

Cemented Versus Screw-Retained Implant-Supported Single-Tooth Crowns: A 4-year Prospective Clinical Study

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Purpose: The purpose of this controlled prospective clinical study was to compare cemented and screw-retained implant-supported single-tooth crowns followed for 4 years following prosthetic rehabilitation with respect to peri-implant marginal bone levels, peri-implant soft tissue parameters, and prosthetic complications. **Materials and Methods:** Twelve consecutive patients were selected from a patient population attending the Implantology Department at the University of Padova. They all presented with single-tooth bilateral edentulous sites in the canine/premolar/molar region with adequate bone width, similar bone height at the implant sites, and an occlusal scheme that allowed for the establishment of identical occlusal cusp/fossa contacts. Each patient received 2 identical implants (1 in each edentulous site). One was randomly selected to be restored with a cemented implant-supported single-tooth crown, and the other was restored with a screw-retained implant-supported single-tooth crown. Data on peri-implant marginal bone levels and on soft tissue parameters were collected 4 years after implant placement and analyzed to determine whether there was a significant difference with respect to the method of retention (cemented versus screw-retained). **Results:** All patients completed the study. All 24 implants survived, resulting in a cumulative implant success rate of 100%. Statistical analysis revealed no significant differences between the 2 groups with respect to peri-implant marginal bone levels and soft tissue parameters. **Discussion:** The data obtained with this study suggested that the choice of cementation versus screw retention for single-tooth implant restorations is likely not based on clinical results but seems to be based primarily on the clinician's preference. **Conclusions:** Within the limitations of this study, the results indicate that there was no evidence of different behavior of the peri-implant marginal bone and of the peri-implant soft tissue when cemented or screw-retained single-tooth implant restorations were provided for this patient population. *INT J ORAL MAXILLOFAC IMPLANTS* 2004;19:260–265

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Prosthetic reconstruction involving endosseous implants can involve screw-retained or cement-retained restorations or both.^{1,2} The choice of cementation versus screw retention seems to be based on mainly the clinician's preference.³ Some authors advocate that the screw-retained prosthesis,

as established by Adell and coworkers,⁴ offers reversibility and more stability and security at the implant-abutment prosthetic interface.^{5–11} During the life of an implant prosthesis, the clinician may need to remove the restoration for hygiene, repairs, and abutment screw tightening,¹² and screw-retained designs make all of these procedures easily achievable. Screw-retained restorations, however, require precise implant placement for optimal location of the screw access hole; deviations from the optimal position and angulation can lead to an unesthetic restoration.¹³ With regard to single-tooth screw-retained restorations, Cordioli and associates¹⁴ reported the clinical experience of 67 patients treated for single-tooth replacement; they exhibited a total implant survival rate of 94.4%.

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Engquist and colleagues¹⁵ evaluated the outcome of single-tooth restorations supported by Brånemark System implants (Nobel Biocare, Göteborg, Sweden) placed during the years 1984 to 1989 and achieved an overall survival rate of 97.6%. McMillan and coworkers¹⁶ investigated the nature, timing, and frequency of complications associated with single-tooth implant therapy in a dental hospital and 2 dental offices and reported an implant survival rate of 96%. Similar results have been reported by other authors.¹⁷⁻²⁰

Some authors have emphasized the advantages of the cement-retained prosthesis, including its greater versatility for esthetics and simplicity of the technique.²¹⁻²⁵ Another advantage might be the potential for complete passivity when a cemented restoration is placed on the implants.^{26,27} The absence of a screw to draw inadequately fitting components together with a clamping force would be likely to eliminate strain that the tightening force of the screw would introduce into the restoration/implant assembly. This potential advantage, together with the others mentioned, has made cement-retained implant restorations increasingly popular.³ Some authors still stress the importance of maintaining the retrievability of cement-retained implant restorations.²⁸ For this purpose, the use of provisional cement has commonly been advocated. Unfortunately, it is probable that a cement that functions well as a provisional cement for restorations cemented to teeth may indeed be a permanent luting agent for metal cemented to metal.²⁹ Because of the clinical abutment height, implant crowns retained by temporary cement can be very difficult to remove.³⁰ Should an abutment screw loosen or any repair become necessary, the restoration may be destroyed during the removal procedure if the cement seal cannot be broken easily. Prestipino and coworkers³¹ and Bastos Valbao and associates³² introduced 2 similar slot designs initiated during the fabrication of custom implant abutments and followed through to the definitive prosthesis. Their techniques would allow the clinician to remove the cemented crown in a simpler and safer way. The introduction into the market of components that need infrequent abutment screw tightening³³ have reduced the need to retrieve cement-retained implant restorations.

Various studies have reported on the predictability of single implant restorations. However, there is a paucity of articles comparing clinically the cemented and the screw-retained approaches. The purpose of this controlled prospective clinical study was to compare cemented and screw-retained implant-supported single-tooth crowns observed for

4 years after prosthetic rehabilitation with respect to peri-implant marginal bone levels, peri-implant soft tissue parameters, and prosthetic complications.

MATERIALS AND METHODS

Twelve consecutive patients were selected from a patient population attending the Implantology Department at the University of Padova, according to the following criteria.

1. No systemic contraindication for oral surgical therapy
2. Single-tooth bilateral edentulous sites in the canine/premolar/molar region
3. Presence of adequate bone width precluding the need for bone augmentation procedures
4. Similar bone height at the implant sites allowing for the placement of implants of identical height and diameter
5. Occlusal scheme allowing for the establishment of identical occlusal cusp-fossa contacts

The consent of patients was obtained prior to implant placement. In each patient, one edentulous site was randomly chosen to receive a cemented implant-supported single-tooth crown, and in the contralateral edentulous site, a screw-retained implant-supported single-tooth crown would be placed. Twenty-four standard-size implants (3i/Implant Innovations, Palm Beach Gardens, FL) were positioned using a 2-stage surgical technique. The surgeries, all of which were performed by the same practitioner, were carefully accomplished with the guidance of a template to decrease the risk of damage to the adjacent teeth. The edentulous sites treated and the length and diameter of the implants used are summarized in Tables 1 and 2.

At second-stage surgery, 4 months after placement of the implants, titanium healing caps were connected. The final impression was made 3 weeks after second-stage surgery, and a single impression, following a regular impression technique, served for both implants of each patient.³⁴ For the impression phase, 2-mm-thick custom impression trays were fabricated with Palatray LC resin (Heraeus Kulzer, Wehrheim, Germany) mixed in accordance with the manufacturer's instructions. The impression trays had 2 windows to allow access for both coping screws and were previously coated with Impregum polyether adhesive (ESPE Dental-Medizin, Seefeld, Germany). Prior to every impression procedure, a square impression coping (pick-up type; 3i/Implant Innovations) was secured to the implant. The

Table 1 Distribution of Single-Tooth Edentulous Sites Treated with Implants

Location	No. of implants
Maxillary canine region	6
Maxillary premolar region	8
Maxillary molar region	6
Mandibular molar region	4

impression material (Impregum Penta; ESPE) was machine-mixed (Pentamix; ESPE), and part of it was meticulously syringed all around the impression coping to ensure complete coverage of the coping itself. Five minutes were allowed for setting of the impression material, after which the coping screws were unscrewed and the impressions removed from the patients' mouths. An implant replica (3i/Implant Innovations) was screwed on top of the impression coping, and the impression was poured with type IV artificial stone (New Fujirock; GC Corporation, Tokyo, Japan) following the manufacturer's instructions. All laboratory procedures were performed by the same technician. Twenty-four gold machined UCLA abutments were used (SGUCA1C; 3i/Implant Innovations).

All prostheses were provided by the same prosthodontist. For the cemented crowns, custom-screwed abutments were fabricated for all 12 implants. The gold UCLA-type abutments were screwed on top of the implant replicas using waxing posts and wax was added directly to the gold cylinders following standard waxing procedures. The waxed-up cylinders were then invested in a carbon-free phosphate-bonded investment (Ceramicor; Cendres & Métaux, Biel-Bienne, France) and cast using a noble alloy (Al Med; Cendres & Métaux). The custom abutments were screwed on top of the implants in the patients' mouths using a gold screw (Gold-Tite; 3i/Implant Innovations) and a torque wrench calibrated at 30 Ncm (Torque Driver CATDO; 3i/Implant Innovations); regular porcelain-fused-to-metal definitive crowns with porcelain occlusal surfaces were fabricated. A noble alloy (Valcambi, Balerna, Switzerland) was used for the metal copings and porcelain (Noritake EX-3; Noritake, Nagoya, Japan) was applied in layers to them. The occlusal surfaces of the restorations were designed to avoid premature contacts during lateral and protrusive movements. All definitive restorations were cemented with temporary cement (Temp Bond NE; Kerr Italia, Scafati, Salerno, Italy).

For the screw-retained crowns, the gold UCLA-type abutments were screwed on top of the implant

Table 2 Dimensions of Implants Used

Dimensions (diameter × length)	No. of implants
3.75 × 11.5 mm (OSS 311)	4
3.75 × 13.0 mm (OSS 313)	6
3.75 × 15.0 mm (OSS 315)	4
4.00 × 13.0 mm (OSS 413)	8
4.00 × 15.0 mm (OSS 415)	2

replicas using waxing posts and wax was added directly to the gold cylinders following standard waxing procedures. The waxed-up cylinders were then invested in a carbon-free phosphate-bonded investment (Ceramicor; Cendres & Métaux) and cast using a noble alloy (Valcambi). Porcelain (Noritake EX-3; Noritake) was applied in layers to the cast abutments, carved, and then baked using manufacturer's recommendations. The occlusal surfaces of the restorations were designed to avoid premature contacts during lateral and protrusive movements. The crowns were screwed on top of the implants in the patients' mouths using a gold screw (Gold-Tite; 3i/Implant Innovations) and a torque wrench calibrated at 30 Ncm (Torque Driver CATDO; 3i/Implant Innovations). The screw access holes on the occlusal surfaces of the restorations were closed with composite resin (Tetric Ceram; Ivoclar Vivadent, Schaan, Liechtenstein) (Figs 1a and 1b).

After prosthetic treatment, a follow-up program was designed for all patients. This provided the opportunity to check the patients every 3 months in the first year and every 6 months in subsequent years. All patients regularly returned to the office for recall. The implant survival was judged on the following criteria.³⁵

- Absence of mobility
- Absence of painful symptoms or paresthesia
- Absence of peri-implant radiolucency during radiographic evaluation
- Absence of progressive marginal bone loss

Four years after implant placement, at the last follow-up appointment, all patients were seen and periodontal parameter data were compiled on the peri-implant mucosal response (records for 4 surfaces of each restoration type): supragingival plaque, gingival inflammation, bleeding on probing, amount of keratinized gingiva around abutment, and probing depth from the gingival margin. All cemented crowns were carefully removed using GC removal pliers (Type KY; GC Corporation) to avoid damaging the porcelain. The custom posts and the screwed



Fig 1a Master cast with (left) a cemented implant-supported single-tooth crown and (right) a screw-retained implant-supported single-tooth crown.



Fig 1b Occlusal view of the 2 implant-supported single-tooth crowns (first mandibular molar regions).

crowns were unscrewed to allow measurement of the mucosal channel; a periodontal probe was used to record the length from the marginal gingiva to the head of the implant. Intraoral radiographic examinations were performed using the paralleling technique and an adjusted film-holding device as suggested by previous studies.^{14,36} The radiographic films were observed using a 5× magnifying lens to reveal the implant threads precisely and permit the measurement of marginal bone resorption with an accuracy of ± 0.3 mm. Occlusal relationships and all complications were recorded. All evaluations were performed by the same prosthodontist who had carried out all prosthetic procedures.

Statistical analysis was performed using a paired Student *t* test to determine whether there was a significant difference in peri-implant marginal bone levels and soft tissue parameters between the cemented implant-supported single-tooth crowns and the screw-retained implant-supported single-tooth crowns.

RESULTS

All patients completed the study. All 24 implants survived the second surgical phase and loading with the definitive restoration. No patient reported any prosthetic complications, such as loosening of the custom screwed abutment or the screwed crown, fracture of the porcelain, or loosening of provisionally cemented definitive crowns.

Bone quality at the implant sites was estimated at the time of implant placement. Twelve implants were placed in type 1 bone, 10 implants were placed in type 2 bone, and 2 implants were placed in type 3 bone.³⁷

Table 3 Periodontal Parameters Recorded by Dichotomous Records (Presence or Absence)

Periodontal indices	Percentage of cemented crowns	Percentage of screw-retained crowns
Presence of plaque	13.0	13.0
Gingival inflammation	4.4	4.3
Bleeding on probing	7.2	7.2
Amount of facial keratinized gingiva	91.0	91.0
Amount of lingual keratinized gingiva	93.2	93.2

Clinical evaluation of the peri-implant mucosa using periodontal indices revealed similar satisfactory results for the implant-mucosa interfaces (Table 3). The status of the soft tissue around crowns and adjacent teeth remained stable over the evaluation period. Dental plaque was present on 13% of the considered surfaces on both types of restorations, and gingival inflammation involved only 4.4% of the cemented crowns and only 4.3% of the screw-retained crowns. Keratinized attached gingiva was not present at 9% of the buccal surfaces and 6.8% of the lingual surfaces for both types of restorations. A mean probing depth of 2.8 mm was recorded for both types of restorations, which is less than that reported in other studies.^{14,38,39} Probing was carefully accomplished and a low percentage of sites (7.2%) had bleeding on probing for both types of restorations. The mean marginal bone resorption at 4 years after implant placement, as measured with the intraoral radiographic examination method^{14,36} from the apical end of the smooth collar of the

implants, was 0.8 mm, with a range of 0.5 to 1.2 mm, for both types of restorations. However, the radiographs obtained at the 1.5-year interval were not standardized as at the 4-year examination. Hence, statistical comparisons between the 2 measurements were problematic.

The paired Student *t* test was used to analyze the numeric data obtained from the examination of peri-implant marginal bone levels and soft tissue parameters. This analysis revealed no significant differences between the 2 groups ($P < .001$).

DISCUSSION

This 4-year prospective study provided the results from 24 implants (12 patients) used for single-tooth crowns retained with either cement or screws. The comparison of these 2 types of restorations with respect to peri-implant marginal bone levels, peri-implant soft tissue, and prosthetic complications did not reveal any clinically different outcome at the end of the evaluation period.

No screw loosening was found with either the cemented crowns or the screw-retained crowns. Screw-retained implant restorations may have the advantage of predictable retrievability, but they demand precise placement of the implant for optimal location of the screw access hole. Deviation from this optimal direction can lead to an unesthetic restoration if screw retention is used. Screw-retained implant restorations may also present a screw access opening that can weaken the porcelain around the openings and at the cusp tips, resulting in unstable occlusal contacts. The centric contact of a screw access hole, which is often in the central fossa and may occupy 50% to 66% of the intercuspal occlusal table, is usually developed with the head of a screw or a composite restorative material.

Cementation of implant restorations eliminates unesthetic screw access holes and problems related to the development of stable occlusal contacts. With the introduction of more precise abutments, which improve abutment-to-implant fit,³³ the arguments against cementation (ie, fear that the abutment complex may loosen) may now be questioned. In the present study, these more precise components were used, which, with careful and selective equilibration to achieve optimal occlusion and the avoidance of contact in lateral and protrusive movements, may also explain the lack of complications related to screw loosening during this investigation. Accurate evaluation of the occlusal scheme and the provision of appropriate variations to the occlusal contacts, both static and dynamic, may also explain the lack

of prosthetic complications, such as porcelain fracture and loosening of provisionally cemented definitive crowns. Furthermore, it should be noted that cemented crowns require particular attention to the removal of all subgingival cement at the cementation phase, so that problems associated with peri-implant gingival tissues may be prevented.

The results of the present clinical study indicate that the choice of cementation versus screw retention is primarily related to the clinician's preference.³ There was no evidence that one method of retention was clinically or biologically superior to the other.

CONCLUSIONS

Twelve patients received 2 implants each for the restoration of bilateral single-tooth edentulous sites. These implants were restored with 1 cemented implant-supported single-tooth crown and contralaterally with 1 screw-retained implant-supported single-tooth crown. This controlled prospective clinical study compared in these patients the cemented and screw-retained implant-supported single-tooth crowns over a period of 4 years following prosthetic rehabilitation with respect to peri-implant marginal bone levels, peri-implant soft tissue parameters, and prosthetic complications. Within the limitations of this study, the following conclusions can be made:

1. All 24 implants survived and no prosthetic complications occurred.
2. No significant differences were revealed between the 2 groups.
3. The choice of cementation versus screw retention seems to be primarily related to the clinician's preference. There was no evidence that one method of retention was superior to another in this limited patient population.

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REFERENCES

1. Albrektsson T, Dahl E, Enbom L, et al. Osseointegrated oral implants. A Swedish multicenter study of 8139 consecutively inserted Nobelpharma implants. *J Periodontol* 1988;59: 287–296.

2. Hebel KS, Gajjar RC. Cement-retained versus screw-retained implant restorations: Achieving optimal occlusion and esthetics in implant dentistry. *J Prosthet Dent* 1997; 77:28–35.
3. Taylor TD, Agar JR, Vogiatzi T. Implant prosthodontics: Current perspectives and future directions. *Int J Oral Maxillofac Implants* 2000;15:66–75.
4. Adell R, Lekholm U, Rockler B, Brånemark P-I. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg* 1981;10:387–416.
5. Rangert B, Jemt T, Jorneus L. Forces and moments on Brånemark implants. *Int J Oral Maxillofac Implants* 1989;4:241–247.
6. Zarb GA, Schimdt A. The longitudinal clinical effectiveness of osseointegrated dental implants: The Toronto study. Part II: Prosthetic results. *J Prosthet Dent* 1990;64:53–61.
7. Zarb GA, Schimdt A. The longitudinal clinical effectiveness of osseointegrated dental implants: The Toronto study. Part III: Problems and complications encountered. *J Prosthet Dent* 1990;64:185–194.
8. Jemt T. Failures and complications in 391 consecutively inserted fixed prostheses supported by Brånemark implants in edentulous jaws: A study of treatment from the time of prosthesis placement to the first annual checkup. *Int J Oral Maxillofac Implants* 1991;6:270–276.
9. Jemt T, Linden B, Lekholm U. Failures and complications in 127 consecutively placed fixed partial prostheses supported by Brånemark implants: From prosthetic treatment to first annual checkup. *Int J Oral Maxillofac Implants* 1992; 7:40–44.
10. Sakaguchi RL, Borgersen SE. Nonlinear finite element contact analysis of dental implant components. *Int J Oral Maxillofac Implants* 1993;8:655–661.
11. Sakaguchi RL. Nonlinear contact analysis of preload in dental implant screws. *Int J Oral Maxillofac Implants* 1995;10: 295–302.
12. Sones AD. Complications with osseointegrated implants. *J Prosthet Dent* 1989;62:581–585.
13. Walton JN, MacEntee MI. Problems with prostheses on implants: A retrospective study. *J Prosthet Dent* 1994;71: 283–288.
14. Cordioli G, Castagna S, Consolati E. Single tooth implant rehabilitation: A retrospective study of 67 implants. *Int J Prosthodont* 1994;7:525–531.
15. Engquist B, Nilson H, Astrand P. Single-tooth replacement by osseointegrated Brånemark implants. A retrospective study of 82 implants. *Clin Oral Implants Res* 1995;6: 238–245.
16. McMillan AS, Allen PE, Bin Ismail I. A retrospective multicenter evaluation of single tooth implant experience at three centers in the United Kingdom. *J Prosthet Dent* 1998;79: 410–414.
17. Haas R, Mensdorff-Pouilly N, Mailath G, Watzek G. Brånemark single-tooth implants: A preliminary report of 76 implants. *J Prosthet Dent* 1995;73:274–279.
18. Henry PJ, Laney WR, Jemt T, et al. Osseointegrated implants for single-tooth replacement: A prospective 5-year multicenter study. *Int J Oral Maxillofac Implants* 1996;11:450–455.
19. Wannfors K, Smedberg J. A prospective clinical evaluation of different single-tooth restoration designs on osseointegrated implants. A 3-year follow-up of Brånemark implants. *Clin Oral Implants Res* 1999;10:453–458.
20. Schwartz-Arad D, Samet N, Samet N. Single tooth replacement of missing molars: A retrospective study of 78 implants. *J Periodontol* 1999;70:449–454.
21. Lewis S, Beumer J III, Hornburg W, Moy P. The “UCLA” abutment. *Int J Oral Maxillofac Implants* 1988;3:183–189.
22. Misch CE. *Contemporary Implant Dentistry*. St Louis: Mosby-Year Book, 1993:651–685.
23. Preiskel HW, Tsolka P. Telescopic prostheses for implants. *Int J Oral Maxillofac Implants* 1998;13:352–357.
24. Andersson B, Odman P, Lindvall AM, Brånemark P-I. Cemented single crowns on osseointegrated implants after 5 years: Results from a prospective study on CeraOne. *Int J Prosthodont* 1998;11:212–218.
25. Guichet DL, Caputo AA, Choi H, Sorensen JA. Passivity of fit and marginal opening in screw- or cement-retained implant fixed partial denture designs. *Int J Oral Maxillofac Implants* 2000;15:239–246.
26. Jones JD, Kaiser DA. A new gingival retraction impression system for a one-stage root-form implant. *J Prosthet Dent* 1998;80:371–373.
27. Chee W, Felton DA, Johnson PF, Sullivan DY. Cemented versus screw-retained implant prostheses: Which is better? [current issues forum]. *Int J Oral Maxillofac Implants* 1999; 14:137–141.
28. Breeding LC, Dixon DL, Bogacki MT, Tietge JD. Use of luting agents with an implant system: Part 1. *J Prosthet Dent* 1992;68:737–741.
29. Kent DK, Koka S, Froeschle ML. Retention of cemented implant-supported restorations. *J Prosthodont* 1997;6: 193–196.
30. Covey DA, Kent DK, St Germain HA Jr, Koka S. Effects of abutment size and luting cement type on the uniaxial retention force of implant-supported crowns. *J Prosthet Dent* 2000;83:344–348.
31. Prestipino V, Ingber A, Kravitz J, Whitehead GM. A practical approach for retrieving cement-retained, implant-supported restorations. *Quintessence Dent Technol* 2001;24: 182–187.
32. Bastos Valbao FP Jr, Perez EG, Breda M. Alternative method for retention and removal of cement-retained implant prostheses. *J Prosthet Dent* 2001;86:181–183.
33. Vigolo P, Majzoub Z, Cordioli GP. Measurement of the dimensions and abutment rotational freedom of gold machined 3i UCLA-type abutments in the as-received condition, after casting with a noble metal alloy and porcelain firing. *J Prosthet Dent* 2000;84:548–553.
34. Vigolo P, Majzoub Z, Cordioli GP. In vitro comparison of master casts accuracy in single tooth implant replacement cases. *J Prosthet Dent* 2000;83:562–566.
35. Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants. A review and proposed criteria of success. *Int J Oral Maxillofac Implants* 1986;1:1–25.
36. Cox JE, Pharoah M. An alternative holder for radiographic evaluation of tissue-integrated prostheses. *J Prosthet Dent* 1986;56:338–341.
37. Lekholm U, Zarb GA. Patient selection and preparation. In: Brånemark P-I, Zarb GA, Albrektsson T (eds). *Tissue-Integrated Prostheses*. Chicago: Quintessence, 1985:199–209.
38. Lekholm U, Adell R, Lindhe J, et al. Marginal tissue reaction at osseointegrated titanium implants. II. A cross-sectional retrospective study. *Int J Oral Surg* 1986;15:53–61.
39. Ape P, Zarb GA, Schmitt A, Lewis DW. The longitudinal effectiveness of osseointegrated dental implants. The Toronto study: Peri-implant mucosal response. *Int J Periodontics Restorative Dent* 1991;11:94–111.