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Review

Peri-Implant Bone Stability Around Tapered Implant Prosthetic Connection: A Systematic Review and Meta-Analysis Comparing Different Cone Morse and Conometric Implants Angle Contact and Coupling Interface Designs

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Abstract: Background/Objectives: Internal implant–abutment connection has been proposed to increase interface stability and reduce biological and prosthetic issues. The aim of the present investigation was to evaluate the influence of the implant abutment conical angle on marginal bone loss and mechanical complications. Methods: The literature screening was performed by considering Pubmed/MEDLINE, EMBASE, and Google Scholar sources. The eligibility process was conducted in order to perform a descriptive synthesis, determine the risk of bias, and carry out network meta-analyses. The following categories were considered for pairwise comparisons: external hexagon (EI), internal hexagon (HI), cone morse (CM) (<8° contact angle), and conometric joint (>8° contact angle). For the descriptive data synthesis, the following parameters were considered: sample size, implant manufacturer, prosthetic joint type, prosthetic complications, marginal bone loss, and study outcomes. Results: A total of 4457 articles were screened, reducing the output to the 133 studies included in the descriptive synthesis, while 12 articles were included in the statistical analysis. No significant differences in marginal bone loss were reported when comparing a cone angle of <8° and a cone angle of >8; Conclusions: Within the limits of the present investigation, the cone interface seems to produce lower marginal bone loss compared to external and internal hexagon connection. No differences were found when comparing a cone angle of <8° and a cone angle of >8°.

Keywords: dental implant; implant–abutment connection; implant-supported dental prosthesis; prosthetic loading

1. Introduction

The dental implant procedure represents a durable and highly predictive technique for edentulism treatment and oral rehabilitation. Considering the medium- and long-term function period, a key factor for dental implant success is the maintenance of healthy peri-implant tissues healthy and the preservation from marginal bone loss. Crestal marginal bone loss (MBL) around a dental implant is common in clinical practice; historically, Albrektsson et al. described a MBL of <0.2 mm/year after the first year of functional loading as one of the key factors for success in implantology [1]. Due to the complexity of this aspect, MBL should be considered a condition that is clinically supported by multifactorial conditions, which are both local and systemic [2,3].

The implant–abutment joint has been described as a key factor for two-stage implantology regarding the related biological and biomechanical implications. A submerged healing implant protocol is reported as a supportive procedure able to preserve the device from the pathogenic noxae induced by biofilm formation and proliferation, addressing the issue of osteointegration during the early healing phases [2,3]. The one-stage healing protocol, including the immediate functional loading, could emphasize the biological and bacterial exposure associated with the mechanical solicitations on the implant joint components, producing a ponderable risk to the peri-implant tissue stability [4]. Since evidence suggests that crestal alveolar bone resorption occurs as a result of the micro-gap present between the implant–abutment interface in dental implants [5], two-stage implantology, with the submerged implant protocol, prevents early colonization by bacteria, especially in the early stages of osseointegration, as well as local inflammatory stress during the bone healing process. On the other hand, there are also the implications of important biomechanical stresses to consider, such as the functional load to which the implant is subjected at the level of the peri-implant marginal components and which, therefore, leads to important instability in the peri-implant soft and hard tissues [2,3]. Immediate functional loading, on the other hand, could emphasize stresses at the level of the peri-implant marginal components and, thus, produce substantial instability in the peri-implant soft and hard tissues [5,6]. Therefore, the design of the implant–abutment interface, the length and stability of the prosthetic joint, and the tolerance of the platform components play a key role in creating a hypothetical bacterial reservoir and maintaining a chronic inflammatory state, triggering peri-implant marginal bone loss (MBL), a complication that after implant insertion exerts a significant influence on the future success and long-term stability of the implant [7]. In the literature, implant success is considered with an MBL of −1.5 mm during the first year after loading and <0.2 mm/year thereafter [1,8,9]. Since peri-implant marginal bone resorption is a multifactorial onset condition, among the various factors related to bone resorption is the peri-implant inflammatory reaction, defined as a consequence of bacterial colonization at the interfaces of dental implants [10]. In fact, after a few seconds of exposure of the implant surface to the oral environment, the process of biofilm adhesion sets in [10].

Such bacterial adhesion can lead to the formation of a true bacterial reservoir at the micro-gap level of the prosthetic joint, resulting in chronic inflammation in the surrounding tissues, which inevitably leads to marginal bone loss [11]. A mismatch generated by the prosthetic abutment joint components leads to microleakage, such that a pump effect is generated under a functional load [11,12]. It follows that in order to reduce marginal bone loss, it is of fundamental importance to prevent bacterial microleakage, a necessary condition for the design of transmucosal dental implants. In this regard, there are several prosthetic joint designs also documented in the literature that provide different implant interfaces [13,14]. The most common implant joints include the external connection, the internal connection and the conical/cone morse joint [9,15,16]. The aim of this systematic review and meta-analysis was to determine the influence of the internal conical connection angle in terms of marginal bone loss.

2. Materials and Methods

2.1. Preliminary Screening Strategy

The electronic screening was conducted in accordance with the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-analyses) and searched the Pubmed/MEDLINE, Google Scholar, Scopus, and Web of Science databases using the following keywords: (taper OR cone OR conical OR Cone morse) AND dental implant (Table 1). The PICO question is detailed as follows:

(1) P = population/patient/problem—subjects needing a dental implant for prosthetic rehabilitations;
(2) I = intervention—dental implant treatment positioning and fixed oral rehabilitation;
(3) C = comparison—comparison between different internal, external and conical prosthetic joints;
(4) O = outcome—marginal bone loss; major prosthetic complications.

Table 1. Search strategy for the electronic database screening.

	Search Strategies
Keywords search:	(taper OR cone OR conical OR Cone morse) AND dental implant
Timespan	No limitations (1995–2023)
Electronic Databases	Pubmed/Medline, EMBASE, Google Scholar

The review process was registered in the NIHR—National Institute for Health and Care Research PROSPERO Database.

2.2. Inclusion Criteria

Articles written in English language were included with no restrictions regarding their date of publication. The titles and abstracts list was considered for a first-level initial screening by two independent reviewers (FL and IA). Clinical trials were included in the descriptive synthesis and meta-regression. For the descriptive synthesis and NMA, only the studies that investigated internal conical implant–abutment joint were considered for the present investigation. The exclusion criteria were implants with a bone regeneration procedure, in vitro studies, in silico studies, literature reviews, articles written in a foreign language, animal studies, zirconia implants, technical notes, and book chapters.

2.3. Study Data Extraction

The following parameters of the study data were extracted from the selected studies: publication date, study model design, population size, age, marginal bone loss, prosthetic complications, and follow-up. For this review, a specially designed electronic database form was used (Excel, Microsoft Office 360, Redmont, WA, USA).

2.4. Risk of Bias Assessment

The risk of bias (RoB) was measured using the OHAT tool while considering the studies included for the qualitative analysis. The RoB categories were low risk (lr), undefined risk (ur), and high risk (hr) [17].

The RoB analysis considered the following studies classes: randomization sequence, allocation, blinding of subjects and operators, outcomes measuring blinding, attrition bias, reporting bias, and other biases [17]. The RoB was calculated using the Review Manager software (RevMan 5.0, The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark).

2.5. Heterogeneity Measurement and Meta-Analysis

The meta-regression was conducted using the freely available package for continuous variables using a full R code [18]. A Bayesian network meta-analysis was conducted, considering random effects hierarchical models. The forest plot was used to evaluate the significance and the consistency of the ranks. The I2 test considered a low heterogeneity result to have a value <40%, while a high heterogeneity result had an I2 test > 40%.

3. Results

3.1. Screening Output

A total of 4457 articles were detected during the electronic database search, and a total of 56 records were removed because they were duplicates. A total of 4401 papers were considered for the abstract assessment, and 2491 records were removed because they were off-topic. The full-text article was obtained for a total of 1910 manuscripts, and these were submitted for the eligibility assessment. A total of 1775 articles were removed for the following reasons: 505 papers described a contextual bone regeneration procedure, 586 described in vitro experiments, 210 described in silico investigations, 153 were literature reviews, 127 papers were written in a language other than English, 127 were pre-clinical studies conducted on animals, 59 were case reports/case series, 5 articles described a zirconia implants procedure, 2 were technical notes, and 1 was a book chapter. A total of 133 studies were included in the descriptive synthesis, and 12 articles were included in the meta-regression assessment (Figure 1).

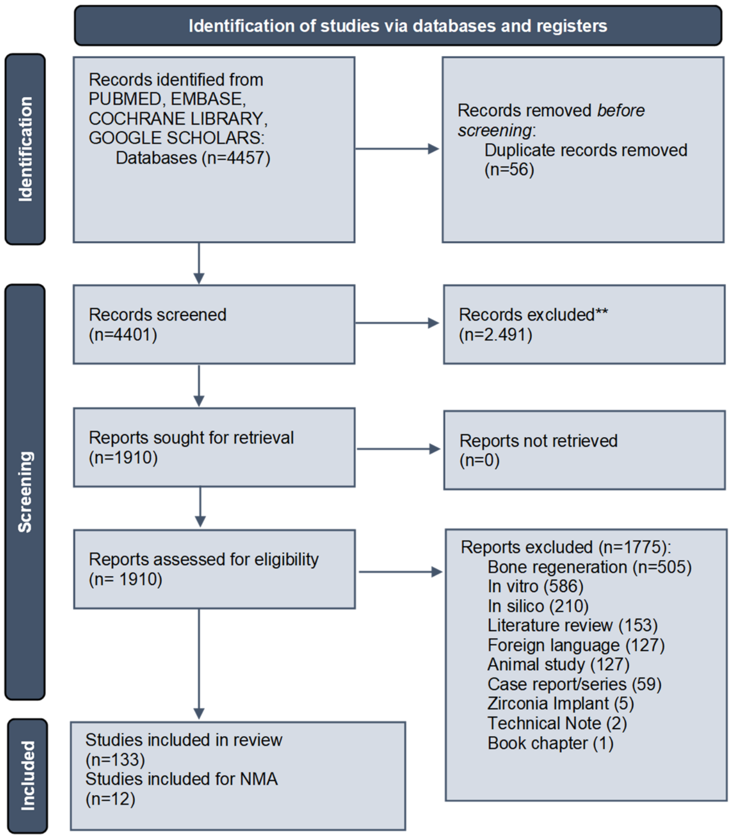

Figure 1. Screening of papers in accordance with the PRISMA guidelines [19] [** the step has been conducted by human with no automation tools].

3.2. General Characteristics of the Studies Included

The cumulative population sample was 19,637 patients [median: 44; mean: 141.27; sd: ±587.70], while a total of 44,109 implants were assessed [median: 88; mean: 329.18; sd: ±1134.0]. Different platforms were evaluated in the present investigation including: (1) cone morse [<8° internal angle] [20–128], (2) internal conical connection [>8° internal angle] [27,30,58,120,122,129–147], (3) external hexagon [30,39,56,57,64,78,86,102,120,122,127,132,140], (4) internal hexagon [20,39,58,63–65,67,68,78,122,130,133], (5) internal octagonal butt-joint [108], (6) internal polygonal butt-joint [148], and (7) internal trilobate joint [72] (Table 2). A total of 1 case-control, 5 cohort prospective studies, 4 cross-sectional studies, 58 non-randomized clinical trials (CTs), 28 randomized clinical trials, and 44 retrospective studies were included in the analysis (Table 2).

3.3. Complications

The most common prosthetic complications were crown loosening [29], chipping and veering material fracture [23,24,29–31,34,35,38,94,96,129,130,141,145], abutment fracture [21,28,31,32,95,110,112,118], screw loosening and fracture [20–22,31–33], aesthetic issues [24], osseointegration failure [36], marginal bone resorption [119,149], and implant joint and body fracture [21,28] (Table 2).

3.4. Risk of Bias Assessment (RoB)

The RoB is reported in Figures 2 and 3. The randomization bias [50.00% wlr; 28.34% ur; 41.66% whr], selection bias [100% wlr; -% ur; -% whr], performance bias [25.03% wlr; 36.82% ur; 16.66% whr], detection bias [50.02% wlr; 24.99% ur; 24.99% whr], attrition bias [100% wlr; -% ur; -% who], reporting bias [100% wlr; -% ur; -% whr], and other biases [100% wlr; -% ur; -% whr] are reported. A total of five studies reported a low risk of bias.

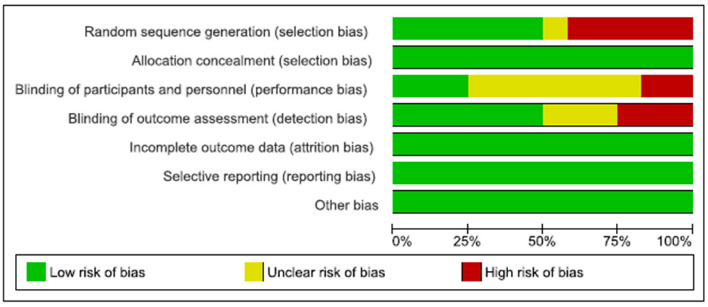

Figure 2. Risk of bias graph: cumulative assessment of each risk of bias item presented as percentages across all included studies.

3.5. Meta-Analysis

A higher surface under the cumulative ranking curve (SUCRA) indicates better performance of the study groups. The SUCRA plot represents the residual deviance for the network meta-analysis, indicating the consistency on the x-axis and the unrelated mean effect inconsistency models on the y-axis. On other hand, the radial SUCRA plot showed higher values, indicating better treatments, while the node sizes represent the sample size in terms of the number of participants. The thickness of the lines indicates the number of trials screened. At the baseline, no significant difference in marginal bone resorption is detected when comparing the cone morse group (CM) with the conometric joint design group ($p > 0.05$) [MD:−0.20; 95%CI:−0.15; 0.55]. The forest plot a significantly higher marginal bone loss at the baseline when comparing the EH and CM groups [MD: 0.38. 95%CI: 0.13, 0.62] and in the HI group compared to the CM group [MD: 0.64. 95%CI: 0.27, 1.02] ($p < 0.05$). A significant difference in marginal bone loss was detected when comparing the EH and conometric joint groups [MD: 0.183; 95% CI:−0.527, 0.899] ($p < 0.05$) and the HI and conometric implant groups [MD: 0.47; 95% CI:−0.00484, 0.956].

3.6. Meta-Regression MBL

The forest plot reporting the relative effects emerged from random effect assessment is reported in Figures 4–7.

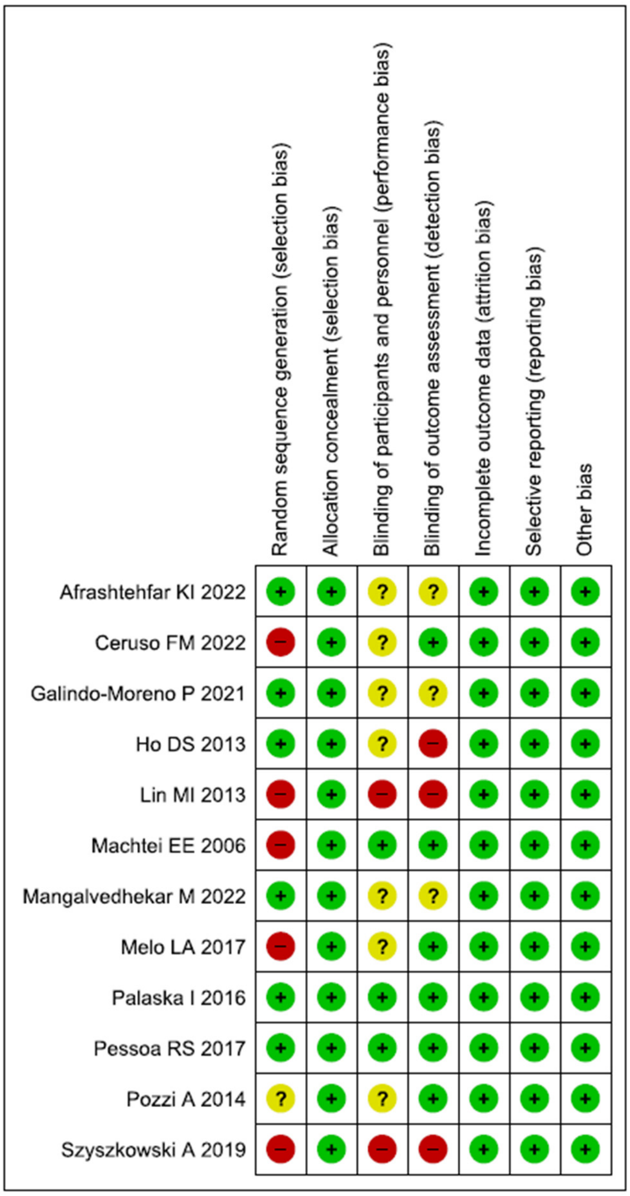

Figure 3. Risk of bias graph: cumulative assessment of each risk of bias for each study considered.

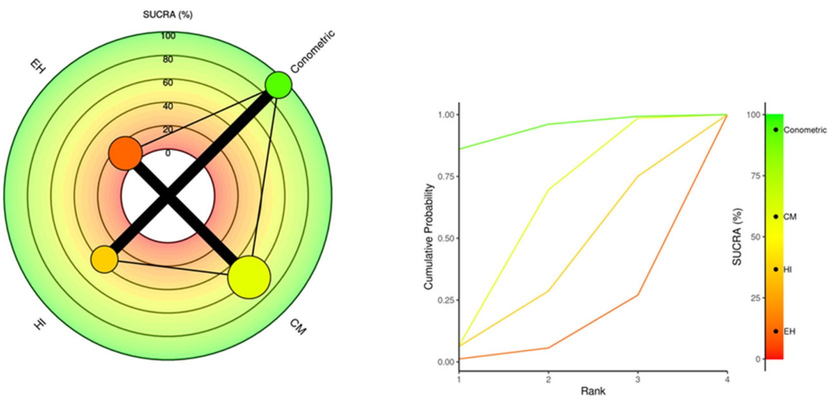

Figure 4. Chart summarizing the Litmus Rank-O-Gram and radial chart: surface under the cumulative ranking curve (SUCRA) values and cumulative ranking curves are indicative of higher clinical performance.

Table 2. Descriptive synthesis of the selected papers.

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Canullo L [79]	*J. Prosthet. Dent.*	2022	Retrospective study	43 participants	48 implants	Premium Kohno; Sweden & Martina Prama; Sweden & Martina (tissue level)	NA	Cone morse	Clinical and radiographic assessment	—
Degidi M [23]	*Int. J. Periodontics Restorative Dent.*	2018	CT	76 patients	156 implants	Ankylos, Dentsply	5.7°	Cone morse	Clinical and radiographic assessment	- One fixed prosthesis (0.76%) fractured [41 months] - Chipping
do Vale Souza JP [48]	*Eur. J. Dent.*	2021	CT	25 patients	25 implants	DSP Biomedical	NA	Cone morse	Clinical and radiographic assessment Insertion torque—ISQ	—
Hartmann R [139]	*J. Oral. Rehabil.*	2020	RCT	37 patients	47 implants	Neodent TI Cortical, Brazil	11.5°	Conometric	Clinical assessment	—
Sánchez-Torres A [31]	*J. Prosthet. Dent.*	2021	Retrospective study	56 patients	288 implants	Replace tapered implants: Nobel Biocare AB Multiunit abutments: Nobel Biocare AB	6°	Cone morse	Oral Health Impact Profile (OHIP)	- Abutment screw loosening (43%), - Chipping - Fracture of the veneering material (25%), - Screw loosening (21%).
Sato RK [41]	*Implant Dent.*	2017	Cohort prospective study	16 patients	16 single implants	Drive cone Morse Acqua, Neodent, Brazil	NA	Cone morse	Clinical and radiographic assessment	—
Abi Rached S [143]	*Minerva Dent. Oral. Sci.*	2023	CT	7 patients	18 implants	Straumann® SP cylindrical implants JD Octa® tapered implants	1:16° 2:15°	Conometric	Clinical and radiographic assessment	

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Ackermann KL [29]	*Int. J. Implant Dent.*	2020	CT	94 patients	130 implants	Conelog Screw-Line; Camlog Biotechnologies	7.5°	Cone morse	- Clinical and radiographic assessment - Marginal bone loss	- Crown loosening (3) - Ceramic chipping (1)
Afrashtehfar KI [75]	*Evid Based. Dent.*	2022	RCT	24 patients	48 implants	Conelog, Camlog Biotechnologies, Basel, Switzerland	7.5°	Cone morse	Clinical and radiographic assessment	—
Al-Fakeh H [92]	*J. Stomatol. Oral Maxillofac. Surg.*	2022	Retrospective study	65 patients	102 implants	NA	NA	Cone morse	Clinical and radiographic assessment	—
Apaza-Bedoya K [97]	J *Periodontol.*	2023	Cross-sectional	99 patients	266 implants	NA	NA	Cone morse	—	
Baer RA [42]	*Clin. Oral. Investig.*	2022	Cohort prospective study	67 patients	81 implants	NA	NA	Cone morse	—	—
Baldi D [80]	*Minerva Stomatol.*	2020	Retrospective study	—	26 implants	NA	NA	Cone morse		—
Bernard L [70]	*J. Prosthet. Dent.*	2019	RCT	15 patients	89 implants	Ankylos; Dentsply Sirona	5.7°	Cone morse	Clinical and radiographic assessment	—
Cacaci C [45]	*Clin. Oral. Investig.*	2019	CT	94 patients	130 implants	Conelog Screw-Line implants; Camlog Biotechnologies AG, Basel, Switzerland	7.5°	Cone morse	Clinical and radiographic assessment	—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Cannata M [20]	*Eur. J. Oral Implantol.*	2017	RCT	90 patients	90 implants	JD Implant, Modena, Italy	5°	Internal hexagon Cone morse	Clinical and radiographic assessment	Screw loosening (2) [HI group]
Canullo L [54]	*Clin. Implant Dent. Relat. Res.*	2018	CT	22 patients	22 implants	Premium Kohno, Sweden & Martina, Due Carrare, Padua, Italy	NA	Cone morse	Clinical and radiographic assessment	—
Canullo L [91]	*Int. J. Prosthodont.*	2022	Retrospective study	85 patients	133 implants	NA	NA	Cone morse	Clinical and radiographic assessment	—
Cassetta M [34]	*J. Oral Sci.*	2016	Cohort prospective study	350 patients	748 implants	NA	NA	Cone morse	—	6 were early failures (0.8%) and 28 were late failures (3.7%)
Cassetta M [38]	*Int. J. Oral. Maxillofac. Surg.*	2016	CT	350 patients	648 implants	NA	NA	Cone morse	Clinical and radiographic assessment	1 fracture of porcelain surface without metal exposure
Cassetta M [34]	*J. Oral. Sci.*	2016	CT	270 patients	576 implants	Osseothread; ImplaDent, Formia, Italy	NA	Cone morse	Clinical and radiographic assessment	—
Ceruso FM [133]	*Materials*	2022	CT	30 patients	30 Implants	1: Nobel Parallel, Nobel Biocare, Swiss (12° Conical connection) 2: Prama, Sweden, and Martina, Italy HI	1: 12° 2:-	Internal hexagon Conometric	Clinical and radiographic assessment	—
Cooper LF [130]	*Int. J. Oral Maxillofac. Implants*	2021	RCT	141 patients	141 implants	NA	NA	Conometric Internal hexagon	—	Six platform-switched interface and eight flat interface implants failed
Corvino E [67]	*Int. J. Oral. Implantol. (Berl)*	2020	RCT	33 patients	53 implants	NA	NA	Internal hexagon Cone morse	Clinical and radiographic assessment	—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Dagher M. [60]	*J. Maxillofac. Oral Surg.*	2022	CT	24 patients	30 implants	UFII, DIOTM, DIO Implant Busan 612–020, Korea	NA	Cone morse	Clinical and radiographic assessment	—
de Melo LA [56]	*J. Indian Soc. Periodontol.*	2017	CT	23 patients	46 implants	Neodent, Curitiba, Brazi	11.5°	External hexagon Cone morse	Clinical and radiographic assessment	—
De Paoli S [62]	*Int. J. Periodontics Restorative Dent.*	2023	CT	12 patients	24 implants	NA	NA	Cone morse	—	—
Degidi M [35]	*J. Prosthodont.*	2018	CT	65 patients	134 implants	ANKYLOS; Dentsply Implants, Mannheim, Germany	5.7°	Cone morse	Clinical and radiographic assessment	- 2 prostheses (3.07%) fractured - 3 patients reported small chips
Degidi M [43]	*Clin. Oral Implants Res.*	2017	Cross-sectional	145 patients	523 implants	Ankylos®, Dentsply Implants, Mannheim, Germany	5.7°	Cone morse	Clinical and radiographic assessment	—
Degidi M [61]	*Int. J. Periodontics Restorative Dent.*	2016	CT	39 patients	78 implants	Ankylos®, Dentsply Implants, Mannheim, Germany	5.7°	Cone morse	Clinical and radiographic assessment, ISQ	—
Dev SV [131]	*J. Pharm. Bioallied. Sci.*	2021	CT	20 patients	20 implants	NA	NA	Conometric	—	—
Ding Y [93]	*Clin. Implant Dent. Relat. Res.*	2023	Retrospective study	33 patients	218 implants	NA	NA	Cone morse	—	—
Doornewaard R [64]	*Clin. Implant Dent. Relat. Res.*	2021	RCT	25 patients	98 implants	DCC, Southern Implants, Irene, South Africa	NA	Cone morse External hexagon Internal hexagon	Clinical and radiographic assessment	—
Eerdekens L [36]	*Clin. Implant Dent. Relat. Res.*	2015	CT	10 patients	60 implants	—	NA	Cone morse		2 out of 59 implants failed

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Fabbri G [30]	*Int. J. Periodontics Restorative Dent.*	2017	Retrospective study	601 patients	965 implants	Nobel Biocare Straumann Biomet 3i	1:6° 2: 11.5° 3: NA	External hexagon Cone morse Conometric	Clinical assessment	Complication rates of 1.14%, 3.42%, and 0.62% for fractures, chipping, and unscrewing, respectively
Farronato D [68]	*BMC Oral Health*	2020	RCT	104 patients	188 implants	Group 1: Anyridge®, MegaGen, South Korea Group 2: Core®, Kristal, Italy	5°	Internal hexagon Cone morse	Clinical, radiographic, and digital assessment	—
Fernández-Figares-Conde I [52]	*Dent. J. (Basel)*	2023	CT	218 patients	218 implants	Proclinic S.A.U, Zaragoza, Spain	NA	Cone morse	Clinical and radiographic assessment	—
Galindo-Moreno P [141]	*J. Clin. Med.*	2021	RCT	30 patients	30 implants	N35/M12 implant, Oxtein Iberia S.L.	11°	Conometric	Clinical and radiographic assessment	Ceramic chipping (1) [HI]
Gao WM [129]	*BMC Oral Health*	2021	Retrospective study	392 patients	541 implants	NA	NA	Conometric	Clinical and radiographic assessment	veneer chipping, with a frequency of 67.53%. The complication-free rate for integrated abutment crowns was significantly greater than for gold porcelain crowns; molar regions were significantly greater than premolar regions, females performed significantly better than males.
Ghensi P [44]	*J. Craniofac. Surg.*	2019	Cross-sectional	120 patients	261 implants	CLC CONIC	6°	Cone morse	Clinical and radiographic assessment	—
Guarnieri R [71]	*Int. J. Periodontics Restorative Dent.*	2015	RCT	77 patients	78 implants	BioHorizons	NA	Cone morse	Clinical and radiographic assessment	—
Guarnieri R [85]	*Implant Dent.*	2014	Retrospective study	46 patients	46 implants	BioHorizons	NA	Cone morse	Clinical and radiographic assessment	—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Hamudi N [53]	*J. Clin. Med.*	2021	CT	21 patients	42 implants	NA	NA	Cone morse	Clinical and radiographic assessment	—
Heydecke G [51]	*Clin. Oral. Investig.*	2019	CT	94 patients	88 implants	NA	NA	Cone morse	—	—
Horwitz J [59]	*J. Oral. Implantol.*	2018	CT	60 patients	117 implants	Branemark implants	NA	Cone morse	Clinical and radiographic assessment	—
Jin X [28]	*Clin. Oral Implants Res.*	2022	Retrospective study	6823 patients	12.538 implants	1: Straumann Bone Level, Straumann AG (contact angle 7.2°) 2: Ankylos, Dentsply Implants (contact angle 5.7°)	1: 7.2° 2:5.7°	Cone morse	Clinical and radiographical assessment	Implant fracture (9): 4 Straumann; 5 Dentsply Abutment fracture (28): 14 Straumann; 14 Dentsply
Koutouzis T [73]	*Int. J. Oral Maxillofac. Implants*	2014	RCT	30 patients	30 implants	ANKYLOS CX, DENTSPLY Implant Manufacturing	5.7°	Cone morse	Clinical and radiographic assessment	—
Koutouzis T [74]	*Int. J. Oral Maxillofac. Implants*	2013	RCT	30 patients	30 implants	Dentsply Ankylos System	5.7°	Cone morse	Clinical and radiographic assessment	—
Koutouzis T [82]	*Int. J. Oral Maxillofac. Implants*	2015	Retrospective study	25 patients	30 implants	Ankylos®, Dentsply Implants, Mannheim, Germany	5.7°	Cone morse	Clinical and radiographic assessment	—
Kruse AB [78]	*Int. J. Implant Dent.*	2021	Retrospective study	36 patients	93 implants	1. Ankylos© 2. Branemark© 3. ITI Bonefit©	1:5.7° 2:- 3:-	Cone morse Internal hexagon External hexagon	Clinical and radiographic assessment	—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Lin MI [88]	*J. Dent. Res.*	2013	Retrospective study	63 patients	103 implants	1: Brånemark System TMMK 2: IV TiUnite, Nobel Biocare, Sweden, 3: Atlas, Cowellmedi, South Korea 4: Ankylos Plus Implant, Friadent, Germany	1: NA 2: NA 3: NA 4: 5.7°	Cone morse	Clinical and radiographical assessment	—
Linkevicius T [138]	*Clin. Implant Dent. Relat. Res.*	2021	RCT	64 patients	64 implants	MIS Implant Technologies Ltd., Bar-Lev Industrial Park, Israel	12°	Conometric	Clinical and radiographic assessment	—
Linkevicius T [98]	*Clin. Oral Implants Res.*	2015	CT	—	60 implants	(1) BioHorizons, Birmingham, AL, USA (2) Certain Prevail; Biomet/3i, Palm Beach Gardens, FL, USA	NA	Cone morse	—	
Lopez MA [89]	*J. Biol. Regul. Homeost. Agents*	2016	Retrospective study	66 patients	66 implants	FMD Falappa Medical Devices, Italy	NA	Cone morse	Clinical and radiographical assessment	—
Lops D [90]	*Materials*	2020	Retrospective study	93 patients	410 implants	Anyridge, MegaGen Implant Co., South Korea	5°	Cone morse	Clinical and radiographical assessment, marginal bone loss	—
Machtei EE [86]	*Clin. Oral Implants Res.*	2006	Retrospective study	27 patients	73 implants	Osseotite/Osseotite TG (3I Implant Innovations Inc., USA)	8°	External hexagon Cone morse	Clinical and radiographical assessment-Marginal bone loss	—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Mangalvedhekar M [120]	*J. Pharm. Bioallied. Sci.*	2022	CT	50 patients	—	Nobel Biocare	12°	Conometric External hexagon	Clinical and radiographical assessment	—
Mangano C [94]	*Clin. Oral Implants Res.*	2015	Retrospective study	49 patients	178 implants	Mac System, Milan, Italy	NA	Cone morse	Clinical and radiographic assessment	Prosthetic complications (10.3%)
Mangano F [24]	*Int. J. Environ. Res. Public Health*	2019	Retrospective study	25 Patients	40 implant	Exacone®, Leone Implants, Florence, Italy	NA	Cone morse	Full-digital Protocol (SCAN-PLAN-MAKE-DONE®)	Occlusal issues (2/40 crowns: 5%), interproximal issues (1/40 crowns: 2.5%), and aesthetic issues (1/40 crowns: 2.5%). Overall incidence of issues at delivery of 10% (4/40 crowns).
Mangano F [55]	*J. Craniofac. Surg.*	2018	CT	578 patients	612 implants	Leone Implants, Florence, Italy	NA	Cone morse	Clinical and radiographic assessment	—
McGuire MK [72]	*Int. J. Periodontics Restorative Dent.*	2015	RCT	12 patients	12 implants	(1) OsseoSpeed, Dentsply Implants (2) NobelSpeedy Replace, Nobel Biocare (3) NanoTite Certain Prevail, Biomet 3i	1: NA 2: NA 3: NA	Cone morse	Clinical and radiographic assessment	—
Melo LA [57]	*Braz. Dent. J.*	2017	CT	20 patients	40 implants	Neodent	11.5°	External hexagon Cone morse	Clinical and radiographic assessment	—
Meloni SM [76]	*Dent. J. (Basel)*	2020	Retrospective study	82 patients	152 implants	NobelReplace CC PMC or NobelReplace Tapered Groovy	6°	Cone morse	Clinical and radiographic assessment	—
Mihali SG [136]	*J. Oral Implantol.*	2021	RCT	49 patient	98 implants	Mis Implant System	12°	Conometric	Clinical and radiographical assessment	—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Moergel M [22]	*Clin. Oral Implants Res.*	2021	CT	24 patients	52 implants	Conelog Screw-Line; Camlog Biotechnologies	7.5°	Cone morse	Clinical and radiographical assessment, marginal bone loss	Screw fracture (1)
Moroi A [69]	*Clin. Implant Dent. Relat. Res.*	2020	RCT	43 patients	88 implants	Nobel Biocare, Sweden	6°	Cone morse	Clinical and radiographic assessment ISQ	—
Naumann M [37]	*Clin. Oral Implants Res.*	2023	RCT	20 patients	-	NA	NA	Cone morse		1 restoration failed after 6 months due to the loss of the abutment interface.
Obreja K [25]	*Int. J. Periodontics Restorative Dent.*	2022	Cross-sectional	44 patients	57 implants	NA		Cone morse	Clinical and radiographical assessment	None
Oda Y [39]	*Clin. Oral Implants Res.*	2021	Retrospective study	65 patients	592 implants	1: Brånemark system implant 2: Ankylos implant 3: Straumann system tissue-level implant—Zimmer screw-vent	1: NA 2: 5.7° 3: 7.2°	Internal hexagon External hexagon Cone morse	Clinical and radiographical assessment Marginal bone loss	—
Ogino Y [66]	*Int. J. Oral Maxillofac. Implants*	2021	RCT	25 patients	30 implants	GC Aadva implants	NA	Cone morse	Clinical and radiographical assessment, marginal bone loss	—
Paganelli OEB [132]	*Gen. Dent.*	2022	CT	9 patients	36 implants	NA	NA	Conometric External hexagon	Clinical evaluation via magnetic transduction resonance frequency analysis	—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Palaska I [148]	*Clin. Oral Implants Res.*	2016	RCT	81 patients	105 implants	1: Osseospeed, Astratech Dental, Sweden 2. Prevail, Biomet 3i, USA	1: 6° 2:-	Internal polygonal butt-joint Cone morse	Clinical and radiographical assessment Marginal bone loss	—
Pariente L. [150]	*J. Oral Implantol.*	2020	CT	33 patients	50 implants	NA	NA	Conometric	Clinical and radiographic assessment	—
Park H [77]	*J. Periodontal Implant Sci.*	2021	Retrospective study	12 patients	24 implants	NA	NA	Cone morse	Clinical and radiographic assessment	—
Penitente PA [102]	*Clin. Ter.*	2023	Retrospective study	319 patients	1227 implants	NA	NA	External hexagon Cone morse	Clinical and radiographic assessment	
Pessoa RS [140]	*Clin. Implant Dent. Relat. Res.*	2017	RCT	12 patients	48 implants	UNITITEVR, SIN—Sistema de Implante, Sao Paulo, Brazil	16°	External hexagon Conometric	Clinical and radiographic assessment	—
Pieri F [65]	*Int. J. Oral Maxillofac. Implants*	2011	RCT	40 patients	40 implants	—	NA	Internal hexagon Cone morse	Clinical and radiographical assessmentMarginal bone loss	—
Radaelli MTB [135]	*J. Periodontal Res.*	2020	CT	33 patients	109 implants	Neodent, Curitiba, PR, Brazil	11.5°	Conometric	Clinical and radiographic assessment	—
Raj HK [134]	*J. Contemp. Dent. Pract.*	2022	CT	20 patients	20 implants	Nobel Biocare	12°	Conometric	Clinical and radiographical assessment	—
Romanos G [83]	*Clin. Implant Dent. Relat. Res.*	2016	Retrospective study	247 patients	634 implants	Ankylos®, Dentsply Implants, Mannheim, Germany	5.7°	Cone morse	Clinical and radiographic assessment	—
Romanos GE [87]	*Int. J. Oral Maxillofac. Implants*	2011	Retrospective study	122 patients	488 implants	—	NA	Cone morse		—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Saglanmak A [101]	*Quintessence Int.*	2021	Retrospective study	—	44 implants	NA	NA	Cone morse	Clinical and radiographic assessment	
Scarano A [63]	*J. Periodontol.*	2016	CT	15 patients	37 implants	NA	NA	Cone morse Internal hexagon	—	—
Sharma V [26]	*J. Indian. Prosthodont. Soc.*	2022	CT	10 patients	20 implants	NA	NA	Cone morse	Clinical and radiographical assessment	none
Simonpieri A [84]	*Quintessence Int.*	2017	Retrospective study	42 patients	334 implants	In-Kone Universal System, Global D	8°	Cone morse	Clinical and radiographic assessment	—
Smojver I [47]	*Int. J. Mol. Sci.*	2022	CT	—	100 implants	NA	NA	Cone morse	Clinical and radiographic assessment	—
Spinelli A [40]	*Materials (Basel)*	2023	Cohort prospective study	36 patients	41 implants	Tapered Tissue-level Laser-Lok, Biohorizons, Birmingham, AL, USA	NA	Cone morse	Clinical and radiographical assessment	—
Stacchi C [137]	*Clin. Implant Dent. Relat. Res.*	2023	RCT	102 implants	51 patients	NA	NA	Conometric	Clinical and radiographical assessment	—
Studenikin R [142]	*Int. J. Dent.*	2021	CT	15 patients	15 implants	Nobel Biocare	12°	Conometric		
Sun Y [100]	*Clin. Implant Dent. Relat. Res.*	2023	RCT	19 patients	42 implants	NA	NA	Cone morse	Clinical and radiographic assessment	
Szyszkowski A [58]	*Implant Dent.*	2019	CT	214 patients	540 implants	(a) Alpha-Bio Tec, Petach Tikwa, Israel (b) MIS Implant Technologies, Shlomi, Israel	1: NA 2: 12°	Conometric Internal hexagon	Clinical and radiographic assessment	—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Tallarico M [96]	*Eur. J. Dent.*	2022	Cohort prospective study	90 patients	243 implants	Osstem TSIII, Osstem Implant Co. Ltd., Seoul, Republic of Korea	NA	Cone morse	Clinical and radiographic assessment	Four prostheses failed
Tetè G [49]	*J. Biol. Regul. Homeost. Agents*	2020	CT	—	-	NA	NA	Cone morse	Clinical and radiographic assessment	—
Thomé G [81]	*Int. J. Oral. Maxillofac. Implants*	2020	Retrospective study	101 patients	453 implants	Helix Acqua GM, Neodent	NA	Cone morse	Clinical and radiographic assessment	—
Toia M [116]	*Clin. Oral Implants Res.*	2022	RCT	50 patients	119 implants	OsseoSpeed Astra Tech Implant System	1: 6°	Cone morse	Clinical and radiographic assessment	(a) Screw loosening (2): [abutment level group (AL) (1); implant level group (IG) (1)] (b) Screw fracture (2): [abutment level group (AL)]
van Hooft J [46]	*J. Clin. Med.*	2022	CT	16 patients	23 implants	NA	NA	Cone morse	Clinical and radiographic assessment	—
Vervaeke S [50]	*J. Clin. Periodontol.*	2018	CT	25 patients	52 implants	Astra Tech Osseospeed TX™, Denstply implants, USA	NA	Cone morse	Clinical and radiographic assessment	—
Weigl P [99]	*J. Prosthet. Dent.*	2019	CT	23 patients	91 implants	Ankylos	5.7°	Cone morse		
Yamada S [27]	*Int. J. Implant Dent.*	2023	CT	31 patients	45 implants	1: NobelActive®/NobelReplace Tapered 2: CC®, Nobel Biocare, Gothenberg, Sweden, 3: Bone Level Implant®/Bone Level Tapered Implant®, Straumann, Basel, Switzerland	1: 6° 2: 11° 3: 15°	Cone morse Conometric	Clinical and radiographic assessment	none

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Yang F [32]	*Clin. Implant Dent. Relat. Res.*	2022	Retrospective study	495 patients	945 implants	Ankylos; Dentsply Sirona	5.7°	Cone morse	Clinical and radiographic assessment	Abutment fracture (AF) (13) Abutment screw loosening (ASL) (12)
Yi Y [21]	*J. Prosthet. Dent.*	2023	Retrospective study	428 patients	898 implants	One-plant FIT; Warantec	1.5°	Cone morse	Clinical and radiographic assessment	Screw fractures (23) Screw loosening (417) Abutment fracture (102) Implant fracture (31)
Frisch E [103]	*Clin. Implant. Dent. Relat. Res.*	2015	Retrospective study	20 patients	80 implants	Ankylos, Dentsply Friadent, Mannheim, Germany)	5.7°	Cone morse	Clinical and radiographic assessment	—
Ho DS [104]	*Clin. Oral. Implants Res.*	2013	RCT	32 subjects	64 implants	Test: NobelActive™ Control: Brånemark	1: 6° 2:NA	Cone morse	Clinical and radiographic assessment	—
Mangano F [105]	*Clin. Oral Implants Res.*	2012	Retrospective study	26 patients	26 implants	Leone Implant System(R), Florence, Italy	NA	Cone morse	Clinical and radiographic assessment	—
Bae MS [144]	*Implant Dent.*	2011	Retrospective study	92 patients	294 implants	MIS Implants Technologies Ltd., Shlomi, Israel	12°	Conometric	Clinical and radiographic assessment	
Mangano C [106]	*Clin. Oral Implants Res.*	2011	CT	60 patients	288 implants	Leone Implant System (®)	NA	Cone morse	Clinical and radiographic assessment	—
Mangano C [107]	*J. Periodontal.*	2011	CT	893 patients	2.549 implants	NA	NA	Cone morse	Clinical and radiographic assessment	Few prosthetic complications at the implant–abutment interface reported (0.37%)
Moberg LE [108]	*Clin. Oral Implants Res.*	1999	CT	29 patients	30 implants	ITI implant system	NA	Cone morse Internal octagonal butt-joint	Clinical and radiographic assessment	—
Palmer RM [145]	*Clin. Oral Implants Res.*	1997	CT	15 patients	15 implants	AstraTech, Molndal Sweden	1: 11.2°	Conometric	Clinical and radiographic assessment	- 1 crown recemented after 18 months - 1 crown replaced due to fracturing of the porcelain

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Levine RA [109]	*Int. J. Oral Maxillofac. Implants*	1997	CT	129 patients	174 implants	ITI implant system	NA	Cone morse	Clinical and radiographic assessment	- Occlusal screw loosening (8.7%) - Solid conical abutment loosening had a 3.6% occurrence rate
Chapman RJ [110]	*Implant Dent.*	1996	CT	—	1.757 implants	NA	NA	Cone morse	—	9 abutment posts fractured for a failure rate of 0.05%. 31 (1.7%) abutments loosened.
Morris HF [111]	*J. Oral. Implantol.*	2001	CT	313 patients	1.419 implants	Ankylos Implant	5.7°	Cone morse	Clinical and radiographic assessment	—
Mangano C [112]	*Int. J. Oral Maxillofac. Implants*	2001	Retrospective study	69 patients	80 implants	Mac System, Cabon, Milan, Italy	NA	Cone morse	Clinical and radiographic assessment	2 fractured abutments and 1 loosened abutment
Gatti C [113]	*Clin. Implant Dent. Relat. Res.*	2002	CT	10 patients	40 implants	Brånemark implants (MK II; Nobel Biocare AB, Gothenburg, Sweden) Nobel Biocare AB	NA	Cone morse	—	—
Kronström M [114]	*J. Prosthet. Dent.*	2003	CT	17 patients	68 implants	Brånemark implants	NA	Cone Morse		
Chou CT [115]	*J. Oral Implantol.*	2004	CT	—	1500 implants	Ankylos Implant	5.7°	Cone morse	Clinical and radiographic assessment	—
Toia M. [116]	*Clin. Oral Implants Res.*	2023	RCT	50 patients	119 implants	NA	NA	Cone morse	Clinical and radiographic assessment	—
Galindo-Moreno P [117]	*J. Clin. Med.*	2023	Retrospective study	-	-	NA	NA			
Gehrke SA [118]	*Medicina (Kaunas)*	2023	Retrospective study	79 patients	120 implants	NA	NA	Cone morse		C. group: fractured abutments (5%), no abutment loosening T. group: no abutment fracture, loosening screws (11.3%)

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Gehrke SA [95]	*J. Funct. Biomater.*	2023	Retrospective study	65 patients	26 implants	NA	NA	Cone morse		One patient failed due to an abutment fracture after 25 months of function
Lops D. [119]	*J. Clin. Med.*	2022	Retrospective study	80 patients	312 implants	Anyridge; MegaGen Implant	5°	Cone morse	Clinical and radiographic assessment	-
Galindo-Moreno P [149]	*Clin. Oral Implants Res.*	2022	Retrospective study	19 patients	160 implants	OsseoSpeed Astra Tech TX implants	6°	Cone morse	Clinical and radiographic assessment	14 implants > 2 mm of MBL (8.75%)
Mangalvedhekar M [120]	*J. Pharm. Bioallied. Sci.*	2022	CT	50 patients	50 implants	1: Nobel Biocare 2: Nobel Biocare	1: 6° 2: NA	Cone morse External hexagon (EH)	Clinical and radiographic assessment	—
Pozzi A [146]	*Int. J. Periodontics Restorative Dent.*	2021	Retrospective study	281 patients	686 implants	NA	NA	Conometric	—	
Eskan MA [147]	*Int. J. Implant Dent.*	2020	Retrospective study	42 patients	171 implants	Straumann	11.5°	Conometric	Clinical and radiographic assessment	—
Friberg B [121]	*Clin. Implant Dent. Relat. Res.*	2019	CT	47 patients	51 implants	NobelParallel CC	6°	Cone morse	Clinical and radiographic assessment	—
Mundt T [122]	*Int. J. Oral Maxillofac. Implants*	2006	Retrospective study	159 patients	663 implants	1:Ankylos Implant 2: Branemark Systems 3: NP MkIII Ti Unite 4: Frialit CELLplust 5: Replaces 6: Select Tapered Ti Unite 7: XiVE S CELL 8: Osseotite XPt 9: Straumann	1: 5.7° 2: NA 3: NA 4: NA 5: 6° 6:6° 7: NA 8: 11.5°	Cone morse Conometric Internal hexagonal External hexagonal	Clinical and radiographic assessment	—

Table 2. *Cont.*

Author	Journal	Year	Study Design	Population	Implant	Producer	Cone Morse Angle	Connection	Methods	Prosthetic Complications
Mangano C [123]	*Eur. J. Oral Implantol.*	2008	CT	302 patients	314 implants	NA	NA	Cone morse	Clinical and radiographic assessment	0.6% implant–abutment loosening rate
Mangano C [124]	*Clin. Oral Implants Res.*	2009	CT	689 patients	1920 implants	Leone Implant System, Florence, Italy	NA	Cone morse	Clinical and radiographic assessment	0.65% rate of loosening at the implant–abutment interface
Mangano C [125]	*Int. J. Oral. Maxillofac. Implants*	2010	CT	295 patients	307 implants	NA	NA	Cone morse	Clinical and radiographic assessment	—
Gultekin BA [126]	*Int. J. Oral Maxillofac. Implants*	2013	CT	25 patients	93 implants	Ti UNITE, Nobel Biocare	6°	Cone morse	Clinical and radiographic assessment	—
Pozzi A [127]	*Clin. Implant Dent. Relat. Res.*	2014	RCT	34 patients	68 implants	1: NobelActive, Nobel Biocare AB, Göteborg, Sweden 2: Nobel Speedy Groovy, Nobel Biocare AB, Sweden	1: 6° 2: 6°	External hexagon Cone morse	Clinical and radiographic assessment	—
Pozzi A [128]	*Eur. J. Oral Implantol.*	2015	CT	54 patients	118 implants	Nobel Replace Conical Connection implants, Nobel Biocare, Swiss	6°	Cone morse	Clinical and radiographic assessment	Crown failure (1)

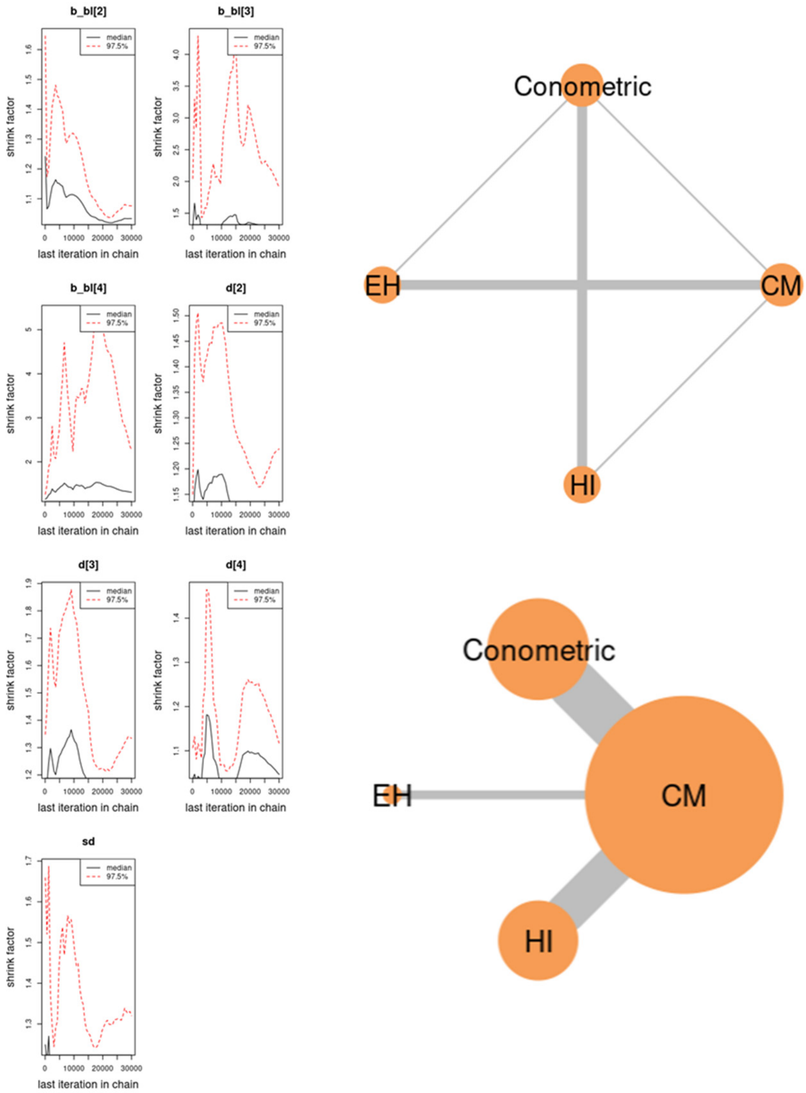

Figure 5. Network meta-analysis summarizing the comparative performance and the interactions between the groups.

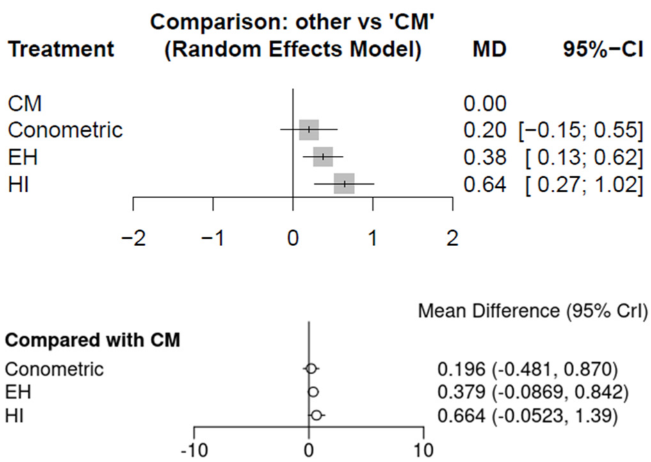

Figure 6. Forest plot summarizing the comparative performance and the interactions between the groups.

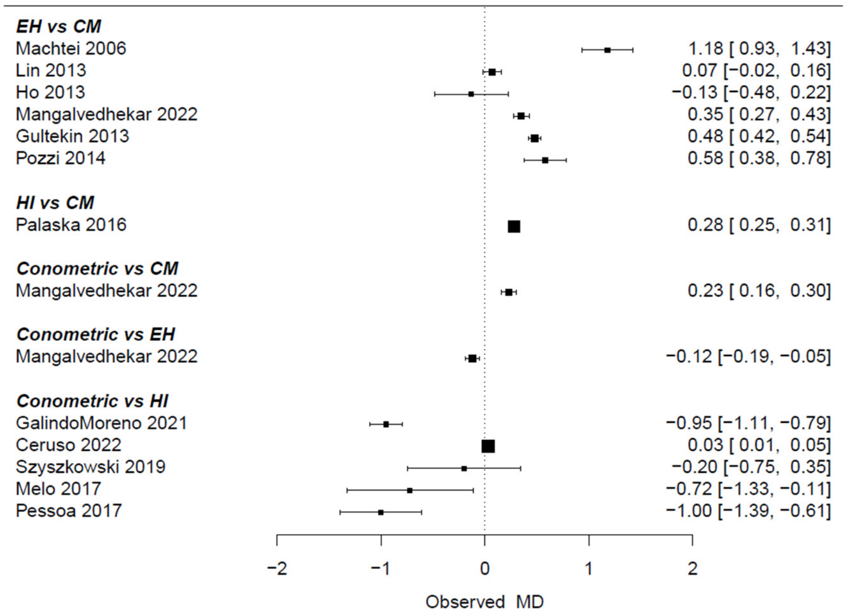

Figure 7. Forest plot summarizing the direct comparative performance between the groups.

4. Discussion

This study was conducted to analyze the geometric characteristics of the implant–abutment connection, their effects on the long-term stability of the connection, and the marginal bone loss of the conical interface joint. In the first instance, the major limitation of the present review is represented by the risk of bias of the articles included which, in most cases, described a non-randomized study model design. This aspect could affect and significantly indicate the strength of a study's effectiveness. Long-term peri-implant stability under loading represents a critical factor when evaluating implants under functional conditions. This aspect is determinant, especially considering the epidemiological consistency of peri-implant-related disease, which represents the most frequent non-disease-free survival condition, with a prevalence of >50% for mucositis and peri-implantitis [151]. The microleakage of the implant–abutment interface occurs in all implant systems, with variability between systems [152]. Cone morse joints with an 8° internal angle in implant dentistry were first proposed by the ITI group [93] in order to provide a more stable mechanical coupling of the implant–abutment interface [153]. Today, other manufacturers use cone morse designs with different cone angles. However, comparative evaluations of the clinical performance of implants with different conical angles are rare in the literature. The NMA approach could represent an optional approach able to overcome these limits offering the possibility to evaluate the marginal bone loss obtained from different studies. Considering the wide range of variability of the study designs and methodologies, the present analysis considered only one experimental time 6 months after the loading in order to avoid the risk of indirectness bias. The main advantage of the increased mechanical stability of the implant/abutment coupling is the reduction in the micro-gap and microleakage at the interface [63]. Morse taper connections have proven to be more stable from a biomechanical point of view [154,155]. The main advantage of the conical interface with or without a geometrical index is determined by the cone-in-cone principle, where the joint stability is consistently increased by the abutment's lateral contact with the internal chamber walls.

Different types of implant connections were evaluated in this review, considering a cone angle cut off >8° to be a conometric joint and a cone morse with a joint angle <8° to have an external and internal hexagon. The purpose of this review was to investigate marginal bone loss and the mechanical complications related to dynamic function [93]. The main findings were that conical connections seem to provide a better reduction in mechanical complications and a lower incidence of marginal bone loss compared to internal and external implant–abutment designs. On the other hand, no significant difference in marginal bone loss has been reported when comparing both of the conical implant joints. The higher mechanical stability of conical joint profile seems to support the hypothesis of its influence on the maintenance of peri-implant health. Several studies reported that the formation of micro-gaps could be correlated with the micromovements generated during masticatory loading, with the forces producing possible biological and mechanical sequelae [152]. Biologically, the bacteria infiltration could represent a critical factor, and the cone morse design seems to reduce the risk of interface penetration at the level of the joint interface [154,155]. The biological response associated with the two types of connections was also evaluated, and it turns out that the biological response is the same, although differences may occur when evaluating the mechanical part. The taper connection is, therefore, analyzed both in the evaluation of the marginal micro-gap with consequent bacterial proliferation in situ, and from the point of view of tissue biology and biomechanics [156]. As previously descripted, the interface micro-gap between the implant and the prosthetic abutment is related to biological and mechanical implications [63]. In vitro studies documented that bacterial penetration has been detected in static conditions and could increase under the loading, producing an inflammatory cell infiltrate (infiltrated connective tissue [ICT]) [157]. On other hand, this crestal sufferance is not visible in sleeping implants, and the reason for this is not completely clarified [157]. As such. the bacterial and mechanical factors are currently considered to be the presumed risk factors for this purpose [158]. The implant's functional connection is determinant and could be presumed to be the trigger step where the cone morse joint demonstrates a superior effectiveness in terms of marginal bone stability. Regarding the micro-gap, it could create an unfavorable distribution of the mechanical loading and stresses on the implant–abutment interface, producing mechanical issues. A previous study reported that the length of the implant–abutment joint is a key factor that produces differences in terms of bacterial penetration. This particular aspect was not investigated in the present study due to there being very little information available publicly in accordance with the patent specifications of the implant devices that were considered; this could be considered a future perspective for novel studies. It is clear from the literature that the interface space generated between the abutment and the implant joint can produce a niche that could favor bacterial penetration, compromising the peri-implant tissue seal [159]. Another aspect to be evaluated are possible prosthetic complications that may occur [160]. The major complications reported in the present review were crown loosening, ceramic chipping, abutment/fixation screw loosening and fracture, and implant loss [45,145]. The biological response between the two types of conical connections appeared similar, lacking the mechanical response, which is, however, superior to the internal and external hexagon. On other hand, other mechanical factors could contribute to the mechanical behavior of conical connections, including the abutment walls' contact length, the screw pitch and length, the implant chamber volume, and the presence/absence of a connection index. This could be considered as a significant limit of the present comparison. In addition, the present investigation did not separately consider tilted and straight implants. In fact, the biomechanics could also contribute significantly to the medium- and long-term complications, both biologically and prosthetically. Also, the methodological differences could be considered as a potential flaw, including differences in insertion torque, implant–abutment fixation coupling torque, prosthetic finalization protocols, and, consequently, the number of interventions on the fixation screw.

These aspects should be considered separately for future pairwise comparisons considering large sample size studies and randomized clinical trials.

5. Conclusions

Within the limits of the present systematic review, the marginal resorption evidence suggests that the implant abutment design seems to influence the peri-implant health and the maintenance of the bone levels in the short-term. The conical joint design seems to provide more efficient stabilization of the marginal bone compared to the internal and external hexagon designs. No significant differences were detected in marginal bone stability when comparing different cone angles. Differences in methodology and follow-up times did not allow a pairwise effectiveness evaluation to be conducted in the medium- and long-term.

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