Clinical Performance of 170 Frictional Morse Taper Implants: 2 Years Follow-Up

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This study evaluated the clinical survival rates of 170 Morse taper implants through clinical and mechanical parameters in different therapeutic approaches such as single crowns, fixed partial prostheses, and fixed full-arch prostheses. Patients referred to the Center on Education and Research on Dental Implants from May 2017 to July 2018 with the indication for dental implant therapy, aged >18 years, without periodontal disease, recent evidence of inflammatory activity or other oral disorders, current pregnancy, uncontrolled diabetes mellitus or heavy smoking habit were included in this study. After 12 weeks of healing since the implants were placed in the mandible and after 16 weeks following implants placed in the maxilla, patients returned to the Center for prosthetic rehabilitation. After implant therapy, all patients underwent periodical, clinical, and prosthetic examinations every 6 months. Prosthetic restorations involved 109 fixed reconstructions in function. Few prosthetic complications were reported (6.55%). Twenty implants were rehabilitated with cemented prostheses; from those, 1 crown suffered a loss in retention/decementation. Of the 148 implants rehabilitated with screwed-retained prostheses, 6.76% suffered prosthetic screw loosening. The cumulative implant survival rate was 98.2%. When peri-implant tissue health was evaluated, the keratinized mucosa band appeared related to peri-implant tissue stability. Thus, Morse taper implants represented a successful procedure for implant rehabilitation, with a high cumulative implant survival rate, low prevalence of biological and prosthetic complications, and good stability of peri-implant tissues over the assessed period.

Key Words: risk factors, complications, dental implants, Morse taper implants

INTRODUCTION

The advent of osseointegration has provided an option for rehabilitating edentulous arches using implant-supported fixed prostheses. Osseointegration has been demonstrated over several years to be a safe and predictable treatment with high implant survival rates.[1] It is presumable that rehabilitated implants should last for many years with the increasing overall life expectancy.[2] In addition, the routine clinical use of any implant system should be based on the evaluation of the behavior of a specific system through clinical follow-up examinations.

Despite the success and predictability of implant-supported rehabilitations, there are reports of a high prevalence of prosthetic complications, such as fractures of screws or abutments, ruptures of the luting cement (loss of retention), fractures or deformations of the veneers, loss of the screw access through the restoration, loosening of screws or abutments, have been published.[2]

Screw-type connections are most clinically applied[3,4]; however, the screw is a common problem of implant-supported prostheses (third most common technical complication).[2] The screw can loosen or fracture when occlusal loads exceed the preload threshold, and lower masticatory forces may lead to gradual loosening of the implant-abutment and crown-abutment connections.[5,6] The second most common technical failure related to implant prostheses is the loss of the screw access through the restoration, with a rate after a 5-year follow-up of 5.4%. Furthermore, the most common technical complication is the fracture of the veneer material (acrylic, ceramic, or composite).[2] On the other hand, according to the third EAO consensus conference, the most common technical complication was screw or abutment loosening, which corroborated other results, which stated 8.9% of screw failures in prostheses are placed over abutments.[7,8]

The relationship between the mechanical immobility of the abutment and the stability of the marginal peri-implant tissue with the formation of biological spaces was described by Hermann et al.[9] They observed that the magnitudes of peri-

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implant bone loss were inversely proportional to the distances between the interfaces of the prosthetic-implant components of the bone crests.[9] Also, in 1997, Cochran et al[10] described the dimensions of the biological space around implants with an area of conjunctival adhesion between the junctional epithelium and the first bone-implant contact. They showed that the dimensions of the biological space were similar to those described by Gargiulo et al[11] for natural teeth. Thus, it was demonstrated that the biological space in implants is a stable and physiologically formed structure, with dynamic changes occurring in the measurements of the junctional epithelium and conjunctive adhesions. In contrast, the dimensions of both biological structures together remain constant.[12] In this context, biological distances and tissue phenotypes are protagonists where the absence of gingival recession and papilla presence are required.[9,12,13]

In 1986, it was demonstrated that implants with external or internal hexagonal connections suffer saucerization, characterized by a physiological vertical bone loss of approximately 1.5 mm after the first year of prosthetic function that should not exceed 0.2 mm annually.[14] This is due to the instability of the abutment, which provides infiltration and bacterial proliferation in the space formed at the implant/abutment interface, which is near the peri-implant bone crest. Biological distances are formed around the implant, apically to the prosthetic abutment/implant interface. Therefore, depending on the gingival phenotype, instability of the marginal peri-implant mucosa may occur.[8,9,14,15]

To better stabilize the prosthetic connection and further reduce the incidence of mechanical and biological complications in the routinely used external and internal hexagonal connections, internal conical connections with different taper angles were introduced, adjusting the frictional locking between abutment and implant internal walls. Furthermore, in the "platform switching" model (abutment diameter smaller than the implant diameter), internal conical connections showed better biological sealing, stability and distribution of forces, thus reducing the incidence of mechanical and biological complications. However, in many cases, screws are still used for prosthetic fixation due to incongruous or excessively expulsive implant internal angles. The mechanical stability of the internal conical connections and the use of platform switching, distancing the implant/abutment interface from the bone crest, hence creating space for the formation of the biological spaces, provided better results concerning marginal peri-implant tissue stability, that is, absence of marginal gingival recession and presence of papilla, which are fundamental for aesthetic outcomes of implant-supported prostheses.[15–20]

A screwless implant-abutment internal conical connection based on the "Morse effect" was introduced as an evolution to screw-retained abutment systems. These implant systems comprise an implant and a prosthetic abutment joined by a Morse taper, which induces a self-locking coupling between component parts. The screw is eliminated, and only the friction between the implant and abutment surfaces guarantees the assembly of the mechanical components. From a mechanical point of view, it becomes a self-retentive system whose compressive forces along the long axis of the implant-abutment favor, over time, the retention and the stability against oblique forces. For this, the angulation of the internal walls of the implant must be 1.5° on each wall, totaling a taper of 3°. It results in a biomechanically more stable watertight joint, with less clearance than screw-type connections, capable of resisting eccentric loads and bending moments and reducing microbial penetration in the interfaces. Thus, the biological distances are formed around the abutment coronally to the prosthetic abutment/implant interface due to the stability of the abutment and minimum space between the internal implant wall and the abutment.[21–23]

A 10-year follow-up prospective study about survival and complication rates of fixed restorations supported by screw-free implants confirmed an acceptable rate of 88.6%, suggesting this implant-abutment system seems to be a promising procedure for dental rehabilitation with a very low incidence of mechanical (0.4%) and technical (3.2%) complications.[24] Moreover, an in vitro study, which assessed the long-term fatigue and retention stability of a Morse taper implant-abutment connection through dynamic chewing simulation, revealed a similarity between the 2 connection types.[25] However, although the literature assures the efficacy of this type of implant connection, there needs to be more evidence of the evaluation of surgical and prosthetic parameters in different clinical applications. Therefore, this observational study aims to evaluate the clinical performance of 170 screw-free implants through the following surgical and prosthetic parameters: implant survival rate, abutment loosening/fracture, screw loosening/fracture, ceramic chipping/fracture, fracture of the veneers or frameworks, loss of retention/decementation and peri-implant clinical health in different implant regions and positions in the arch and clinical applications, such as single crowns (SCs), fixed partial prostheses (FPPs), and fixed full-arch prostheses (FFAs).

Materials and Methods

This is a prospective study. The selected patients underwent surgery between 2017 and July 2018 at the Federal University of Santa Catarina (Florianópolis - Brazil) and were followed up for at least 1 year. The study protocol was approved by the Research Ethical Committee Protocol no. 2.079.136. This clinical investigation takes place in compliance with the European Community Marking Certificate of Registration) - CE 6703901 meets the MDR directive 2017/745/EU2 and the ISO 20416:20203 standard. The investigation protocol was explained to everyone who signed the informed consent. The inclusion criteria were: indication for treatment with dental implants, age >18 years, good systemic health, and good oral health full-mouth plaque score (FMPS) <20%, full-mouth bleeding score (FMBS) <20%.

The exclusion criteria were poor oral hygiene, periodontal disease with recent evidence of inflammatory activity or other oral disorders, current pregnancy, uncontrolled diabetes mellitus, and heavy smoking habit (>10 cigarettes/day).

Implant design

Internal conical screw-free connection implants (Arcsys system FGM, Joinville, Brazil) were used. The inner walls of these internal

conical implants are at a 1.5-degree angulation, which is designed to eliminate mechanical screw retention (Morse taper). The implant-abutment connection is based on the principle defined as "cold welding,"[1] where the connection of the mechanical components is secured only by friction between the implant and the microscopic irregularity of the prosthetic abutment surfaces.[15,21] This implant system provides the possibility of abutment angulation between 0 and 20 degrees upon installation, according to each clinical case situation, due to a solid body (without a passing screw) and a more resistant material (Stainless Steel).

Surgical and prosthetic procedures

Before placing the implant, a complete oral examination was carried out for each participant enrolled in the study. Patients received appropriate treatments and oral hygiene instructions. Cone-beam computed tomography (CBCT) was obtained to assess the width and thickness of each implant site, the density of the cortical and cancellous bone, and the relationship with critical anatomical structures. Based on the diagnostic wax-up, surgical guides were manufactured.

Patients were divided into groups according to clinical requirements: late implant placement, immediate implant placement, implant placement with xenogenous or synthetic bone substitutes (with or without membranes), conventional loading, and immediate loading. Parameters included at the time of implant placement were the teeth position, moment of implant placement, implant length and diameter, placement torque, need for bone substitutes, and implant loading protocol.

All patients received antibiotic prophylaxis with oral 2 g amoxicillin (Bayer S.A., São Paulo, Brazil) 1 hour before the surgery and used 0.12% chlorhexidine mouthwash for 1 minute immediately before starting the surgical intervention. All surgeries were performed under local anesthesia. When there was no indication for the use of bone substitutes, a minimally invasive full-thickness flap was elevated. When an immediate implant was placed, flapless and minimal traumatic tooth extraction was performed, and the gap (space between the implant and the socket's walls) was filled with particulate bone substitutes. Implant sockets were prepared following manufacturer recommendations, under constant irrigation, with implants positioned 2 mm below the bone crest level. Immediate loading with provisional prosthesis was performed only in cases where a torque $>$32N was obtained. When the implant was not immediately loaded, the cover cap was positioned, and the full-thickness flap was sutured over it. All patients continued to be administered oral antibiotics – 2 g of amoxicillin per day for the other 6 days after surgery. Postoperative pain was controlled by administering 100 mg nimesulide (Aché S.A., São Paulo, Brazil) every 12 hours for 3 days. Detailed instructions about postoperative care were given, and mouthwashes with 0.12% chlorhexidine (Periogard Colgate-Palmolive Company, New York, NY) were administered twice a day for 10 days. Suture removal was performed after 7 to 10 days.

After 12 weeks of healing for implants placed in the mandible and after 16 weeks for implants placed in the maxilla, patients returned to start the prosthetic rehabilitation with SCs, FPPs, or FFAs. A second-stage surgery was performed to obtain access to the underlying implants. All bone or soft tissue interferences in and around the implant were removed, and healing abutments were placed. After 2 weeks, the abutments were selected, angulated when needed according to the clinical situation, and placed and activated with 3 seating knocks in the long implant axis with the handle/mallet so that the definitive prosthetic restorations could be installed over it. The definitive rehabilitation process began for those with a provisional prosthesis due to immediate loading.

Full-arch prostheses were fabricated with acrylic resin with a metal framework, and SCs and FPPs were manufactured with a metallic framework coated with ceramic (metalloceramic prosthesis). When the prosthesis was cemented over the abutment, the cementation was performed with zinc phosphate cement (SSWhite Duflex, Rio de Janeiro, Brazil); when the prosthesis was screwed, the torque of the screw was 10 N, according to the manufacturer's recommendations.

After implant therapy, all patients underwent periodical clinical, radiographic, and prosthetic examinations every 6 months. Two examiners with a kappa concordance carried out the evaluations. The cumulative implant survival rate was investigated, and careful attention was dedicated to analyzing prosthetic complications (abutment loosening, abutment fracture, screw loosening, screw fracture, loss of retention/decementation, ceramic chipping/fracture, fracture of the framework). All these mechanical complications were carefully registered and managed during the follow-up visit.

For peri-implant health clinical examination, a universal millimeter periodontal probe (Hu-Friedy, Chicago, IL) was used to assess the following parameters: Modified Plaque Index (MPI), amount of keratinized mucosa (KM), peri-implant mucosal recession (PMR), probing depth (PD), clinical attachment level (CAL), bleeding on probing (BP), and suppuration (S).

An implant was classified as a survival implant when it was still functioning at the last clinical and radiographic control session. An implant was considered to fail when removed or in cases of lack of osseointegration (detected by implant mobility). The implant survival rate was expressed as a percentage of the function of implants related to the total amount of implants installed. The implant was used as the unit of evaluation for all analysis parameters.

Statistical analysis

Descriptive statistics were employed to summarize and evaluate the distribution of patients, implants, restorations, and peri-implant probing to calculate the incidence and 95% CI of implant failures and prosthetic complications. Peri-implant health variables were presented using absolute distribution (n) and relative distribution (%) for categorical variables and measures of central tendency (mean, median) and dispersion (SD) for continuous variables. The variable KM displayed skewness and kurtosis values within the range of -1 to $+1$, indicating a normal distribution. A 2-way ANOVA with Posthoc Bonferroni test was employed to assess the impact of implant position (anterior and posterior) and implant region (upper and lower) on the quantity of keratinized mucosa. Comparison between implant regions and categories for Keratinized Mucosa, as well

as categories for Modified Plaque Index, was conducted using a χ^2 test.

Furthermore, the Spearman Rho correlation coefficient test performed correlation analysis between peri-implant health variables. The results were evaluated with 95% CIs, and the significance level was set at .05 ($P < .05$). The study data were analyzed using IBM SPSS Statistics 26 software.

Results

A total of 55 patients met the inclusion criteria and were included in the study. In total, 170 Morse taper implants were installed. Of these, 104 implants (61%) were installed in the maxilla (41 in the anterior region and 63 in the posterior region), and 66 implants (39%) were placed in the mandible (10 in the anterior region and 56 in the posterior region). The implant lengths were >5 mm in approximately 96% of the cases, and the implant diameters were >3.3 mm in approximately 73% of the total implants placed. Information on frequencies and CIs for all variables is summarized in Table 1. In 25% of the sites, bone substitutes were used at the time of implant placement, including 11 gaps filled when an implant was placed immediately. Only 13 implants were immediately loaded (8 in the anterior region of the maxilla), even with an average torque of 42 N.

The restorations involved 109 fixed prostheses (89 SCs and 20 multiple prostheses) functioning for at least 6 months. A few prosthetic complications were reported (6.55%). A total of 168 implants received prosthetic rehabilitation. Twenty implants were rehabilitated with cemented prostheses, from which 1 SC suffered a loss of retention/decementation. One hundred forty-eight implants were rehabilitated with screwed retained prostheses, of these, 10 SCs (6.76%), suffered prosthetic screw loosening. Ceramic chipping/fracture occurred in 3 screw-retained SCs (1.8%). All mechanical complications were reported in the posterior area. No abutment loosening or fracture was reported, even when the abutment was angulated.

A total of 107 implants were evaluated on peri-implant health clinical examination. For the PD, CAL, and PMR parameters, 6 probing sites were performed on each implant (buccal, mesiobuccal, distobuccal, lingual, mesiolingual, and distolingual), and only the highest measured probing site (worst situation) was considered for statistical analysis for each implant. To measure the amount of KM, 3 measurement sites (buccal, mesiobuccal, and distobuccal) were performed, and the value corresponding to the mean between the 3 points was considered for statistical analysis. For the MPI parameter, data were collected according to 4 categories (0 – no plaque; 1 – visible when probing; 2 – visible; 3 – abundant), and for the parameters BP and S, data were collected and classified into 2 categories (1 – present; 2 – absent).

When the KM measurements of each implant were analyzed in relation to its position (anterior and posterior) and region (upper and lower) in the arch, there were statistically significant effects of region ($F_{1,106} = 10.407$; $P = .002$) and position ($F_{1,106} = 16.150$; $P < .001$); however, the interaction (region*position) was not statistically significant ($F_{1,103} = 2.443$; $P = .121$). Thus, it was observed that the upper region and

Table 1

Frequencies and CI of mechanical variables

	Proportion (%)	*α 0.05%
Implant Region (n = 170)		
Upper anterior	24.1	(18.2; 31.2)
Upper posterior	37.1	(30.1; 44.6)
Lower anterior	6.0	(03.2; 10.6)
Lower posterior	32.9	(26.2; 40.4)
Installation time (n = 170)		
Up to 6 months	0	0
Up to 1 year	30.0	(23.5; 37.4)
More than a year	70.0	(62.6; 76.5)
Diameter of the implant (n = 170)		
3.3 mm	27.0	(20.9; 34.3)
>3.3 mm	72.9	(65.7; 79.1)
Length of the implant (n = 170)		
5 mm	4.1	(02.0; 08.4)
>5 mm	95.9	(91.6; 98.0)
Immediate installation (n = 170)		
No	85.9	(79.7; 90.4)
Yes	14.1	(09.6; 20.3)
Regeneration (n = 170)		
No	74.7	(67.6; 80.7)
Yes	25.3	(19.3; 32.4)
Immediate loading (n = 170)		
No	92.3	(87.1; 95.5)
Yes	7.7	(04.5; 12.9)
Time loading (n = 168)		
Up to 6 months	0	—
More than a year	100	—
Type of prosthesis (n = 168)		
Single	53.0	(45.3; 60.5)
Bridge	47.0	(39.5; 54.7)
Type of prosthesis (n = 168)		
Screwed	88.1	(82.2; 92.2)
Cemented	11.9	(07.8; 17.8)
Type abutment (n = 130)		
Foldable	66.2	(57.5; 73.9)
No foldable	33.9	(26.1; 42.5)
Mobility (n = 168)		
No	100	—
Yes		—
Abutment loss (n = 168)		
No	100	—
Yes		—
Decementation (n = 20)		
No	95.0	(67.7; 99.4)
Yes	05.0	(00.6; 32.3)
Screw loosening (n = 148)		
No	93.2	(87.8; 96.4)
Yes	06.8	(03.6; 12.2)
Screw fracture (n = 148)		
No	100	—
Yes		—
Ceramic chipping (n = 168)		
No	98.2	(94.6; 99.4)
Yes	1.8	(00.6; 05.4)
Framework fracture (n = 168)		
No	100	—
Yes		—
Abutment fracture (n = 168)		
No	100	—
Yes		—
Implant loss (n = 170)		
No	98.2	(94.6; 99.4)
Yes	1.8	(00.6; 05.4)

*There were significant differences in all frequency comparisons.

TABLE 2

Effects of region, position, and interaction on the comparison of mean values of keratinized mucosa quantity (n = 107)*

	MK Mean (SD)	Two-Way ANOVA - F Test	Posthoc Tests (Bonferroni)
Region		$F_{1,106} = 10.407$; $P = .002$	
Upper	3.77 (1.84)		.002
Lower	2.13 (1.64)		
Position		$F_{1,106} = 16.150$; $P < .001$	
Anterior	4.13 (1.54)		<.001
Posterior	2.50 (1.86)		
Interaction (region*position)		$F_{1,103} = 2.443$; $P = .121$	
Anterior/upper	4.37 (1.33)		—
Anterior/lower	3.76 (1.82)		
Posterior/upper	3.47 (1.99)		
Posterior/lower	1.73 (1.33)		

*In Table 2, the effects of region, position, and their interaction on the comparison of mean values of keratinized mucosa quantity are presented. There were statistically significant effects of region ($F_{1,106} = 10.407$; $P = .002$) and position ($F_{1,106} = 16.150$; $P < .001$); however, the interaction (region*position) was not statistically significant ($F_{1,103} = 2.443$; $P = .121$). Thus, it was observed that the upper region and anterior position had higher mean values of keratinized mucosa quantity than the lower region and posterior position, respectively.

anterior position had higher mean values of keratinized mucosa quantity than the lower region and posterior position, respectively as shown in Table 2.

The data corresponding to the KM parameter were also grouped into 3 categories: 0 < 2 mm, 2 < 5 mm, and >5 mm, which represented 34.6%, 52.3%, and 13.1% of the total number of implants, respectively. The distribution was not the same among the groups, with 71.1% of the implants measuring 0 < 2 mm in the lower posterior region, representing 61.4% of the implants in this region presenting statistically significant results ($P < .01$). The information on the KM and MPI categories regarding the position in the arch is in Table 3.

As shown in Table 4, PMR values decreased as KM measurement values increased, demonstrating a negative correlation between these 2 parameters ($P < .05$). The number of implants that presented PMR measurements different from zero adds up to 29.6% of the total number of the implants measured, being these 14.1% with measurements of 1 mm, 3.7% with measurements of 2 mm, and 1.8% with measurements of 3 mm, representing respectively 71.4%, 19%, and 9.6% of PMRs. When related to the BP parameter, where the highest measured values of PD and CAL were in category 1 (present) with greater frequency in the 3 mm measurement ($P < .05$) as shown in Figures 1 and 2.

The present study showed a cumulative implant survival rate of 98.2%, with 3 loosened implants in the posterior area (2 in the maxilla and 1 in the mandible). Two implants were classified as "early failures," showing clinical mobility caused by lack of osseointegration in the healing period and 1 as "late failure" because it was loosened after abutment activation. None of the loosened implants was immediate loaded.

DISCUSSION

The study highlights the mechanical stability advantages of internal conical connections over external hexagonal connections.[5,26] In addition, the intimate contact of the implant-abutment walls minimizes biofilm penetration and the risk of

TABLE 3

Comparison between Implant region versus categories for Keratinized Mucosa and categories for Modified Plaque Index

		Implant Region					
		Upper Anterior	Upper Posterior	Lower Anterior	Lower Posterior	Total	Sig.
KM Categories							
0 < 2	n	1	8	2	27	38	$P < .01$
	%	2.6%	21.1%	5.3%	71.1%	100.0%	
2 < 5	n	12	21	6	17	56	
	%	21.4%	37.5%	10.7%	30.4%	100.0%	
>5	n	4	6	3	0	13	
	%	30.8%	46.2%	23.1%	0.0%	100.0%	
MPI							
0	n	8	15	6	25	54	$P < .01$
	%	14.8%	27.8%	11.1%	46.3%	100.0%	
1	n	6	12	0	16	34	
	%	17.6%	35.3%	0.0%	47.1%	100.0%	
2	n	1	4	5	3	13	
	%	7.7%	30.8%	38.5%	23.1%	100.0%	
3	n	2	4	0	0	6	
	%	33.3%	66.7%	0.0%	0.0%	100.0%	

Table 4

Correlation between peri implant health variables*

	PMR	PD	CAL
KM			
Rho	**−.226***	.072	.155
Sig.	**.019**	.460	.110
n	107	107	107
PMR			
Rho		−.081	−.155
Sig		.408	.112
n		107	107
PD			
Rho			**.966****
Sig			**.000**
n			107

*KM indicates amount of keratinized mucosa; PMR, peri-implant mucosal recession; PD, probing depth; CAL, clinical attachment level. * $P < 0.05$; ** $P < 0.01$, indicates bold values.

abutment loosening, resulting in better clinical and biological performance.[21,22,27] However, it acknowledges that despite the benefits of internal taper connections, some systems still rely on screws for abutment fixation, which can lead to mechanical problems.[1–3,7,17,28] The implant-abutment connection system used in this study is a Morse taper, where abutment and implant are joined by friction due to a 3-degree taper (1.5 degrees on each internal wall of the implant) that behaves like a "cold welding," dispensing with the use of screws.

The present study showed a cumulative implant survival rate of 98.2%, which is congruent with results found in other clinical follow-ups that also evaluated Morse taper connection implants and internal conical connection implants used in different prosthetic applications.[22,24,29–31] In addition, the use of an internal connection system removes the implant-abutment interface from the bone crest by the "platform switching" used

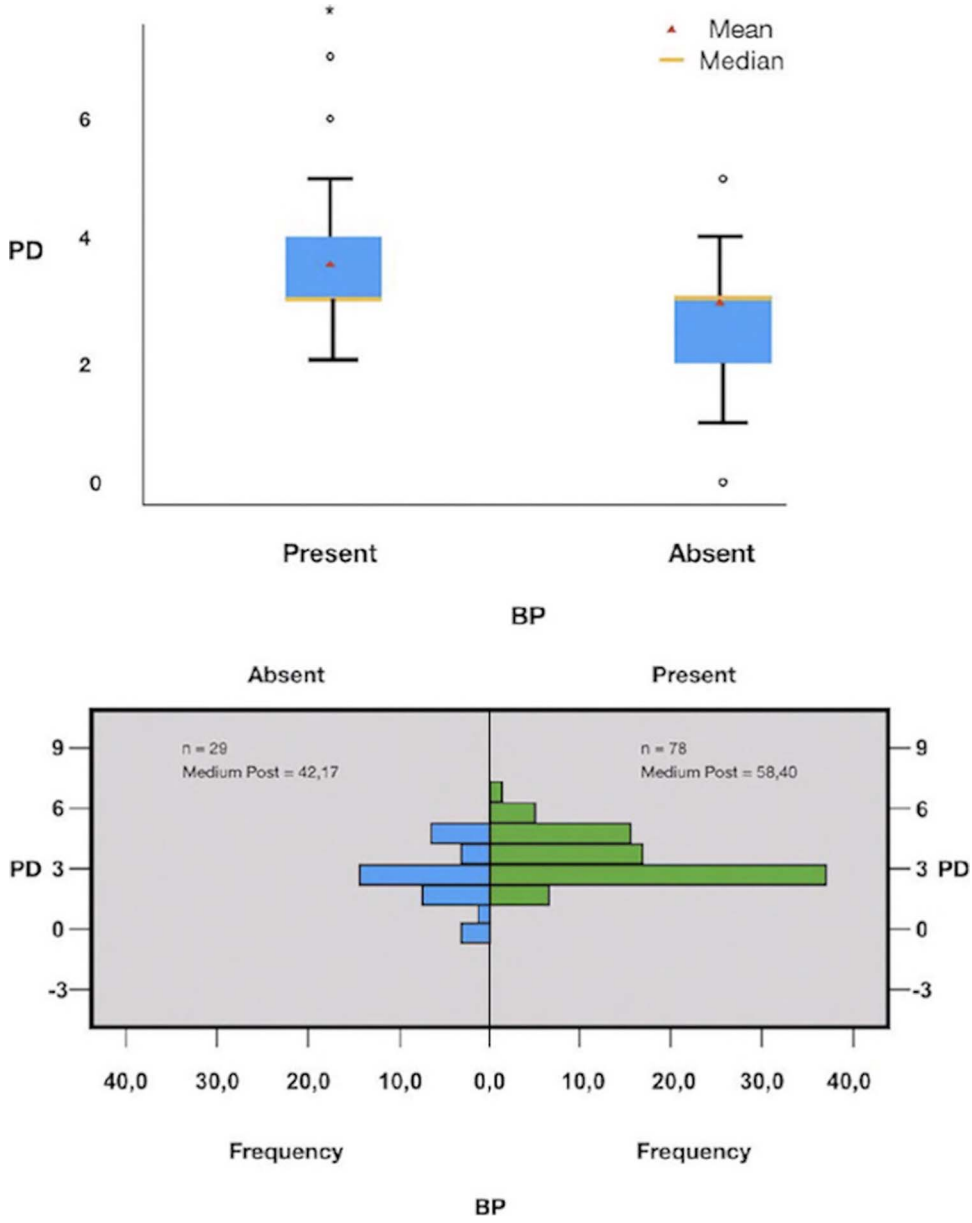

Figure 1. Bleeding on probing related to measurements of probing depth.

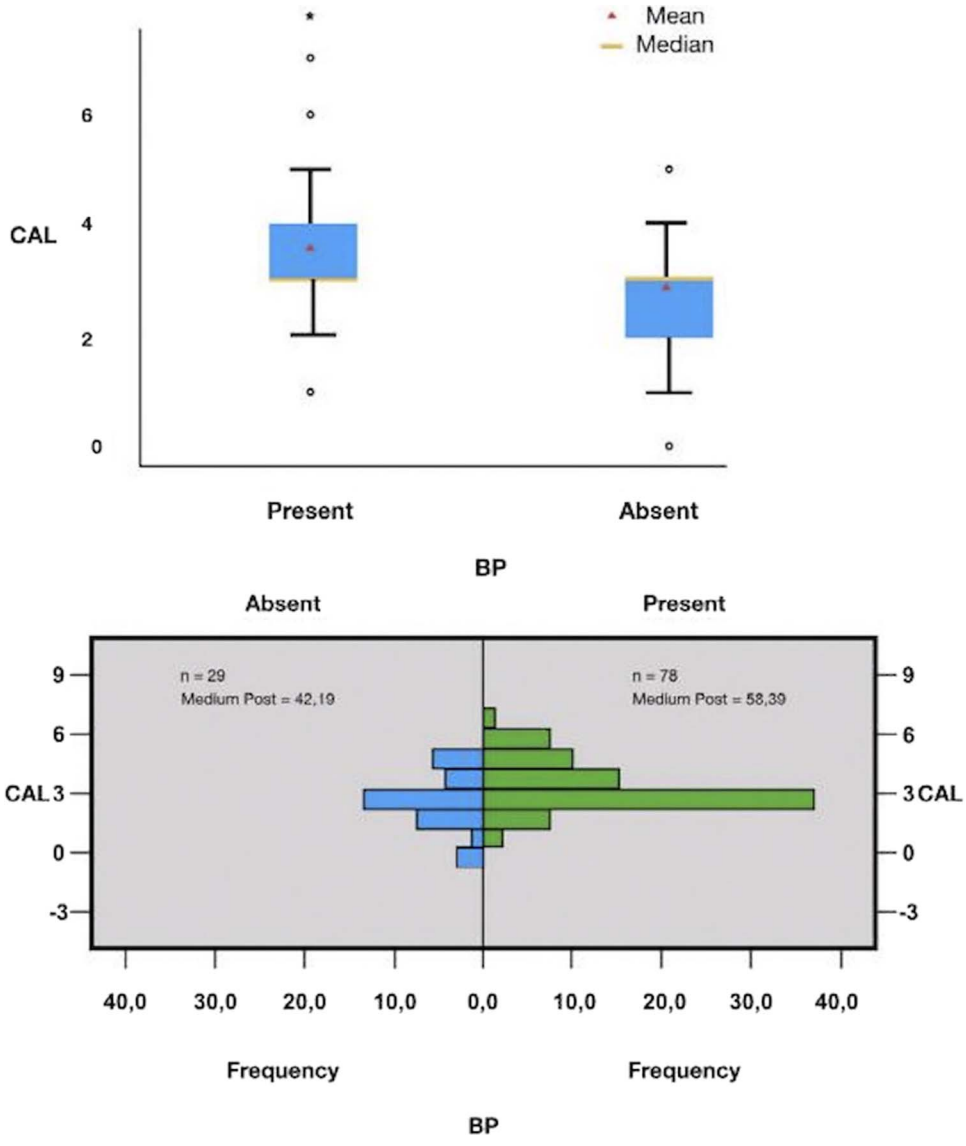

Figure 2. Bleeding on probing related to measurements of clinical attachment level.

in this system, providing space for the formation of biological distances.[21,22] This shows that higher prosthetic connection stability is clinically related to peri-implant tissue health and a successful function over several decades.

The overall goal is to maintain the marginal stability of peri-implant tissues. In this context, previous studies have shown that biological distances and phenotypes determine marginal immobility, with biological space physiologically formed to promote marginal sealing.[9–12,14,32] In addition, in a prospective controlled clinical trial, Puisys and Linkevicius[32] concluded that if mucosal tissue is 2 mm or less, significant crestal bone loss might be expected. Corroborating this, the data in this study showed that the size of the KM was inversely proportional to the recession width, indicating that larger KM bands decrease the chances of mucosal recession. However, of the 107 implants that had the peri-implant health parameters evaluated, 94.5% were within the physiologically expected loss threshold for implant rehabilitation.

A few prosthetic complications were reported in this prospective study (6.55%). This is in accordance with the study of Wittneben et al,[33] which also observed a low prosthetic-related failure rate (4.5%). The most frequent complication in the present study was screw loosening (6.76%) in single crowns, which agrees with the third EAO Consensus Conference.[8] The finding that the most common technical complications in single crowns on implants were screw or abutment loosening[8] corroborates with the results found in the study of Morsch et al,[7] with 8.9% of screw failures in prostheses placed over abutments and Priest[34] with 7.1% of screw failures.

A clinical study on implant-supported SCs and fixed dental prostheses (FDPs) observed a prevalence of occlusal screw loosening of 2.57%, the second most recurrent complication after a mean follow-up time of 10 years.[33] The prevalence of screw loosening in the present study was only in SCs, corroborating the study that found the highest incidence of screw loosening in SCs than FDP.[31]

The second most recurrent mechanical complication was ceramic chipping/fracture in 3 screws which retained SCs (1.8%). The occlusal access through the screw interrupts the structural continuity of the porcelain, then resulting in an area of reduced resistance and fragility, which may result in fracture.[27] Mangano et al[24] observed an incidence rate of 1.2% related to ceramic chipping/fracture, which is in accordance with the current study, and a systematic review reported 1.62% of ceramic chipping/fracture per 100 FDPs in a follow-up of 5 years.[2] A prevalence of 5% of decementation was observed in the present study, according to another clinical follow-up study that reported a 2.7% decementation rate.[24]

In the current study, no abutment loosening, fracture, framework or screw fracture was observed even with some abutments' angulation according to the clinical situation. This result agrees with other clinical studies that evaluated pure Morse taper connection.[35–37] With regards to mechanical complications, only 3 implants were registered and consisted of abutment loosening.[38] In addition, another study agrees with a low rate (0.3 to 1.5%) of abutment loosening.[24,29] Fracture of pure Morse taper connections abutments was related in other clinical studies. Two (0.5%) fractures were attributed to abutments placed in the posterior region.[38] In the current study, no abutment presented fracture, even when angulated abutments were applied.

Conclusion

The frictional implant system in this study exhibited a remarkable survival rate and minimal mechanical complications, including an absence of abutment loosening and a low occurrence of biological complications. Furthermore, it demonstrated excellent preservation of peri-implant tissue stability. However, to establish the long-term reliability and predictability of this system, additional prospective longitudinal studies are warranted.

Notes

The authors declare no conflicts of interest related to this study.

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