

Observational Study

TOTAL CONOMETRIC FULL-ARCH PROSTHESES ON IMPLANTS: A MULTICENTRIC OBSERVATIONAL STUDY AFTER ONE YEAR

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ABSTRACT

This multicentric retrospective pilot study explored peri-implant soft-tissue conditions one year after full-arch rehabilitation using a conometric connection at both the prosthetic and implant levels. Twenty patients were treated across three private dental clinics in Italy, with a total of 101 implants placed. Probing pocket depth (PPD) was measured at four sites and analyzed at the site, implant, and patient levels. The overall median PPD at the site level was 2.0 mm, and only 3% of sites showed PPD ≥ 4 mm, all at interproximal positions. At the implant level, 6.9% of implants had at least one site ≥ 4 mm; at the patient level, only 25% had any site ≥ 4 mm. No clinical signs of disease were observed, and no major technical complications were recorded. These descriptive findings suggest an overall favorable outcome for total conometric full-arch prostheses on implants, which may help in maintaining healthy peri-implant soft tissue conditions under functional loading, although the retrospective design and small sample size warrant cautious interpretation.

KEYWORDS: *dental implants, dental prosthesis, implant-supported, peri-implantitis, dental prosthesis design*

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INTRODUCTION

Implant-supported full-arch rehabilitations have become an established therapeutic solution for edentulous patients, providing predictable survival rates and long-term outcomes even in regenerated bone (1–4). Over the past decades, the clinical focus has thus shifted from the once-challenging achievement of osseointegration and bone regeneration, to the management of complications, the use of minimally invasive techniques, and the maintenance of peri-implant health under optimal esthetic results (5). Systematic reviews indicate that while implant survival frequently exceeds 90% over 10 years, the prevalence of complications remains considerable, including biological events such as mucositis and peri-implantitis and mechanical events such as screw loosening and restorative material chipping, affecting a substantial number of patients (6). These complications directly impact patient satisfaction, the cost of care, and the predictability of long-term success (7).

Among the influencing factors, retention strategies play a relevant role in both mechanical reliability and biological response (8). Screw-retained prostheses remain the most widely used for full-arch cases due to their retrievability; however, they are prone to technical complications, including screw loosening and fractures, and require prosthetic access holes that may compromise esthetics. Cement-retained restorations, while offering esthetic advantages, are limited by the risk of residual cement, which is strongly associated with peri-implant inflammation and bone loss (9, 10). Consensus documents, including those from the ITI (International Team for Implantology) and ACP (American College of Prosthodontists), emphasize that neither method is universally superior but highlight that cement-related biological risks remain a major concern and should be avoided whenever possible (10, 11).

In this context, innovative alternatives such as conometric retention systems have gained attention. These systems rely on precision-milled conical connections that achieve retention by friction, thereby eliminating the need for screws or cement at the prosthetic interface (10, 12). Clinical and in vitro studies have demonstrated that conometric designs provide a highly passive fit, reduce microleakage, and minimize bacterial colonization at the implant–abutment junction (13, 14). Importantly, they also simplify maintenance, as prostheses can be retrieved without compromising structural integrity, facilitating professional debridement (15, 16). Prospective cohorts have reported stable peri-implant tissues and minimal bone remodeling at 1 and 5 years of follow-up, with low bleeding indices (17, 18).

Building on this concept, the total conometric approach extends the conical friction-fit design to both the implant–abutment and abutment–prosthesis interfaces (10). This dual application aims to enhance mechanical stability while maintaining a biological seal and eliminating cement-associated risks. Laboratory studies suggest that total conometric couplings resist functional loading without micro-movement and maintain retentive forces even after thousands of insertion cycles. Nevertheless, while mechanical and prosthetic aspects of total conometric systems are increasingly documented, their impact on probing depth remains poorly documented. Existing studies suggest favorable tissue stability, but the quantitative distribution of probing depth across sites, implants, and patients remains poorly characterized. This gap is particularly relevant, as probing depth in full-arch rehabilitated patients is a fundamental parameter for long-term success (11, 19).

The present multicentric retrospective pilot study addresses this need by reporting one-year peri-implant outcomes in patients treated with full-arch total conometric prostheses, using a total conometric connection. Using site, implant, and patient-level data, the authors describe the distribution of peri-implant probing depth to inform future prospective trials.

MATERIALS AND METHODS

This retrospective multicentric observational study followed the 2014 STROBE Guidelines for Strengthening the Reporting of Observational Studies in Epidemiology (20). The investigation was conducted in accordance with the principles of the Declaration of Helsinki (2024 revision). Ethical oversight was sought from the local Ethics Committee, which acknowledged the study and confirmed that formal approval was not necessary due to its retrospective design. All participants provided written informed consent prior to inclusion, and all data were anonymized to ensure confidentiality.

Study design

Patients enrolled in this study were consecutively treated in three private dental clinics in Italy, all applying a uniform protocol for full-arch rehabilitation with total conometric prostheses (Studio Dentistico Stella, Ravenna; Studio Odontoiatrico Musiello, Foggia; Studio Odontoiatrico Zanotti, San Bonifacio, Verona). Given the retrospective nature of the investigation, minor variations in the clinical workflow may have occurred on a case-by-case basis; however, all

treatments adhered to the key steps of the standardized protocol. To minimize variability related to guided procedures, no guided-surgery protocol was used, even though this may have reduced some potential advantages (21).

Patient selection

Patients were consecutively included if they presented with complete edentulism of a single arch and were rehabilitated with a full-arch prosthesis supported by implants with a total conometric connection. Eligibility further required that patients had complete clinical records, including probing pocket depth (PPD) measurements and complication status, and had attended a minimum of 12 months of follow-up. Only patients who provided written informed consent for treatment and retrospective use of anonymized data were considered eligible.

Treatments were performed between 01/2022 and 06/2024. On the other hand, patients were excluded if they presented with partial edentulism or required rehabilitation of both arches, if clinical documentation was incomplete or inconsistent, or if they had systemic conditions or pharmacological therapies contraindicating implant surgery, such as uncontrolled diabetes, recent chemotherapy or radiotherapy, or long-term corticosteroid or bisphosphonate use. Smokers were not excluded, but additional exclusion criteria included untreated periodontal disease in the opposing arch, discontinuation of follow-up due to drop-out during the maintenance program, or refusal of consent to the use of anonymized data in scientific reporting.

Surgical and prosthetic protocol

All patients were treated following a surgical and prosthetic protocol for full-arch rehabilitation with total conometric connection prostheses previously reported by the authors (22). Given the retrospective nature of the investigation, minor variations in the clinical workflow may have occurred on a case-by-case basis.

Preoperative planning was systematically carried out using initial photos, an intraoral scan, digital smile design associated with diagnostic wax-ups, and cone-beam computed tomography (CBCT). Prosthetically driven implant positioning was achieved through digital planning and the use of surgical guides in all cases. Surgery was performed under local anaesthesia using a minimally invasive flap approach to preserve soft tissues while ensuring direct visualization of the bone. Patients were rehabilitated with between four and eight implants per arch, depending on anatomical conditions and prosthetic requirements. Most documented cases used a four- or six-implant configuration. In the maxilla, anterior implants were positioned between the canines, with posterior units tilted distally in the premolar region when indicated. In the mandible, anterior implants were placed in the interforaminal region, with posterior implants tilted distally when possible. All implants were placed at the bone crest.

The prosthetic workflow was standardized across all centers but varied according to the loading protocol (23). In cases of immediate loading, conometric resin provisional prostheses were delivered on the day of surgery, provided that adequate primary stability (≥ 35 Ncm) was achieved. In delayed-loading cases, resin mock-ups were used after healing to verify vertical dimension, esthetics, and static and dynamic occlusal conditions prior to finalization. In both protocols, definitive impressions were obtained using a combination of digital scans and conventional polyvinylsiloxane impressions. Final frameworks were fabricated in cobalt–chromium alloy and tested intraorally for passivity. Retention was achieved exclusively through total conometric couplings, with secondary caps luted within the metallic framework. Composite resin was used for the artificial teeth and gingival components. Definitive prostheses were delivered with bilaterally balanced occlusion.

Maintenance protocol

All patients were enrolled in a structured maintenance program consisting of professional hygiene visits scheduled every six months. Biofilm control was performed using ultrasound with implant-safe tips and air polishing with erythritol powders. At each maintenance appointment, probing pocket depth (PPD) was measured at four sites per implant (mesial, distal, buccal, and palatal/lingual) using a calibrated UNC-15 periodontal probe. Presence of visible plaque and bleeding on probing was recorded at the same sites. Prostheses were systematically dismounted at every recall appointment and cleaned with air-polishing.

Outcomes and statistical analysis

The primary outcome was probing pocket depth (PPD) one year after functional loading, assessed at three levels: site (mesial, distal, buccal, palatal/lingual), implant, and patient. For each level, median, interquartile range (IQR), and maximum PPD values were calculated. The proportion of sites with $PPD \geq 4$ mm was also reported. Secondary outcomes were plaque and bleeding index at the site level, calculated as (sites with plaque / total sites) x 100 and (bleeding sites //total sites) x 100, respectively.

Descriptive statistics were reported. Exploratory comparisons were performed at the implant level. Given the exploratory nature and limited sample size, no formal adjustment for clustering at the patient level was applied. All analyses were performed using Stata 16 (StataCorp LLC, College Station, TX, USA). Given the descriptive observational design of the study, no causal inferences were attempted.

RESULTS

A total of 20 patients were included in the present study, rehabilitated with 101 implants (Table I). The number of implants per patient varied, with 4 implants (n=10), 5 implants (n=3), 6 implants (n=5), and 8 implants (n=2). The cohort comprised 12 females and 8 males (aged 64.3 ± 3.6 years).

Table I. *Summary of the enrolled population.*

Implant positions	Implants (n)	Arch	Age (years)	Sex	Patient ID
1.2, 1.4, 1.6, 2.2, 2.4, 2.6	6	Maxilla	67	F	1
3.4, 3.2, 4.2, 4.4	4	Mandible	68	F	2
1.2, 1.4, 1.6, 2.2, 2.4, 2.6	6	Maxilla	68	F	3
3.2, 3.4, 4.2, 4.4	4	Mandible	68	M	4
1.2, 1.4, 1.6, 2.2, 2.4	5	Maxilla	67	M	5
1.2, 1.5, 2.2, 2.4, 2.6	5	Maxilla	65	M	6
3.2, 3.4, 4.2, 4.4	4	Mandible	63	F	7
1.2, 1.4, 2.2, 2.4	4	Maxilla	62	M	8
1.2, 1.4, 2.2, 2.4	4	Maxilla	59	F	9
3.2, 3.4, 4.2, 4.4	4	Mandible	62	F	10
1.2, 1.4, 2.2, 2.4	4	Maxilla	60	F	11
3.2, 3.4, 4.2, 4.4, 4.5	5	Mandible	60	F	12
3.2, 3.4, 4.2, 4.4	4	Mandible	59	M	13
1.2, 1.4, 1.6, 2.2, 2.4, 2.6	6	Maxilla	58	F	14
3.2, 3.4, 4.2, 4.4	4	Mandible	68	M	15
3.2, 3.4, 4.2, 4.4	4	Mandible	65	M	16
1.2, 1.4, 1.5, 1.6, 2.2, 2.4, 2.5, 2.6	8	Maxilla	65	M	17
3.2, 3.4, 3.6, 4.2, 4.4, 4.6	6	Mandible	68	F	18
1.2, 1.4, 1.5, 1.6, 2.2, 2.4, 2.5, 2.6	8	Maxilla	68	F	19
1.2, 1.4, 1.6, 2.2, 2.4, 2.6	6	Maxilla	65	F	20

Concerning the primary outcome, namely peri-implant pocket depth (PPD) one year after final prosthetic loading, exploratory statistics were conducted (Table II). At the site level, the overall median PPD was 2.0 mm with an interquartile range (IQR) of 1.0 mm. The maximum recorded PPD was 4 mm. Only 3% of sites (12 of 404) exhibited a PPD ≥ 4 mm, all of which were located at interproximal positions. Fisher's exact test indicated a statistically significant association between interproximal location and the occurrence of deeper pockets ($p < 0.001$). Given the small number of affected sites and the pilot nature of this study, this finding should be interpreted with caution.

Table II. *Probing pocket depth (PPD) distribution at the implant and patient levels.*

PPD $\geq$ 4 mm	Median max PPD (mm)	Median PPD (mm)	Level
7	2.0	2.0	Implant (n=101)
5	3	2.0	Patient (n=20)

At the implant level, the median of implant-level PPDs was 2.0 mm, with an interquartile range (IQR) of 1.0 mm. The median of implant-level maximum PPDs was also 2.0 mm. Only 6.9% of implants (7 of 101) presented at least one site with a PPD $\geq$ 4 mm. Exploratory analyses using the Mann–Whitney U test were conducted to evaluate potential influencing factors. Neither arch (maxilla vs. mandible), implant area (anterior: between the first premolars; posterior: distal to the first premolars), nor age group (<65 vs. $\geq$ 65 years) showed a statistically significant effect on median PPD (all $p > 0.05$).

At the patient level, the median PPD was 2.0 mm, and the median maximum PPD was 3.0 mm. Only 5 of 20 patients (25%) had at least one site with PPD $\geq$ 4 mm, while the remaining had only shallow pockets. Peri-implant plaque and bleeding indices at one year were low. The mean plaque index was 13.14% (median 14.50%, IQR 10.945–16.62%). The mean bleeding index was 6.21% (median 7.00%, IQR 3.85%–8.50%).

DISCUSSION

The present multicentric study explored peri-implant soft tissue conditions one year after full-arch rehabilitation following the total conometric concept, using total conometric connection. The overall tissue response appeared favorable, with low median probing depths and only a small proportion of sites exceeding 4 mm. No pathological pockets or peri-implantitis were observed. These descriptive outcomes suggest that the total conometric connection approach is compatible with stable peri-implant tissues under functional load and regular maintenance conditions, although the retrospective design and limited sample size require cautious interpretation.

At the implant-abutment junction, the conometric interface may provide biological protection by limiting microbial penetration. This connection is manufactured with extremely small tolerances, creating an almost gap-free seal that resists bacterial leakage. Experimental studies using DNA-based microbial quantification and CT scans have shown that conometric junctions allow negligible bacterial translocation, in contrast to screw-retained or cemented abutments, which commonly exhibit microgaps associated with bacterial colonization (24, 25). By minimizing internal contamination of the implant cavity, the conometric connection may reduce the risk of peri-implant mucositis and peri-implantitis, complications frequently linked to microbial ingress at conventional interfaces. Furthermore, randomized clinical trials and a systematic review have similarly reported lower bone resorption with conometric abutments compared with screw-retained alternatives, despite equivalent implant survival (26, 27). No specific mechanical drawbacks have been reported for the implant–abutment conometric interface in clinical practice.

At the prosthetic level, the conometric retention between the abutments and the full-arch framework eliminates the use of both cement and screws, thereby addressing key limitations of traditional retention strategies (18). By avoiding cement, it removes the risk of undetected submucosal cement remnants, a major and well-established etiologic factor in peri-implant inflammation and bone loss (9, 28). By avoiding screws, it eliminates screw channel access and screw loosening and prevents repeated abutment disconnection, a process known to disrupt the mucosal barrier (29, 30). An additional clinical benefit of the abutment–prosthesis conometric connection is its straightforward maintenance; as these prostheses can be dismounted easily and non-destructively during routine visits, they enable through professional cleaning of both the abutments and the prosthetic surfaces (15, 31) and also allow a more in-depth examination of the oral mucosa (32). This simplifies biofilm control, which is often challenging in screw-retained or cemented rehabilitations that remain in place for long intervals (33). One theoretical concern, documented only in vitro studies, is that repeated removal and reconnection might gradually reduce retention strength; however, this phenomenon has not shown clinical relevance in short-term follow-up and alternative materials have already been investigated (23, 34).

Overall, a recent systematic review and meta-analysis by De Angelis et al (35) reported high implant (99.17%) and prosthesis (98.73%) survival rates and no significant increase in probing depth over time for such a retention system. From a practical perspective, the simplified workflow and reduced component requirements of conometric systems also tend to lower laboratory and maintenance costs compared with screw-retained alternatives. However, the same review highlighted that most available studies are small, short-term, and methodologically heterogeneous, with very low certainty of evidence regarding probing depth outcomes and insufficient data to quantitatively analyze

marginal bone loss. Minor technical events, such as occasional fractures of the framework or veneer, were described but appeared rare.

In the present cohort, this combined strategy was associated with uniformly shallow probing depths, suggesting stable peri-implant soft tissue integration. No clinical signs of disease were observed. Even if minor technical events such as veneer chipping or composite wear are known to occur in full-arch rehabilitations, but are not specific to the total conometric connection approach, they were not observed in this series. Future research should evaluate whether guided implant placement and prosthetically driven planning based on telescopic principles influence long-term outcomes of this rehabilitation concept (36). Larger prospective studies with longer follow-up and adjunctive microbiological and immunological analyses are needed to confirm and clarify the potential benefits suggested by this pilot study.

CONCLUSIONS

This multicentric retrospective pilot study found an overall association between total conometric connection prostheses and favorable peri-implant soft tissue conditions one year after loading. Low probing depths and the absence of clinical signs of peri-implantitis were consistently observed across sites, implants, and patients. These findings suggest a possible link between the total conometric approach, simplified maintenance, and reduced technical complications. Nonetheless, given the retrospective design, small sample size, and currently limited, low-certainty evidence on conometric retention systems, these results should be interpreted with caution. Larger prospective studies are needed to confirm and further investigate these preliminary observations.

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