THE PREVALENCE OF IMPLANT SUCCESS *VERSUS* FAILURE IN A ROMANIAN SAMPLE POPULATION. A RETROSPECTIVE STUDY

Doriana Agop-Forna, R. F. Curca*, Norina Consuela Forna
"Grigore T. Popa" University of Medicine and Pharmacy, Iasi, Romania
Faculty of Dental Medicine,
Department of Implantology, Removable Prostheses, Dental Prostheses Technology
*Corresponding author. E-mail: florin.curca@umfiasi.ro

THE PREVALENCE OF IMPLANT SUCCESS VERSUS FAILURE IN A ROMANIAN SAMPLE POPULATION. A RETROSPECTIVE STUDY (Abstract**):** Research has revealed that patterns of dental implant failure often occur in groups within individuals and are linked to various factors such as dietary preferences, intake of cold/hot beverages. **Materials and methods**: this research was to investigate the potential correlation between changes in the frequency of dental implant loss due to consumption of hot/cold beverages and dietary habits. Information was gathered from the patient records of individuals seeking implant-prosthetic treatments at the "M. Kogălniceanu" Dental Education Base. **Results:** Out of the examined database, 47 cases were chosen based on the selection criteria. The average age of the study group was 41.6 ± 5.051 years (with a minimum age of 27 years and a maximum age of 49 years). Over half of the participants were male. It has been noted that the intake of solid foods is linked to dental implant loss, showing a positive but moderate level of association (r=0.573). In terms of the impact of consuming hot beverages on the lifespan of implants, the statistical analysis suggests a positive relationship between the two factors, albeit with a relatively weak correlation (r=0.382). **Conclusions:** It is recommended that additional research be conducted to identify the possible risk of implant failure associated with the regular intake of extremely hot beverages, which patients rarely report. **Keywords:** DENTAL IMPLANT, DIETARY HABITS, TEMPERATURE.

INTRODUCTION

In recent years, technological advancements and research in the field of biomechanics have brought about a series of innovations in the realm of implant-prosthetic restorations (1). From new materials and computer-aided design techniques to improvements in implant placement and integration, these new discoveries have revolutionized the way these restorations are planned, fabricated, and implemented (2, 3).

The introduction of advancements in the field of biomechanics applied to implant-prosthetic restorations represents an essential approach to understanding the complexity of interactions between implants, bone, soft tissues, and restoration as a whole (4, 5).

The biomechanics of implant-prosthetic restorations involves the study of forces and stresses acting on these structures during normal oral cavity function (6). It is crucial to understand how these forces are distributed and how they can be managed to prevent restoration failures and ensure optimal long-term functionality (7, 8). From the initial conception of a treatment

plan to the completion of the restoration, bio-mechanical aspects must be considered at every stage of the process (9-11).

Nevertheless, there are certain drawbacks to this treatment approach. Various studies have shown that dental implants have failure rates anywhere from 1% to 19% (12, 13). The abutment connection time determined whether the failure occurred before or after functional loading. In the former case, the failure occurred before occlusal loading or the first removal of the provisional restoration, while in the latter case, the failure occurred after (14).

A dental implant is considered to have failed early if osseointegration cannot be achieved, and a dental implant is considered to have failed late if either osseointegration or function cannot be maintained (15). In early failure, there are just biologic difficulties (16), but in late failure, there could be mechanical as well as biologic issues. Resorption of both soft and hard tissues is a common symptom of peri-implantitis, which can lead to biologic problems (17, 18). Inadequate implant loading design is a potential source of mechanical problems, which can cause the implant body, screw body, or implant suprastructure to fracture (19).

The aim of this study was to find the existence of a link, between the increase/decrease the frequency of losing dental implants because of the intake of hot/cold beverages and dietary preferences.

Thus, patients, doctors, and prosthodontists/restorative experts may all benefit from a better understanding of the causes of late dental implant failure in order to better anticipate treatment results and avoid disagreements.

MATERIALS AND METHODS

The retrospective study aimed at detecting correlations between dental implant loss and the presence of certain risk factors. Data were collected from the patient records of those who presented at the "M. Kogalniceanu" Dental Education Base for implant-prosthetic treatments.

The selection criteria for the clinical cases were as follows: patients who lost one or more implants due to peri-implantitis, without associated systemic diseases, without dental trauma, without periodontal disease, non-smokers, and patients aged between 25 and 50 years.

From the patient's record, data were extracted regarding the patient's age, gender, origin environment, number of implants lost, their location, the type of prosthesis made on these implants, the duration of their survival on the arch, the type of opposing arch, the type of diet (consistency), as well as the consumption of hot beverages, factors that can affect the integrity and persistence on the arch of the implants.

To achieve the purpose of this study, associations between the number of implants lost and the type of diet and beverages consumed were analyzed.

The statistical analysis was conducted using *SPSS 26.0* (IBM, NY, USA). The results of the statistical analysis were presented in the form of mean values and frequencies. Statistical differences between genders and origin environments were analyzed. Pearson's correlation coefficient was used to analyze the correlations between variables. The level of statistical significance was set at $p=0.05$.

RESULTS

From the analyzed database, 47 cases were selected that met the selection criteria. The study group had an average age of 41.6±5.051 (min. age - 27 years, max. age = 49 years). More than half of the participants were males (62.2%), with 82.2% of participants coming from an urban environment (tab. I).

TABLE I.
Demographic characteristics of the study group

	No	%
Age	41.6±5.051 (min. age - 27 years old, max. age = 49 years old)	
Sex		
Females	17	37.8
Males	28	62.2
Place of residence		
Urban Area	37	82.2
Rural	8	17.8

In Table 2, information is presented regarding the distribution of cases based on demographic characteristics and the status of the lost implants. 63.8% of cases lost 2 implants, with more than half of these having a survival period on the arch of 6-10 years (59.6%). 61.7% of the implants were overdenture with removable prostheses, the implants being placed predominantly in the lateral areas. The type of opposing arch was 40% natural or mixed (31.9%). The majority of lost implants were recorded in male subjects from urban areas, many of the implants having a survival period on the arch of 6-10 years.

TABLE II.
Distribution of cases

			Gender		Residence	
	No.	**%**	**Female**	**Male**	**Urban**	**Rural**
Number of implants						
1 implant	17	36.2	35.3%	64.7%	88.2%	11.8%
2 implants	30	63.8	36.7%	63.3%	80.0%	20.0%
p			0.591		0.385	
Number of years since implantation						
<5 years	11	23.4	45.5%	54.5%	90.9%	9.1%
6-10 years	28	59.6	28.6%	71.4%	85.7%	14.3%
>10 years	8	17.0	50.0%	50.0%	62.5%	37.5%
p			0.412		0.222	
Type of denture						
Dental bridges	18	38.3	90.9%	9.1%	88.9%	11.1%
Removable denture	29	61.7	85.7%	14.3%	79.3%	20.7%
p			0.107		0.334	
Type of opposing arch						
natural arch	19	40.4	26.3%	73.7%	84.2%	15.8%
mixed arch	15	31.9	46.7%	53.3%	86.7%	13.3%
artificial arch	13	27.7	38.5%	61.5%	76.9%	23.1%
p			0.462		0.778	
Implant location						
frontal area	17	36.2	35.3%	64.7%	82.4%	17.6%
lateral premolar area	15	31.9	53.3%	46.7%	80.0%	20.0%
Lateral molar area	15	31.9	20.0%	80.0%	86.7%	13.3%
p			0.164		0.885	

The statistical analysis results of the associations between the number of lost implants and the dietary preferences of participants are presented in table III. It is observed that the consumption of foods with a hard consistency is associated with the loss of dental implants, with a positive but moderate intensity of association (r=0.573); however, the differences in the number of implants lost are statistically insignificant (p=0.840). Regarding the effect of consuming hot beverages on the survival period of implants, the statistical analysis indicates a positive association between the two variables, though the correlation is relatively weak (r=0.382).

TABLE III.
Correlations between number of lost implants and dietary preferences

	No of lost implants		p	r
	1 implant	2 implants		
Dietary preferences				
Soft food	5.9%	3.3%	0.840	0.573
Hard food	82.4%	80.0%		
Both	11.8%	16.7%		
Beverage preferences				
Cold beverages	23.5%	13.3%	0.306	0.382
Hot beverages	76.5%	86.7%		
Frequency of hard food consumption				
daily	88.2%	90.0%	0.603	0.854
occasionally	11.8%	10.0%		
Frequency of hot/cold beverage consumption				
daily	76.5%	83.3%	0.417	0.875
occasionally	23.5%	16.7%		

Significant positive correlations were recorded between implant loss and the frequency of daily consumption of hard foods and hot beverages. Thus, participants who consumed hard foods or hot beverages daily lost more implants compared to those who consumed them occasionally (r=0.854 for hard foods and r=0.875 for hot beverages).

DISCUSSION

Systemic diseases including diabetes and osteoporosis are more common among older individuals seeking implant rehabilitation. The stability of osseointegration could be jeopardized if these illnesses negatively impact bone metabolism. Because we aimed on the dietary habits of the patients, we excluded from the study this type of patient, in order not to interfere with the results.

Dental implants can only last if the bone is healthy and the place is prepared correctly. Research has linked factors like cigarette use to clustering of dental implant failure patterns within participants. It is now well acknowledged that the bone should sustain minimum mechanical and thermal damage when the location is prepared for an implant. No research in Romanian literature has examined temperature variations in and around implants during normal oral functions, despite the fact that heat-induced bone injury may happen during uncontrolled drilling or acrylic polymerization near an implant abutment.

Exposure to heat, in terms of both tem-

perature and time, is the determinant of thermal damage. There has been reports of hyperemia at 40°C. At 42°C, proteins such procollagen and collagen I, which are essential in bone remodeling. Additionally, exposing cortical bone to 47°C for one-minute produces necrosis (20-23).

The oral cavity temperature can rise to 67°C16 and even 76°C to 77°C after drinking hot beverages, according to previous research (24, 25).Ex vivo simulations of implanted bovine mandibles showed that the highest temperatures recorded at the implant-bone interfaces were higher above the temperature threshold for transitory alterations in bone, which is 42°C (24). The importance of minimizing mechanical and thermal stress on the bone during the preparation of the implant site has recently been acknowledged.

A significant risk factor for late failure in the oral history is a history of periodontitis. A need for implant rehabilitation might be prompted by periodontitis, which is a leading cause of tooth loss. Not only that, but a prior review found that periodontitis is a risk factor for peri-implantitis, which in turn increases the likelihood of late failure (24). Inflammation around implants, known as peri-implantitis, is strongly linked to a patient's history of periodontitis, according to research by Jemt *et al.* (25). The transfer of periodontal bacteria from natural teeth to the implant may be the cause of this impact (26). Although peri-implantitis is an indication of late failure, only one study (11) looked at implant loss and not the correlation between a periodontitis diagnosis and late failure.

It is intriguing to note that according to two investigations, every individual who had a late loss had also suffered an early loss (25, 27). There was no statistical study done, however while treating patients who have experienced early implant loss, doctors should keep in mind that there is a substantial association between early and late implant loss.

While some studies have shown a link between posterior implant placement and late failure (17, 28, 29), others have failed to find such a correlation (30, 31). The reason behind the substantial association result could be because the occlusal forces on the back teeth are three times larger than on the front teeth (32). There is evidence that dental plaque accumulates more readily in posterior regions than in anterior ones, and that this buildup causes inflammation of the gums and the beginning of various oral disorders, all of which can contribute to the failure of dental implants (33).

The impact of maxilla implant site on late failure is debatable, despite the fact that it is known to increase the likelihood of early failure (34). Some research have suggested that implants put in the mandible (25, 35) or the maxilla (29) could increase the likelihood of late failure, while the majority of studies have shown that implant placement site does not significantly affect late failure (30, 31, 36).

Implant implantation in the maxilla may be associated with late failure because the cortical bone is thinner and the trabecular bone is less dense compared to the mandible (37, 38).

A decreased initial stability due to weakened bone structure increases the likelihood of dental implant failure in the long run (25). At the same time, it is not known why implants placed in the mandible are associated with late failure.

CONCLUSIONS

Osseointegration is the most important factor in the success of dental implant therapy. While dental implants are a reliable and popular option for individuals who are missing teeth, there is a risk that the high temperatures used to place the implants could harm the surrounding tissues and organs, leading to

unfavorable consequences. To sum up, we have tackled the intriguing issue of dental implants experiencing temperature variations and transitory heat transfer when hot liquids are consumed in this work.

According to our research, one possible cause of clustered implant failures is the regular drinking of very hot/cold drinks. It is possible to warn patients about the risk of harm from prolonged exposure to temperatures greater than 42°C or even 47°C at the interface between osseointegrated implants and bone, even if this risk has not been adequately studied.

Further clinical studies are required to determine whether the habitual consumption of hot food and beverages might be considered a risk factor in the success of implant-supported restorations.

It is recommended that additional research to be conducted in order to identify the possible risk of implant failure associated with the regular intake of extremely hot beverages, which patients rarely report.

CONFLICT OF INTEREST AND FUNDING

The authors declare that there is no conflict of interest, and they received no specific funding regarding this scientific research.

REFERENCES

1. Kwok V, Caton JG, Hart ID, Kim TS. Dental implant prognostication: A commentary. *J Periodontol.* 2023; 94(6): 713-721.
2. Ogawa T, Sitalaksmi RM, Miyashita M, *et al*. Effectiveness of the socket shield technique in dental implant: A systematic review. *J Prosthodont Res* 2022; 66(1): 12-18.
3. Elani HW, Starr JR, Da Silva JD, Gallucci GO. Trends in Dental Implant Use in the U.S., 1999-2016, and Projections to 2026. *J Dent Res* 2018; 97(13): 1424-1430.
4. Alghamdi HS, Jansen JA. The development and future of dental implants. *Dent Mater J* 2020; 39(2): 167-172.
5. Saini M, Singh Y, Arora P, Arora V, Jain K. Implant biomaterials: A comprehensive review. *World J Clin Cases* 2015; 3: 52-57.
6. Norton MR. Biologic and mechanical stability of single-tooth implants: 4- to 7-year follow-up. *Clin Implant Dent Relat Res* 2001; 3: 214-220.
7. Busenlechner D, Fürhauser R, Haas R, Watzek G, Mailath G, Pommer B. Long-term implant success at the Academy for Oral Implantology: 8-year follow-up and risk factor analysis. *J Periodontal Implant Sci* 2014; 44: 102-108.
8. Krebs M, Schmenger K, Neumann K, Weigl P, Moser W, Nentwig G. Long-Term Evaluation of ANKYLOS® Dental Implants, Part I: 20-Year Life Table Analysis of a Longitudinal Study of More than 12,500 Implants. *Clin Implant Dent Relat Res* 2013; 17: e275-e286.
9. Barootchi S, Wang HL. Peri-implant diseases: Current understanding and management. *Int J Oral Implantol (Berlin)* 2021; 14(3): 263-282.
10. Khan FR, Raza Kazmi SM, Siddiqui YF. A bibliometric analysis of the studies on dental implant failure. *J Pak Med Assoc* 2022; 72(Suppl 1) (2): S76-S80.
11. Derks J, Håkansson J, Wennström J, Tomasi C, Larsson M, Berglundh T. Effectiveness of implant therapy analyzed in a Swedish population: Early and late implant loss. *J Dent Res* 2015; 94: 44S-51S.
12. Romeo E, Chiapasco M, Ghisolfi M, Vogel G. Long-term clinical effectiveness of oral implants in the treatment of partial edentulism: Seven-year life table analysis of a prospective study with ITI Dental Implants System used for single-tooth restorations. *Clin Oral Implant Res* 2002; 13: 133-143.
13. Adell R, Lekholm U, Rockler B, Brånemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg* 1981; 10: 387-416.
14. Esposito M, Hirsch JM, Lekholm U, Thomsen, P. Biological factors contributing to failures of osseointegrated oral implants, (I). Success criteria and epidemiology. *Eur J Oral Sci* 1998; 106: 527-551.
15. Tonetti MS, Schmid J. Pathogenesis of implant failures. *Periodontol* 2000; 1994(4): 127-138.

16. Elaskary A. *Fundamentals of Esthetic Implant Dentistry*. Hoboken, NJ, USA: John Wiley & Sons, 2008.
17. Mano Y, Oubai, S, Mardinge, O, Chaush, G, Nissa, J. Characteristics of early *versus* late implant failure: A retrospective study. *J Oral Maxillofac Surg* 2009; 67: 2649-2652.
18. Sakka S, Baroudi K, Nassani MZ. Factors associated with early and late failure of dental implants. *J. Investig Clin Dent* 2012; 3: 258-261.
19. Clark D, Levin L. Dental implant management and maintenance: How to improve long-term implant success? *Quintessence Int* 2016; 47: 417-423.
20. Eriksson A, Albrektsson T, Grane B, *et al*. Thermal injury to bone. A vital microscopic description of heat effects. *Int J Oral Surg* 1982; 11: 115-121.
21. Eriksson AR, Albrektsson T. Temperature threshold levels for heat-induced bone tissue injury: A vital-microscopic study in the rabbit. *J Prosthet Dent* 1983; 50: 101-107.
22. Benington IC, Biagioni PA, Crossey PJ, *et al*. Temperature changes in bovine mandibular bone during implant site preparation: An assessment using infrared thermography. J Dent. 1996; 24:263- 267
23. Palmer DS, Barco MT, Billy EJ. Temperature extremes produced orally by hot and cold liquids. *J Prosthet Dent* 1992; 67: 325-327.
24. Heitz-Mayfield LJ. Peri-implant diseases: Diagnosis and risk indicators. *J Clin Periodontol* 2008; 35: 292-304.
25. Jemt T, Karouni M, Abitbol J, Zouiten O, Antoun H. A retrospective study on 1592 consecutively performed operations in one private referral clinic. Part II: Peri-implantitis and implant failures. *Clin Implant Dent Relat Res* 2017; 19: 413-422.
26. Karoussis IK, Kotsovilis S, Fourmousis I. A comprehensive and critical review of dental implant prognosis in periodontally compromised partially edentulous patients. *Clin Oral Implant Res* 2007; 18: 669-679.
27. Chrcanovic BR, Kisch J, Albrektsson T, Wennerberg A. Bruxism and dental implant treatment complications: A retrospective comparative study of 98 bruxer patients and a matched group. *Clin Oral Implant Res* 2017; 28: e1-e9.
28. Noda T. A longitudinal retrospective study of the analysis of the risk factors of implant failure by the application of generalized estimating equations. *J Prosthodont Res* 2015; 59: 178-184.
29. Alsaadi G, Quirynen M, Komárek A, Van Steenberghe D. Impact of local and systemic factors on the incidence of late oral implant loss. *Clin Oral Implant Res* 2008; 19: 670-676.
30. Dvorak G, Arnhart C, Heuberer S, Huber CD, Watzek G, Gruber R. Peri-implantitis and late implant failures in postmenopausal women: A cross-sectional study. *J Clin Periodontol* 2011; 38: 950-955.
31. Strietzel FP, Karmon B, Lorean A, Fischer PP. Implant-prosthetic rehabilitation of the edentulous maxilla and mandible with immediately loaded implants: Preliminary data from a retrospective study, considering time of implantation. *Int J Oral Maxillofac Implant* 2011; 26: 139-147.
32. Chrcanovi BR, Albrektsso, T, Wennerber, A. Bruxism and dental implants: A meta-analysis. *Implant Dent* 2015; 24: 505-516.
33. Sreenivasan PK, Prasad KV. Distribution of dental plaque and gingivitis within the dental arches. *J. Int Med Res* 2017; 45: 1585-1596.
34. Manzano G, Montero J, Martín-Vallejo J, Del Fabbro M, Bravo M, Testori T. Risk factors in early implant failure: A meta-analysis. *Implant Dent.* 2016; 25: 272-280.
35. Jemt T. A retro-prospective effectiveness study on 3448 implant operations at one referral clinic: A multifactorial analysis. Part II: Clinical factors associated to peri-implantitis surgery and late implant failures. *Clin Implant Dent Relat Res* 2017; 19: 972-979.
36. Doll C, Nack C, Raguse JD, *et al.* Survival analysis of dental implants and implant-retained prostheses in oral cancer patients up to 20 years. *Clin. Oral Investig* 2015; 19: 1347-1352.
37. Park HS, Lee YJ, Jeong SH, Kwon TG. Density of the alveolar and basal bones of the maxilla and the mandible. *Am J Orthod Dentofac Orthop* 2008; 133: 30-37.
38. Chugh T, Ganeshkar SV, Revankar AV, Jain AK. Quantitative assessment of interradicular bone density in the maxilla and mandible: Implications in clinical orthodontics. *Prog Orthod* 2013; 14: 38.