jan 2018 – Dec 2023 inclusive)	To ensure recency of the data collected

Table 4. Exclusion criteria

Exclusion criteria	Rationale
Multiple complex co-morbidities or dental problems	Patients may be able to give informed consent but having multiple complex co-morbidities or dental problems can affect their ability to participate in the study.
Having multiple-unit implants and no single-tooth implants	We aim to understand patients' experiences with single-tooth implants
Unrestored single-tooth implant	Those with an unrestored single-tooth implant will be unable to take part in the study as we are looking to understand patients' experiences with the entire process from tooth loss to implant restoration

was granted by the University of Otago Human Ethics Committee (Health) (H24/026).

Data management procedures were put in place and every effort was made to ensure anonymity and confidentiality of participants. All identifiers were removed from transcripts and reporting, and participants' names were replaced by identifiers. All data were electronically saved in password-protected University of Otago cloud storage, and all audio files were destroyed after transcription. Written and/or verbally informed consent was gained from all participants. All information relevant to the study was provided and explained to participants. Participants had the chance to ask questions and could withdraw from the project with no disadvantage to them. Only the interviewer and primary research supervisor knew the identity of the participants. All demographic or other identifying information about the participants has been separated from interview transcripts. Because clinical data is not reported in this article, ethical approval to report clinical data was not required.

Results

A total of 24 invitations were sent out and 13 replies were received. Of those who replied, one was lost to follow-up and 12 were willing to take part in interviews. Ten interviews were held; eight over Zoom® and two in person. Saturation was deemed to have been reached at the tenth interview, so no further interviews were held.

Despite efforts to include a wide demographic, participants were mostly female (80% (n=8)) with most identifying as European ethnicity. Full participant demographics have not been reported to ensure participants' anonymity. Non-identifying demographic information has been summarised in Table 1. Participants were each given a number from 1-10 with the first participant labeled P1, second P2, and so on.

Throughout the interviews, participants expressed a range of experiences, including their emotions and views on tooth loss, their experiences with implant therapy, and their perceptions and views of tooth value. Most participants reported an unremarkable experience with exodontia. "I haven't had any issues. I just followed what they've given me as instructions, not eat certain foods, and just trusted it to heal in time" (P1). However, P3 expressed viewing tooth extraction as an unpleasant experience, "There was a lot of blood. The extraction itself was quite traumatic, because it was quite lodged in there and took quite a bit of effort to and strength to remove it."

All participants reported having an overall positive experience with implant therapy despite having some negative experiences. The common features reported included experiencing pain-free treatment, little to no complications, good staff involvement in their care, and treatment satisfaction. For example, P4 stated, "Didn't have to take a Panadol or anything." Similarly, P6 said, "the whole process was so easy, so easy and not painful, … It was easier than having the tooth out."

Negative aspects of the experience for patients were linked to complications during treatment with the prosthesis, treatment taking a long time, and an uncomfortable treatment environment. For example, P3 explained, "the ways that implants originally inserted in

that theatre, it was really uncomfortable, like physically … if it was in the dentist's chair in that room, it would have been fine".

Four main themes were identified through the process of thematic analysis: stages of grief, knowledge, decision, and expectation vs reality. In the following section, each of these themes will be discussed separately and quotes will be provided that exemplify what participants said within each code. The themes are not distinct but instead intertwine and overlap and some quotes were coded under more than one theme. However, for the purposes of this report, the themes are reported individually.

Theme 1: Stages of Grief

Participants' reported experiences echoed the Kübler-Ross model of the five stages of grief (Kübler-Ross, 1969). Although this model represents the stages of grief related to the death and dying of terminally ill patients, the participants' explanations of their experiences drew on the same stages. The five stages are denial, anger, bargaining, depression, and acceptance. Although consistent with the model, the sequence of participants' experiences may not have occurred in this order, each is explained below in turn to provide structure and context to participants' experiences.

Denial

Denial was evident in participants' reflections on their past decisions and about the long-term consequences of not addressing their dental issues earlier. Participants acknowledged their regret and spoke of rationalising their past choices. For example, P3 reflected on the treatment options originally offered by their dentist: "I didn't think that it was worth it…but yeah, really regretted not doing this at that stage … after a while … I struggled to chew my food properly." This quote reflects that at the time of first being offered implant therapy for a posterior tooth, this participant underestimated, or was in denial, regarding the importance of their teeth for function.

Other participants also displayed a lack of concern about their tooth loss, and this seemed to be related to the availability of alternatives. These participants often reported they initially denied the severity of the problem, focusing on solutions rather than the emotional or quality-of-life impact of tooth loss. For example, P4 shared, "I wasn't too worried about it [tooth loss] … So it didn't come as a surprise, and because implants were on offer, I knew that there was an alternative." Whereas P3 displayed denial about the impact of a missing tooth, P4 was expressing denial about the impact of loss of the natural dentition even though there was a treatment available.

Anger and Depression (Sadness)

Anger and depression were inextricably intertwined in the participants' responses. In this instance, as opposed to grief from dying, participants felt a sense of sadness over their tooth loss. Most participants, except those who had experienced an accident, reported they had some control over the sequence of events that led to their tooth loss, and they felt sad about the consequences of their actions and how they had allowed it to happen to themselves. For example, P6 explained how they felt about the gap in their teeth:

> I was very conscious, very conscious of this gap that I had, and I hated it … I wish I'd listened to him [dentist], but I didn't, and had it pulled out then … But hindsight, I tell everybody now, if you have a choice, don't pull the tooth, don't get one pulled out, get it repaired as much as you can.

P6 was expressing both anger and sadness regarding choosing to have a tooth extracted contrary to their dentist's recommendation.

Awareness of the impact on appearance was also evident in the interviews. For example, P2 expressed some level of emotional distress and self-consciousness about their appearance. "It's a wee bit traumatic, a little bit vain about my looks … .you just feel like a second-rate citizen when you're walking around with big hole in the front of your mouth like that". P2 expressed frustration with having a visibly missing tooth and indicated the associated feelings of inferiority and sadness about it.

The experience also impacted participants' self-esteem. P3 spoke of anger at experiencing tooth loss, and the perceived impact on their self-worth saying "I felt like my body was failing me, and I felt like I needed to be super rich in order to have a healthy mouth." This comment also relates to the cost of treatment. Participants displayed anger through the language they used when talking about the cost of treatment. For example, P4 stated, "Bloody expensive. It was nearly $1,000 with this dentist in Dunedin to have two teeth out. I mean, it was so expensive. It was ridiculous." This sense of inadequacy and frustration with the financial burden of dental care and the associated feeling of unfairness was a common response from participants and was also reflected in the theme of bargaining.

Bargaining

Many participants indicated some form of bargaining in their decision-making process around tooth loss and implant therapy. They talked about trying to negotiate or rationalise their situation, explore alternatives, consider delays, or reflect on how they could have avoided the situation. For example, P6 reflected on how they could have avoided tooth loss:

> I think he was starting a crown, and then it just broke off right at the gum and I said, just pull it out. He tried to talk me out of it and I wish I'd listened to him, but I didn't, and had it pulled out then.

Similarly, P7 considered their options to delay the decision and rationalise the situation.

> [I] was scared they would just pull it out on the spot 'cos it was pretty obvious it was gonna come out. But I was still hoping for a miracle that they could do a construction of some sort at that point.

P7 was explaining the process of negotiating with themselves on what could happen, alongside exploring the alternatives to tooth loss.

P2 and P9 described bargaining with themselves regarding their options and deciding whether to proceed with a treatment based on their financial status. Bargaining was also evident in participants' explanations of how they avoided proceeding with implants in favour of cheaper acceptable alternatives, even despite their preference for an implant. For example, P10 explained, "I did talk, uh, about a false tooth, but obviously that wasn't my preference". When discussing their dislike for dentures, this participant expressed a clear preference for implants over other solutions: "I would hate dentures. Even my partner has got a plate and has to take it out at night and things, and I don't." This comment reflects a form of bargaining where P10 weighed the options and negotiated with themselves about what they would find more acceptable when comparing their dental implant to other solutions.

Acceptance

Most participants viewed their tooth loss as inevitable but temporary and indicated that they expected a solution that was permanent in the form of an implant. This perspective seemed to indicate a sense of acceptance of their situation as they tolerated having a missing tooth for a period of time before the commencement of implant therapy. For example, P2 stated:

> But I had my 60th and I had to take the plate out that night. I just couldn't be bothered to put it in. It was very difficult to socialise and eat and drink with it, so I just took it out and the photos all done with this big gap in my mouth and I'd sort of come to terms with it to a certain degree.

This statement indicates some acceptance of tooth loss and its impermanence. Along with the problems they faced with the temporary partial denture, P2's comment indicates they felt comfortable having photographs taken without their temporary plate for an important life event. P2's narrative also indicates that knowing something was to replace the tooth soon seemed to help in providing a sense of comfort.

Another participant expressed acceptance of tooth loss and stated that the reason was they knew that implants were an option: "… I live and breathe my teeth, I have done for many years. So it didn't come as a surprise, and because implants were on offer, I knew that there was an alternative" (P4). It seemed, during the interviews, that acceptance was related to the availability of treatment.

Theme 2: Knowledge

Under the theme of knowledge, participants expressed varying understandings of exodontia and implants. They spoke about their sources of knowledge and revealed an amount of misinformation. This theme was informed by several sub-themes: sources of knowledge, 'future-proofing' teeth, and misinformation.

Sources of knowledge

Many participants either indicated or outright stated that when they first lost their tooth, they did not know what an implant was or only had a vague idea. For example, P5 said, "Hadn't really heard much about it. To be fair, hadn't really considered it.". P8 echoed this sentiment stating the idea of implants sounded daunting: "No, I had no idea what an implant was, and I had no idea what a crown was".

When asked about how they found out about dental implants, participants spoke about obtaining information on dental implants from various sources such as personal connections and dental professionals. For example, P6 described obtaining some of their knowledge from their friends and family: "I did know about them because my brother and sister-in-law have each had a front tooth implant … " and some of their knowledge from professionals "… so they gave me some options. There was a partial denture, a bridge or the implants". In another example, P2 first found out about dental implants from their dentist and said, "I did go to a … private dentist who specialised in implants, and they took me through what the implant was all about and gave me a bit of a background on it, and talked to me about the cost". Similar to P6 and P2, most participants obtained their information about dental implants from a dental professional.

'Future-proofing' teeth

Some participants described an implant as a means to "future-proof" their mouth after losing a tooth. For example, P3 thought that their other teeth were deteriorating as they were 'doing more work' following the loss of other teeth. They explained, "But yeah, and at my bottom teeth, I think they were suffering because they were doing more work. And then all the top teeth that I still had were also doing more work because those teeth were missing." Similarly, another participant explained their understanding that having a tooth replaced by an implant helped prevent their other teeth from breaking:

> I'm pretty sure I future proofed my mouth, the other teeth around it … I grew up in a place that had no fluoride in the water, and with dental nurses that drilled the bejesus out of your teeth with the tiniest of cavity, and my teeth were full of amalgam so they're at risk of breaking anyway, so I don't need more risk with having teeth missing. (P6)

When asked to explain how having an implant was future-proofing their mouth P6 explained it was due to reduced pressure on the other teeth:

> Well, if I have the gap, it's going to put more pressure on the teeth around where the gap was, so there's a likelihood that they're going to break down at some stage as well, especially with the amount of amalgam I've got in there. So having the implants has filled that gap, so hopefully helped keep the teeth around it in a better state.

P3 and P6 both felt that having an implant helped protect and increase the longevity of their other dentition and exemplified participants' perspectives on how the replacement of their lost tooth with an implant benefitted them.

Misinformation

When participants were asked their views regarding the longevity of implants, a level of misinformation was evident. One participant explained that an implant would last forever saying, "don't foresee any problems or that with it. I basically think that it's there now and that's going to be there practically forever" (P9). Another recalled their dentist stating the implant would last around 10 years only if they looked after it well. " … [I] feel like they told me they can last around, like, 10 years or something, if you look after them well." (P8). Conversely, P6 could not recall being told how long the implant would last but explained that cleaning around the implant was important:

> I've been told that I need to be more careful with the cleaning of my teeth … there's likelihood that there's going to be infection, and that around them, if I'm not careful, I don't know about how long they last. I didn't ask. I was possibly told, but I don't recall.

These responses indicate that some patients did not have an accurate understanding of the longevity of their implant. However, we cannot assume that it was not explained to them by their practitioner, we can only report that for some reason, their understanding was inaccurate.

Theme 3: Decision

Participants went into some detail regarding their decision to proceed with an implant. Aesthetics and function were the most common concerns expressed by participants. The financial aspect of implant therapy was a common theme discussed by all participants. Participants also considered the impact of implants on their dentition, and implant longevity, which was also reflected in the previous theme, knowledge.

Influences on decision making

Financial considerations (Economics/Socioeconomics)

The cost of implant therapy mentioned by participants in all the interviews. This was mostly brought up when participants were asked about their experiences and perceptions of dental implants. Most participants expressed their concerns regarding the high cost of the procedure. For example, P1 stated, "I kind of wish that. I wasn't having to borrow my parents' money. That costs a lot (the implant)." P2 mentioned the high cost, even though their treatment was subsidised because it was done at a teaching facility. They described their tooth as being "like gold" and stated, "it's a very long process, and even through the Dental School it's still an expensive one."

One participant mentioned that the cost of an implant put them off treatment initially, however, the fixed nature of an implant finally attracted them to go through with treatment:

> The reason I didn't want to do the implant [was] because I just thought it was going to cost too much, and then thinking about it more, I decided I wanted more permanence than the partial denture, so I went with the implants. (P6)

Another mentioned how the cost of implant therapy would have been prohibitive had they not had the implant covered by NZ's no-fault accidental injury compensation scheme (Accident Compensation Corporation – ACC) (Accident Compensation Act 2001):

> They let me know that it would be a process, and it's not guaranteed, but it's likely that it'll be covered by ACC, so I didn't have to worry about the cost of it, but I would say if it wasn't, I would it would be a little bit more scary thinking about how much it would cost. (P8)

These responses indicated that cost was a big consideration for many participants, but for those who chose to go ahead with the treatment, the functional and psychological benefits outweighed the costs. This is expanded on further below.

Aesthetic considerations

Most participants mentioned aesthetics as one of the key factors in choosing to have an implant rather than other treatment options they were offered. The aesthetic impact of tooth loss and its subsequent effect on participants has been previously noted under the theme 'anger and depression' and this was a large factor in participants' decisions to proceed with implant therapy. For example, P6 mentioned,

> My first tooth. I was a young mum at home with my kids, and wasn't working, so we didn't have a lot of money, and I thought pulling that tooth out was the best option that's near the back It doesn't matter … Then I the one next to it broke in half and was closer to the front. And I thought, what am I going to do here? Because I didn't like having the gap … it was, it was not nice giving that big gap near the front of my mouth. And as I said before, I was really, really conscious of not having a tooth there.

P6 was explaining that when they first lost a tooth, cost was a large factor in dissuading them from going for implants. However, when they lost another tooth in a more visible area, they felt like they had to do something due to how they were affected aesthetically.

Restoring function

All participants mentioned restoring lost function as a key reason for choosing to have an implant. For example, P3 shared, "Because after a while, I started having trouble with the gums where you know, I had the tooth loss. I struggled to chew my food properly, and I was also getting headaches quite a bit."

Another participant explained the difficulties they suffered with chewing; "losing the tooth, other than the fact that it was uncomfortable without a tooth there, couldn't really eat on that side properly, so I was having to eat on the left side." (P10). When asked why they decided on implants instead of other treatments, they said "So that I could eat normally again and smile normally". The restoration of both aesthetics and function were the main reasons why they chose to have implant therapy.

Theme 4: Expectation vs reality

Differences regarding participants' expectations and what they experienced from implant therapy were evident during the interviews. There were differences in participants' perceptions of dental implants, expectations of the length of treatment and its complexity, the impact of having an implant on their oral hygiene practices and the impact a dental implant would have on their quality of life. This theme overlaps with the theme of knowledge but is qualitatively different in that participants realised their actual experience differed from their expectations once they had experienced treatment.

Understandings and perceptions of dental implants before and after implant therapy

When asked about their perceptions of dental implants prior to finding out more about them, some participants thought the process was going to be painful and 'not a good experience'. For example, P9 mentioned how a family member chose not to have implants because of this:

> You always hear that they drill into your jawbone and that type of thing, and it's supposed to be not bad, that's not the word, probably more not a good experience, or a bit painful or just I had friends that said no they wouldn't do it. My sister, for instance, should have had this done and just opted to have the teeth removed and nothing done.

The same participant then explained that they had a good experience with implant therapy and that it exceeded their expectations. They thought following the instructions of the practitioners was key to this: "No there wasn't the whole, the whole process was fine because I followed the instructions of aftercare [laughs]." (P9)

Length of treatment (time)

Almost all participants mentioned that the entire process from tooth loss to implant placement took a significant amount of time. For many the amount of time seemed to differ from their expectations. Many participants brought up the length of the implant procedure. For example, P8 mentioned, "It was quite long." Similarly, another participant said, "It was a very long, drawn up procedure. I mean, it wasn't like … it took months and months so, so that was a bit annoying" (P3), feeling that the procedure had more steps and took longer than expected. Another participant commented on the longer than expected treatment time saying:

> Erm it was a bit of a longer process than I thought it was gonna be … erm … it should've taken at least a year to get it done, but it probably took like two to three years to actually get it, like, actually properly done up. (P1)

Most participants expected the duration of treatment to be shorter than what they had experienced and brought this up as something that was unexpected.

Multiple participants thought that the lengthened treatment time was due to being treated at a teaching facility. When asked about what they found unexpected or surprising from the entire process of getting implants they said aspects such as, "Just how long it was going to take between steps I guess, only because the Dental School, obviously, is, you know, periods where it doesn't work and things like that." (P2). Participants explained that treatment paused during the scheduled University breaks, and also mentioned the length of time between appointments. One participant said "obviously just the inconvenience of having to go back to have it done a second time, whereas it could have been initially, that was more difficult than anything else" (P3). Mentioning that having a complication during one of the steps of treatment and requiring that step to be redone played a role in the extended treatment time. P9 stated explicitly that they thought that being treated at the Dental School led to delays. They said "And then that had to that had to be left for a while. It was probably left longer than if I'd gone say private." P9 believed that a private dentist would have been able to complete the treatment in a shorter time frame.

Some participants thought the length of treatment could be attributed to disruptions from COVID-19. For example, a participant said "the fact that it did take so long as well, but that could also be because of COVID. I think it's possible that it could have been quicker, but COVID probably delayed us getting appointments and doing the work that needed to be done" (P3). Another participant echoed the same sentiments: "Yeah the treatment has it seemed to drag out a long time. That was said before, but that probably wasn't anybody's fault. It was COVID times, things like that." (P5)

Participants' experience of long treatment times could be due to treatment taking place at a teaching facility and the effects of the COVID-19 lockdowns in NZ. Although treatment at a private dental clinic would have taken a shorter time, it would likely be more expensive. Participants' comments on the cost of implant therapy indicated that treatment at a private dental clinic may have been prohibitive for them. One participant explained that they had their costs covered by participating in a research study, which would likely only be possible at a teaching facility.

Expectations met

Despite comments on time, cost, and some negative experiences, all the participants expressed that they were very happy with the outcome of implant therapy and that all their expectations were either met or exceeded. For example, P2 said "all my expectations were met, I have no, yeah I can't think of anything that could have been better as an outcome." Similarly, P8 stated, "I'd say it's probably exceeded my expectations…it feels like a normal tooth." These comments indicate that the outcome outweighed any negative experiences.

Oral hygiene

Many participants found oral hygiene to be slightly more involved after implant therapy. For example, P8 mentioned that food often got stuck around their implant, and they must clean the area often, however, they stated that they still find it easy to clean:

> The gap is quite big on either side, which um it's easy to clean because I can fit dental brushes into it. But it's really annoying. it might just be that I monitor that tooth more, because I'm worried about it and all *laughs*, making sure that it's clean, but it's real easy to look after.

Similarly, P10 mentioned they needed to take care with cleaning and were using floss and interdental brushes, whereas before treatment they only brushed the area.

> I have to be very careful cleaning, because obviously there's not quite as much room… and so have to floss and what do you call those little brushes … make sure that I'm not getting food stuck there so that's different to before where you just brush there.

Although the interviews did not go into detail about oral care habits subsequent to treatment, it seemed that none of the participants viewed the extra care they needed to take as a problem.

Improved Quality of Life

Many participants mentioned an improvement in their self-confidence and recognised the positive impact of the implant on their quality of life. For example, one participant mentioned that they felt more confident and smiled more after receiving implants: "I smile a lot more now I was very conscious, very conscious of this gap that I had, and I hated it" (P6). Another participant expressed the same thoughts on the effect of implant therapy on confidence "It brings your confidence right back up … I can speak confidently to someone looking them in the eye without turning my head slightly so that they didn't see the tooth missing or anything like that." (P10). Another participant felt that their confidence improved tremendously and stated that this was a common thing to hear from others who have had implants. "yeah, this is the ultimate, this is the pinnacle [laughs] it does lift your confidence, and everyone says it lifts it right up." (P2). This view of increased confidence was consistent among almost all participants, and they all described an improvement in the social/emotional dimension of oral health related quality of life.

Many participants also shared that their ability to chew and eat improved after having the implant. For example, one participant expressed their ability to eat certain foods they hadn't been able to properly eat before. They stated that eating was more enjoyable now: "I wasn't able to eat an apple properly before I had the implants, and now I can chew on an apple, and I can chew on both sides" "It's made eating a bit more pleasurable" (P4). Another participant mentioned similar experiences: "it's fantastic. I can eat either side and eating's obviously important to me [laughs]" (P10). The comments of both these participants show a self-perceived improvement in the functional dimension of oral health related quality of life after implant therapy.

Discussion

This study explored the perceptions of patients who had undergone tooth loss and single-tooth implant therapy. Our findings explain the loss and grief process that patients go through between losing teeth and replacing them with implants. The study also highlighted a gap in patients' knowledge about dental implants.

The main aim of the study was to understand the experiences of patients who have had tooth loss and replacement with single-tooth implants, and how this aim is addressed by the study is explained below. Study objectives are discussed as follows:

1. To understand patients' experiences with tooth loss and how they value their teeth

Participants expressed that, prior to treatment, all had experienced negative quality of life impacts of tooth loss, especially aesthetics and function. This finding is in line with other research that has found high impacts on quality of life in patients who underwent tooth extraction (Adeyemo *et al.*, 2012). The Kübler-Ross model of grief (Kübler-Ross, 1969) was used in this study as a basis on which to categorise how participants expressed their experiences of tooth loss, as participants expressed experiences drew on the same concepts. Participants did not necessarily experience the defined stages of grief in a linear fashion. Rather, they experienced them fluidly and it was noted that some stages seemed to occur simultaneously with some participants. Not all participants experienced all the stages. That individuals experience the stages of loss in different ways has been commented on by Kübler-Ross herself (Kübler-Ross and Kessler, 2005) and is consistent with our findings.

2. To understand patients' perceptions and experiences with single-tooth implant therapy

According to our participants, cost had the largest influence on their decision to get dental implants. This finding is similar to Atieh *et al.* (2016) who also found cost to be a major factor in patients' choices of restorative options at a teaching facility. Although our participants received treatment at a reduced cost because it was provided at a teaching facility, cost was still reported as a major determining factor in choosing dental implants. Despite the issues our participants reported, such as waiting and cost, they all reported great satisfaction with their treatment and stated it exceeded their expectations. This finding is also consistent with previous studies (Atieh *et al.*, 2016; Johannsen *et al.*, 2012).

Many participants in our study had experienced the loss and replacement of an anterior tooth. Findings indicate that aesthetics was one of the main driving factors behind participants' decisions to proceed with implant therapy. Many participants had received implants to replace their anterior teeth, with one participant only prioritising implant therapy after losing an anterior tooth as compared with a previously lost molar. Conversely, in the Atieh (2016) study, many participants did not find that the implant contributed to their self-esteem or aesthetics, as they received molar implants. This may suggest that those who have had greater aesthetic impact of tooth loss may experience more of the grief process while those who had lost a posterior tooth may grieve less and be more concerned about function.

An interesting finding was that our participants thought that having an implant would protect their remaining teeth and be a long-lasting option, with some thinking it would

last forever. This was also reported in previous literature, with patients thinking that having an implant was the more durable, longer lasting option and were either unsure or hoped it would last them the rest of their life (Atieh *et al.*, 2016; Insua *et al.*, 2017). This finding is also consistent with a study that reported patients' misconceptions that implants are just like natural teeth and highlighting a communication gap between the patients and practitioners regarding advertising implants as an ideal solution for tooth replacement and raising patients' expectations (Grey *et al.*, 2013; Wang *et al.*, 2015).

The current study highlights the implications of clinician communication with patients. Some level of misinformation and/or misunderstandings regarding the duration of treatment, the effect of implants on the other remaining dentition, and implant longevity were noted in participants' responses. Similar findings are also reported in other literature (Grey *et al.*, 2013; Wang *et al.*, 2015). Studies have reported that approximately 24% to 59% of implant patients expect their implants to last a lifetime (Hof *et al.*, 2012; Pommer *et al.*, 2010; Tepper et. al., 2003). Furthermore, past research has shown that patients' recollections of treatment information is often suboptimal and varies greatly (Kessels, 2003; Van Der Meulen *et al.*, 2007; Wolderslund *et al.*, 2019). Greater dialogue is a good predictor for improved patient recall (Richard *et al.* 2016) and in-person dialogue could improve patient-provider communication (Atieh *et al.*, 2016). Therefore, effective communication is essential, especially for implant therapy which has multiple steps and often encompasses a considerable amount of time.

3. To provide knowledge that can inform the treatment of patients experiencing tooth loss and undergoing implant therapy.

It is important for oral health professionals to understand that there is a grieving process associated with tooth loss, that is not linear and consider this in patient management. This grief process has been noted in prior studies on tooth loss (Fiske et. al. 1998). There are also cultural and societal differences in the process of grief and loss. Experiences may differ according to culture, religion, gender, and other factors; oral health professionals should consider patients' cultures, values, and beliefs when treating tooth loss and replacement.

Next, misunderstandings and misinformation about implant therapy are present among patients. To help minimise this, the implementation of the following efforts could be beneficial. Firstly, understanding patient expectations of implant therapy, such as expected treatment duration, longevity of the implant, and the perceived benefits of implant therapy prior to treatment. Next, tempering these expectations, if unrealistic, when discussing treatment. Finally, continued discussion and clarification on what to expect as treatment progresses and the provision of both written and verbal information on the risks, benefits and possible complications of implant therapy.

Strengths and limitations

This research had a few limitations, first, despite efforts to recruit a cross-section of genders and ethnicities, there was a higher proportion of female and European participants in this study. This composition of participants may skew the findings and affect their generalisability to the general population and, in the NZ context, the Māori population. However, qualitative research does not claim to be generalisable but instead provides a rich explanation of people's experiences (Braun and Clarke, 2021). Next, this research utilised a retrospective view of participants' experiences which may introduce certain biases such as recall bias. Potential data loss could have also occurred as most of the interviews (8/10) were conducted over a video conferencing platform. Again, this limitation is not unique to this study but is a characteristic of qualitative research (Braun and Clarke, 2021). However, further qualitative research with male, Māori, and Pasifika patients could provide further information regarding how people experience tooth loss and implants, and knowledge of how clinicians can facilitate patients' expectations and experiences. Further areas of research can also be done on comparing between patients' perceptions of treatment time compared to clinically acceptable treatment times and comparing patients' OHRQoL, expectations and understandings of dental implant therapy pre- and post-implant therapy.

Strengths of the study include the use of a semi-structured interview format which enabled flexibility to explore more detailed information and provided greater control over the data being generated, enhancing the likelihood that the data is useful. This format allowed the gathering of rich information that allowed the researchers to determine the similarities and differences in people's experiences and analyse them accordingly. Another strength of the study is the use of reflexive thematic analysis which allowed for flexibility in selecting theoretical frameworks, formulating the research questions, data collection methods, and determining sample size (Braun and Clarke, 2013).

Our findings suggest that practitioners need to consider the grieving process their patients would experience when losing teeth, be prepared to understand their expectations of the implant treatment, provide adequate information about the treatment, and engage in clear effective communication with their patients to manage their expectations and ensure their understanding of the process.

Conclusion

Oral health practitioners should understand that patients experiencing tooth loss undergo a process of grief that has sociocultural nuances. Effective communication with patients, particularly ensuring they have a good understanding of expectations with tooth loss and dental implants, is essential. While procedures such as implant therapy, with its multiple steps, may be routine to the practitioner, they are often new experiences for patients. Clear, thoughtful dialogue helps manage patients' expectations, ensure they feel informed and supported throughout the process, and enhance the experiences of both patient and clinician.

Author contributions

Conception or design of the work – KHML, ZAN, LAA
Data collection – KHML, ZAN
Data analysis and interpretation – KHML, ZAN, LAA
Drafting the article – KHML
Critical revision of the article – KHML, ZAN, LAA
Final approval of the version to be published – KHML, ZAN, LAA

Conflict of interest

The authors declare no conflicts of interest.

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