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Prosthodontic Perspectives on Implant Complications and Failures in Women: A Survey-Based Analysis

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Abstract

Background: Dental implants are a highly predictable treatment for tooth replacement, yet success rates vary across patient demographics. In women, physiological shifts including menopause, hormonal fluctuations, and hysterectomy - can alter bone metabolism and impact long-term osseointegration.

Objective: This study aims to evaluate prosthodontic perspectives on implant complications and failures in women.

Methods: A cross-sectional online survey was conducted among 377 participants, including dental postgraduates, practitioners, and faculty. The questionnaire evaluated clinical experiences and perspectives regarding implant complications in women, focusing on hormonal fluctuations, systemic diseases (e.g., osteoporosis), medication use, and metabolic factors (Vitamin D3 and Calcium). Statistical analysis was performed using descriptive statistics and the Chi-square test, with a significance level set at $p < 0.05$.

Results: Most clinicians reported moderate implant utilization, with an estimated failure frequency of 20–30% among female patients. Systemic health factors (46.7%) and peri-implantitis (41.9%) were identified as the primary causes of failure. While 96.6% were aware of the role of Calcium and Vitamin D3, only 0.8% routinely assessed these levels. Significant consensus (88.1%) identified osteoporosis as the leading systemic risk factor.

Conclusion: The study underscores that biological and systemic variables, particularly hormonal changes and bone metabolism, are perceived as critical determinants of implant success in women.

Keywords: Implant Failure, Menopause, Hysterectomy, Osseointegration, Vitamin D Deficiency, Diphosphonates.

Introduction

Dental implants are widely recognized as a predictable and effective treatment modality for the replacement of missing teeth in contemporary prosthodontics. Long-term studies have consistently reported survival rates exceeding 90–95%, with implant-supported restorations significantly enhancing masticatory function, aesthetics, and overall patient quality of life.[1]

Despite these high success rates, implant complications and failures remain a clinical concern, arising from a combination of biological, mechanical, and patient-related factors. A thorough understanding of these risk factors is essential for optimizing treatment outcomes and ensuring long-term implant success.[2]

Implant failure is generally classified as early or late. Early failure occurs prior to successful osseointegration, whereas late failure develops after functional loading and is often associated with biological complications such as peri-implantitis and marginal bone loss, or biomechanical factors including occlusal overload. Several contributing factors have been identified, including bone quality, implant design, and surgical technique.[3]

In recent years, attention has increasingly focused on gender-specific influences on implant outcomes, particularly in female patients. Women undergo various physiological and hormonal changes throughout life stages such as puberty, pregnancy, lactation, and menopause, all of which may affect bone metabolism and healing.[4]

Hormonal fluctuations, especially variations in estrogen levels, play a critical role in bone remodeling and density. Estrogen deficiency, particularly following menopause, has been associated with increased osteoclastic activity and reduced bone mineral density, which may adversely affect osseointegration and implant stability.[5]

Additionally, systemic conditions are more prevalent in women—such as osteoporosis and vitamin D deficiency—as well as the use of medications like bisphosphonates and hormone replacement therapy, can influence bone turnover and healing. Evidence suggests that inadequate vitamin D levels may impair osseointegration and increase the risk of implant-related complications.[6]

Furthermore, clinical outcomes in female patients may be affected by age-related bone loss, systemic health status, and lifestyle factors such as smoking and nutritional deficiencies. These multifactorial influences underscore the importance of comprehensive risk assessment prior to implant placement.[7]

Despite the growing number of studies on implant survival, limited research has specifically explored the prosthodontic perspective on implant complications and failures among female patients, particularly from the viewpoint of clinicians managing prosthetic rehabilitation. A survey-based analysis can provide

valuable insights into clinical experiences, diagnostic approaches, and management strategies adopted by prosthodontists when dealing with implant complications in women.

Therefore, the aim of the present survey-based study is to evaluate prosthodontists' perspectives regarding implant complications and failures in women, focusing on contributing systemic factors, clinical observations, and preventive or management strategies. Understanding these factors may help clinicians develop more personalized treatment planning and improve long-term implant success in female patients.

Study design and methodology

The present study is a cross-sectional online survey was designed to determine prosthodontic perspectives on implant complications and failures in women. It aims to shed light on how clinicians evaluate gender-unique variables - such as hormonal shifts, systemic health, and bone metabolism - within their prevailing practices. The survey provides comprehensive insights into the diagnostic, preventive, and management strategies used to ensure implant stability in female patients.

The present survey comprised total 15 questions. The questionnaire was designed to assess clinicians' experiences regarding implant failures in female patients and to explore potential contributing factors such as hormonal changes, systemic diseases, medication use, and metabolic factors including calcium and vitamin D status.

A total of 377 responses were included. The diversity of participants' experience provided a robust dataset to analyse current trends in managing implant complications in female patients. The findings identify critical knowledge gaps and provide guidance for future educational initiatives focused on gender-specific dental care.

Data Collection

Data were collected using a structured questionnaire designed to capture the following:

1. **Demographic and Professional Information**

- **Designation:** Dental postgraduate, Dental practitioner, Dental practitioners & faculty.

2. **Clinical Experience and Risk Perception**

- Frequency of implant failures observed in female patients.
- Correlation between patient age and clinical outcomes.
- Identification of primary causes of failure (e.g., systemic health vs. technical errors).

3. Hormonal and Systemic Factors

- Influence of hormonal milestones (menopause, lactation, hysterectomy).
- Impact of systemic conditions like osteoporosis and diabetes.
- Awareness of medications (bisphosphonates, HRT) on bone stability.

4. **Metabolic Assessment and Management**

- Awareness and optimization of Vitamin D and Calcium levels.
- Routine diagnostic investigations (DEXA scans, serum tests).
- Preventive measures and initial management strategies for failing implants.

Statistical Analysis

The collected data were compiled and analysed. Descriptive statistics were used to summarize the responses, and the results were expressed as frequencies and percentages. Where applicable, the Chi-square test was used to evaluate associations between variables. A p-value < 0.05 was considered statistically significant.

Results

A total of 377 responses were analysed. The majority of respondents (55.2%) reported that approximately 25–50% of their patients receive dental implants, indicating moderate utilization in routine clinical practice. Additionally, 32.6% of clinicians reported a higher utilization rate (50–75%), reflecting increasing acceptance of implant therapy. Only a small proportion (0.8%) indicated very high utilization (75–100%), suggesting that implants are not universally applicable to all patient cases.

When assessing the frequency of implant failures among female patients using a 10-point scale (each point approximating 10%), the mean score was 2.81 ± 1.29. This corresponds to an estimated failure frequency of approximately 20–30%. The distribution of responses suggests that implant failures in female patients are generally perceived as infrequent to occasional, with relatively low variability among clinicians.

Regarding etiological factors, systemic health conditions (46.7%) and peri-implantitis (41.9%) were identified as the most common causes of implant failure. In contrast, poor bone quality (9.5%) and incorrect implant placement (1.9%) were less frequently reported. These findings indicate that biological and systemic determinants play a more significant role than technical factors in implant failure.

A strong consensus was observed regarding the influence of age, with 87.5% of respondents reporting a correlation between increasing age and implant outcomes in female patients. Only a minority reported no association (5%) or uncertainty (6.1%), highlighting the clinical relevance of age-related physiological changes.

The impact of medications on implant success was widely acknowledged, with 88.6% of clinicians recognizing the effects of drugs such as bisphosphonates on bone density and implant stability. A smaller proportion (7.2%) indicated that hormone replacement therapy (HRT) may influence healing, while minimal respondents (1.6%) perceived no significant drug-related impact.

Similarly, 90.9% of respondents (87.5% agree, 3.4% strongly agree) believed that post-hysterectomy health influences bone changes, suggesting that hormonal alterations following hysterectomy are considered clinically significant in implant planning. Furthermore, 86.7% of clinicians agreed that hormonal changes during menopause and lactation adversely affect bone density and healing, reinforcing the importance of endocrine factors in implant prognosis among women.

Awareness regarding the role of calcium and vitamin D_3 in implant success was nearly universal (96.6%). However, only 0.8% of respondents reported routinely assessing these parameters, indicating a notable gap between knowledge and clinical practice. Nevertheless, 90.2% believed that optimizing calcium and vitamin D_3 levels improves implant outcomes.

In terms of diagnostic investigations, serum 25-hydroxyvitamin D [25(OH)D] (87.0%) and serum calcium levels (85.4%) were the most commonly prescribed tests prior to implant placement. Bone mineral density assessment using DEXA was reported by 72.7% of clinicians, particularly in patients at risk of compromised bone quality. In contrast, serum parathyroid hormone (11.4%) and alkaline phosphatase (5.0%) were infrequently used, suggesting their application is limited to selected cases.

Although 71.9% of respondents reported that hysterectomy had no direct impact on implant outcomes, a notable proportion perceived either negative (9.5%) or positive (10.1%) effects. This variability indicates that hysterectomy alone may not be a decisive factor, but its

systemic consequences may influence outcomes in specific patient groups.

Preventive strategies were predominantly pharmacological, with 77.7% of respondents favoring the use of antibiotics or anti-inflammatory agents. Other approaches included delayed loading (10.6%) and bone grafting (6.9%). Only 4.8% emphasized systemic or hormonal evaluation, suggesting that preventive protocols remain largely non-holistic.

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In the management of implant complications, the majority of clinicians (85.1%) preferred non-surgical interventions, such as antimicrobial therapy and occlusal adjustments. Surgical approaches were less frequently adopted (9.8%), while implant removal and replacement were rarely considered (1.9%), indicating a strong preference for conservative, implant-preserving strategies.

The most commonly reported clinical challenge was difficulty in accurate diagnosis (80.1%), followed by management of hormonal fluctuations (10.1%). Psychological factors and long-term monitoring were less frequently cited. These findings highlight the complexity of diagnosing and managing implant-related complications in female patients.

Finally, osteoporosis was identified as the most significant systemic risk factor (88.1%), far exceeding other conditions such as diabetes (5.3%). Autoimmune disorders, thyroid diseases, and cancer-related treatments were reported infrequently. This underscores osteoporosis as the predominant systemic contributor to implant failure in women.

Discussion

This study aimed to evaluate prosthodontic perspectives on implant complications and failures in female patients, with particular emphasis on systemic, hormonal, and clinical factors influencing implant outcomes. The findings provide important insights into clinicians' perceptions, diagnostic approaches, and management strategies in implant dentistry specific to women.

The majority of respondents reported moderate utilization of dental implants in routine practice, with 25–50% of patients receiving implant therapy. A substantial proportion also reported higher utilization (50–75%), reflecting the increasing acceptance and reliability of implants as a preferred treatment modality. These findings are consistent with current trends in prosthodontics, where implant-supported restorations are widely considered a predictable and long-term solution for tooth replacement.

The perceived implant failure rate in female patients was relatively low to moderate (approximately 20–30%), suggesting that failures are not highly prevalent in routine clinical practice. However, this perception may slightly overestimate actual failure rates reported in the literature, which generally indicate high implant survival. The variability in responses highlights the influence of patient-specific factors, particularly systemic and hormonal conditions unique to female patients.

Systemic health factors and peri-implantitis were identified as the most common causes of implant failure, whereas technical factors such as improper implant placement were reported infrequently. This emphasizes that implant success is largely dependent on host-related factors rather than operator-related variables. These findings reinforce the importance of thorough patient evaluation, risk assessment, and long-term maintenance in achieving successful outcomes.

A significant majority of clinicians recognized the influence of age on implant outcomes in female patients. Age-related changes, including reduced bone density, delayed healing, and increased prevalence of systemic conditions, may compromise implant success. In women, these effects are further influenced by hormonal changes associated with menopause, which can accelerate bone resorption and negatively impact osseointegration.

The role of medications, particularly bisphosphonates, was widely acknowledged by respondents. These medications are known to affect bone remodeling and may influence implant stability and healing. The recognition of hormone replacement therapy (HRT) as a contributing factor further highlights clinicians' awareness of the complex interaction between pharmacological and hormonal influences on implant outcomes.

Hormonal factors emerged as a critical determinant in this study. Most respondents agreed that menopause, lactation, and post-

hysterectomy status can significantly affect bone density and healing capacity. Estrogen deficiency, especially following menopause or hysterectomy, is associated with increased bone turnover and reduced bone mineral density, which may compromise implant stability. However, variability in responses regarding the impact of hysterectomy suggests that clinicians may perceive its effects as indirect, depending on associated systemic changes.

Despite the high level of awareness regarding the importance of calcium and vitamin D_3 in bone health, only a very small proportion of clinicians reported routine assessment of these parameters. This indicates a clear gap between knowledge and clinical practice. Given the critical role of these nutrients in bone metabolism and osseointegration, their routine evaluation could significantly improve implant outcomes, particularly in high-risk female patients.

The preference for serum vitamin D_3 and calcium testing, along with DEXA scans, indicates that clinicians recognize the importance of assessing bone health. However, the limited use of additional investigations such as parathyroid hormone and alkaline phosphatase suggests that comprehensive metabolic evaluation is not routinely performed and may be reserved for selected cases.

Preventive strategies reported in this study were predominantly pharmacological, with most clinicians favoring the use of antibiotics and anti-inflammatory agents. Other approaches such as delayed loading and bone grafting were less commonly utilized, while systemic and hormonal evaluation was rarely considered as a preventive measure. This highlights a tendency toward symptomatic management rather than a holistic, preventive approach addressing underlying risk factors.

In terms of management, the majority of clinicians preferred non-surgical interventions, including antimicrobial therapy and occlusal adjustments, reflecting a conservative approach aimed at preserving existing implants. Surgical interventions and implant replacement were less frequently preferred, indicating that clinicians prioritize minimally invasive strategies whenever possible.

The most commonly reported challenge was difficulty in diagnosing implant-related complications in female patients. This may be attributed to the complex interplay of systemic conditions, hormonal fluctuations, and nonspecific clinical symptoms, which can complicate diagnosis and treatment planning. Additionally, managing hormonal variations was identified as a secondary challenge, further emphasizing the need for individualized treatment approaches.

Osteoporosis was overwhelmingly identified as the most significant systemic condition contributing to implant failure, far exceeding other conditions such as diabetes and autoimmune diseases. This finding underscores the critical role of bone quality and density in determining implant success in female patients and highlights the importance of early diagnosis and management of osteoporosis.

Overall, the results of this study demonstrate that implant success in female patients is multifactorial and strongly influenced by systemic health, hormonal status, and bone metabolism. While clinicians show good awareness of these factors, the limited integration of systemic evaluation into routine practice indicates the need for improved clinical protocols. A more comprehensive, multidisciplinary approach incorporating medical, hormonal, and nutritional assessment may enhance implant success and reduce complications in female patients.

Conclusion

Dental implant therapy in female patients shows generally favourable outcomes with low to moderate failure rates. Implant failure is mainly influenced by systemic and hormonal factors rather than technical errors, with osteoporosis being the most significant risk factor. Although awareness of calcium and vitamin D_3 is high, routine assessment is lacking. A holistic approach including systemic, hormonal, and nutritional evaluation is essential to improve implant success in women.

Ethical Considerations

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants prior to their participation in the study. The confidentiality and anonymity of the participants were maintained throughout the study.

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Table 1:

1. On average, what percentage of your patients who receive dental implants are female?

Category	Frequency	Percent
0–25%	43	11.4
25–50%	208	55.2
50–75%	123	32.6
75–100%	3	0.8

Table: 2

Questions asked to participants –

2. How often dental implant failures occur among female patients in your practice, using a scale of 1 to 10 where each point represents approximately 10% of cases?

Parameter	Mean ± SD	Range
Dental Implant Failure Frequency	2.81 1.29	0-10

3. In your practice, what are the most common reasons for implant failure in female patients?

Reason	Frequency	Percent
Incorrect implant placement	7	1.9
Peri-implantitis	158	41.9
Poor bone quality	36	9.5
Systemic health factors	176	46.7

4. Have you noticed any correlation between the age of female patients and the likelihood of implant failure?

Response	Frequency	Percent
Yes	330	87.5
No	19	5.0
Unsure	23	6.1
Further analysis needed	5	1.3

5. Is there a correlation between medications like bisphosphonates and hormone replacement therapy that female patients may be taking, and their potential impact on the success of implants?

Response	Frequency	Percent
Bisphosphonates affect implant stability	334	88.6
HRT may influence healing	27	7.2
Unsure	10	2.7
Minimal impact	6	1.6

6. Do you feel that your post-hysterectomy health (e.g., bone changes, hormone shifts, healing capacity) made

Response	Frequency	Percent
Agree	330	87.5
Strongly agree	13	3.4
Neutral	28	7.4
Disagree	3	0.8
Strongly disagree	3	0.8

7. Do you believe hormonal changes in female patients (e.g., menopause, lactation period) play a significant role in implant failure?

Response	Frequency	Percent
Yes, affects bone density and healing	327	86.7
Some evidence	17	4.5
No significant impact	24	6.4
Further research needed	9	2.4

8. Are you aware that calcium and vitamin D3 levels influence bone metabolism and osseointegration of dental implants?

Response	Frequency	Percent
Yes	364	96.6
Yes, routinely assess	3	0.8
No	9	2.4
Not routinely assessed	1	0.3

9. In your clinical experience, does optimization of calcium and vitamin D3 levels contribute to improved implant survival?

Response	Frequency	Percent
Yes	340	90.2
Case dependent	27	7.2
No	6	1.6
No response	4	1.1

10. Which investigations do you routinely prescribe to assess calcium and vitamin D3 status before implant placement?

Investigation	Frequency	Percent
Serum 25-hydroxyvitamin D [25(OH)D]	328	87
Serum calcium level	322	85.4
Bone mineral density [DEXA scan]	274	72.7
Serum alkaline phosphatase	19	5
Serum parathyroid hormone [PTH]	43	11.4

11. Do you feel your hysterectomy had an impact on your dental implant outcome?

Response	Frequency	Percent
No impact	271	71.9
Yes, positively	38	10.1
Yes, negatively	36	9.5
Not sure	32	8.5

12. Did your provider suggest any preventive measures?

Measure	Frequency	Percent
Antibiotics/anti-inflammatory therapy	293	77.7
Delayed loading	40	10.6
Bone grafting	26	6.9
Hormonal/systemic health check	18	4.8

13. What is your initial approach when managing cases of ailing/failing implants in women?

Approach	Frequency	Percent
Non-surgical intervention	321	85.1
Surgical intervention	37	9.8
Bone grafting	12	3.2
Implant removal and replacement	7	1.9

14. Are there any specific challenges you encounter when treating female patients for implant-related issues?

Challenge	Frequency	Percent
Diagnostic difficulty	302	80.1
Hormonal fluctuations	38	10.1
Psychological concerns	26	6.9
Long-term monitoring	11	2.9

15. Which condition do you personally believe most likely contributed to implant failure?

Condition	Frequency	Percent
Osteoporosis	332	88.1
Diabetes	20	5.3
Autoimmune disease	16	4.2
Thyroid disease	5	1.3
Cancer-related treatment	4	1.1

Chi-square test; * indicates a significant difference at $p \leq 0.05$