# Patient-Based and Clinical Outcomes of Implant Telescopic Attachment–Retained Mandibular Overdentures: A 1-Year Longitudinal Prospective Study

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***Purpose:*** *The purpose of this study was to evaluate and compare Oral Health–Related Quality of Life (OHRQoL), denture satisfaction, and masticatory performance in edentulous patients provided with mandibular implant-supported overdentures (ISODs) retained with telescopic attachments and those of conventional complete dentures (CCDs). Peri-implant soft tissue changes were also evaluated at various intervals during a 1-year observation period.* ***Materials and Methods:*** *Participating patients received new CCDs and later received two mandibular interforaminal implants and had their mandibular CCDs converted into ISODs with telescopic attachments. Questionnaires were used to assess OHRQoL (Shortened Oral Health Impact Profile-14, Malaysian version) and denture satisfaction at different stages of treatment with CCDs and ISODs. Objective masticatory performance with the CCDs and ISODs was recorded with a mixing ability test. Evaluations were carried out at 3 months with the new CCDs, 3 months after mandibular ISOD provision, and 1 year after receiving the ISOD. Peri-implant parameters were additionally assessed at specific intervals during the treatment period. The data obtained were statistically analyzed and compared.* ***Results:*** *In the 17 patients who completed the protocol, significant improvements were observed in OHRQoL and patient satisfaction when CCDs were modified to ISODs, after 3 months, and at 1 year. Significantly better mixing ability with the ISOD was noted, with the highest values observed at 1 year. Statistically insignificant differences were observed for all the peri-implant parameters, except for gingival recession, for which significant changes were observed 6 months after ISOD delivery (values had stabilized by 1 year).* ***Conclusion:*** *Telescopic crown attachment–retained mandibular ISODs improved OHRQoL, dental prosthesis satisfaction, and masticatory performance compared to CCDs. Peri-implant soft tissue response and implant stability were found to be favorable after 1 year.* Int J Oral Maxillofac Implants 2014;29:1149–1156. doi: 10.11607/jomi.3328

**Key words:** *denture satisfaction, implant-supported overdentures, masticatory function, peri-implant parameters, quality of life, telescopic crown attachments*

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Patient-reported outcome measures, such as oral health–related quality of life (OHRQoL), have often been used as tools to capture the functional, social, and psychologic effects of oral disease conditions,[1] while evaluation of patient satisfaction allows direct quantification of patients' opinions on different aspects of a given treatment.[2] Studies have indicated that conventional complete denture (CCD) wearers rehabilitated with mandibular implant–supported overdentures (ISOD) experience better retention and stability, resulting in improved overall function, satisfaction, and QoL.[3–5]

QoL has been found to be closely related to masticatory performance, and one of the subjective means for measuring masticatory ability is through self-reported methods such as questionnaires.[6] However, the development of reliable and valid questionnaires might be tedious for countries in which several ethnic groups with different dietary intakes live. The mixing ability test is an alternative method for objective

measurement of masticatory performance that uses two-color paraffin wax cubes. The reliability, validity, and responsiveness of this technique have been deemed favorable by previous investigators.[7,8]

The pairing of a maxillary CCD with a mandibular overdenture supported by two splinted or unsplinted implants has long been regarded as an acceptable treatment option for the rehabilitation of completely edentulous patients.[9] The most commonly used means to retain mandibular ISODs include ball attachments, locator attachments, and, less commonly, magnets.[10–13] Telescopic crown attachments provide an alternative for retention with unsplinted implants[14] and have been shown to exhibit fewer technical complications compared to ball attachments.[15]

The Ankylos SynCone telescopic attachment (Dentsply Friadent) concept is based on a friction-locked connection between the prefabricated tapered crown abutment and the secondary coping (matrix). The conical abutment design is purportedly more favorable for the preservation of the gingiva than a splinted bar attachment.[14] Compared to some other solitary implant attachment systems of varying biomechanical designs,[16] the vertical walls of the telescopic abutments provide horizontal stability to the prosthesis against lateral dislodgment forces,[17] and this feature is considered favorable in patients with advanced alveolar crest atrophy.[18] However, there are still few patient-based and clinical data on the outcomes of two early loaded implants supporting overdentures retained by a telescopic attachment system.

With regard to the number of implants used for overdenture retention, studies have failed to elicit significant improvements in patient satisfaction when more than two implants were used.[19,20] Fewer implants are reported to simplify oral hygiene maintenance, in addition to costing relatively less.[14,21,22]

The main aim of this prospective study was to verify whether QoL, prosthesis satisfaction, and masticatory performance improved in CCD patients when their mandibular dentures were converted into overdentures retained by two unsplinted telescopic attachments. The comparisons were made by conducting evaluations at 3 months after the provision of new CCDs, 3 months after the provision of ISODs, and 12 months after ISOD provision. Peri-implant soft tissue changes around prefabricated telescopic abutments and gold matrices were also evaluated at various intervals during this observation period.

## MATERIALS AND METHODS

Patients were recruited from patients requesting CCDs at the Faculty of Dentistry, University of Malaya, between 2008 and 2010. Of the 76 completely edentulous patients listed for replacement dentures, 27 agreed to and were eligible to participate after the initial clinical and subsequent radiographic assessment. Patient selection was based upon the following criteria: agreement to receive a new set of CCDs, at least 6 months of experience with CCDs, consent for dental implant placement and mandibular ISOD conversion 3 months after provision of the new maxillary and mandibular CCDs, and the ability to communicate in English or Malay. The protocol for the study was approved by the Ethical Committee, University of Malaya, Kuala Lumpur, Malaysia.

Consecutive patients were provided with oral and written information about the dental implant surgical and prosthodontic procedures and then given new maxillary and mandibular CCDs. Implant treatment was offered at no cost, and patients were informed of the need to participate in scheduled follow-up for 1 year after receiving the ISOD. Two implants (Ankylos, Dentsply Friadent) were inserted in the mandibular parasymphyseal region following the protocol recommended by the manufacturer. Digital panoramic radiographs and cone beam computed tomography scans were performed for the preoperative surgical evaluation of the placement sites. Implants of 3.5 mm in diameter and varying lengths (9.5, 11, and 14 mm) were placed.

The anterior ridge height at the mandibular symphysis was determined on the digital panoramic radiographs using image manipulation software (Sidexis XG, Sirona). The vertical magnification factor of the panoramic machine was verified by measuring the lengths of the implants on the postoperative radiographs and comparing these to the known implant lengths. The mandibular residual ridge heights of the patients were then categorized as low ($\leq$ 21 mm), moderate ($>$ 21 $<$ 28 mm), or high ($\geq$ 28 mm) according to the classification of Kimoto and Garrett.[23]

The mandibular CCD was relined with soft material during the healing period. After 4 to 6 weeks, stage-two surgery was performed. Prefabricated straight and angled (15-degree) telescopic abutments with 4 to 6 degrees of axial wall conical taper (Ankylos SynCone, Dentsply Friadent) were connected within 1 to 3 weeks after uncovering of the implants (Fig 1a). The angled abutments were specifically chosen in some cases to correct the lack of parallelism between the implants and to compensate for less-than-ideal implant inclinations. Paralleling guide pins were used to achieve proper alignment (parallelism) of the two abutments prior to the application of the final recommended torque of 15 Ncm (Fig 1b). This step was aimed at eliminating abutment undercuts related to the prosthesis path of insertion and removal. The corresponding prefabricated

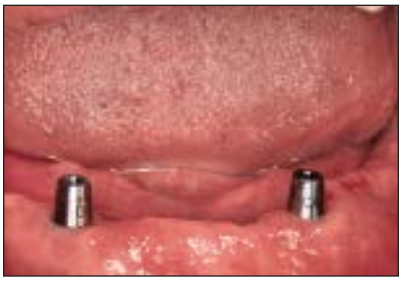

**Fig 1a** Intraoral view of the prefabricated straight telescopic abutments with 6-degree conical crown tapers connected to the implants.

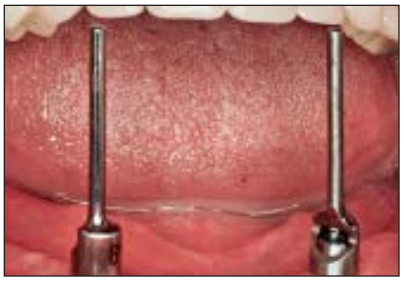

**Fig 1b** Intraoral view of the paralleling guide pins seated over the conical crown abutments to check for abutment parallelism and orientation before final torquing.

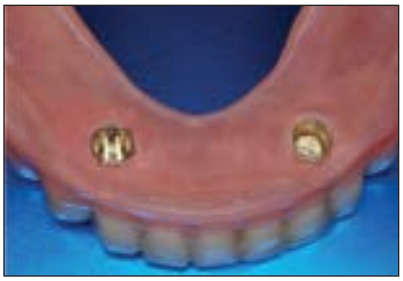

**Fig 1c** Gold matrix caps are visible on the intaglio surface of the overdenture following intraoral pickup.

**Fig 2a** Example of the two-color paraffin wax cubes used for the MAI test, with dimensions of 12 $mm^3$.

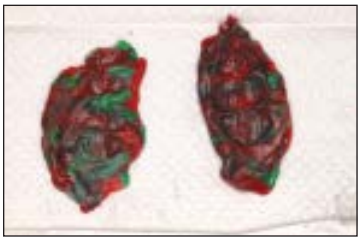

**Fig 2b** Chewed wax pieces before optical scanning and digital processing for MAI calculation.

gold matrix copings were fitted onto the SynCone abutments and transferred to the existing mandibular CCDs (Fig 1c) using a direct intraoral pickup technique with self-curing relining resin (Kooliner, GC America). The patient was instructed to close gently while the relining material was allowed to set. The occlusion was checked and the relined overdenture was completed. All prosthodontic procedures were performed by the same operator for the entire patient cohort.

Evaluation of mandibular arch form was performed on stone study casts of patients, on which the crest of the edentulous ridge was outlined from one end of the retromolar pad to the other. Arch form templates (Orthoform, 3M Unitek) representing three different arch shapes (tapered, ovoid, and square) were successively overlaid on the outlined cast, and the best fit arch form was determined.[24]

## Outcome Measures

OHRQoL, denture satisfaction, and masticatory performance were each assessed at 3 months after the patients were provided with the new CCDs, 3 months after the mandibular ISOD conversion, and at 12 months after receiving the mandibular ISODs.

OHRQoL was measured by means of the Shortened Oral Health Impact Profile-14, Malaysian version (S-OHIP 14 [M]).[25] The OHIP records data in seven domains: functional limitation, physical pain, psychologic discomfort, physical disability, psychologic disability, social disability, and handicap. Each domain consisted of two items, each of which the patients rated on a six-point Likert scale (from 0 = never to 4 = very often; 5 = do not know). Total scores and domain scores were calculated by adding the item scores with weighting. The "do not know" subscale, if used, was imputed into the mean of that particular item for the subject (patient). Composite scores (total scores) were computed for the OHIP data totals. Lower scores indicated better OHRQoL.

Denture satisfaction in patients was evaluated using questionnaires, which were also based on a Likert response format with a four-point scale ranging from 0 = very satisfied to 3 = not at all satisfied. The questions focused on three domains: maxillary and mandibular prosthesis satisfaction (in terms of denture stability, comfort, and chewing ability); general satisfaction; and esthetics. The domain score for satisfaction with individual maxillary and mandibular prostheses was calculated by adding the responses on the three items concerning stability, comfort, and chewing ability.

Masticatory performance was determined by following the method described by Sato et al.[7] The patients were made to chew temperature-controlled two-color paraffin wax cubes (weighing approximately 1.5 g each) (Fig 2a) for 10 strokes on the preferred chewing side. A mixing ability index (MAI) was derived for each patient by optically scanning the chewed wax pieces and analyzing the digital images with an image analyzer (Luzex-FS). The analysis was based on the shape and characteristics of the color mixture in the chewed wax (Fig 2b). Mean values for the three chewed wax cubes were then calculated.

### Clinical Parameters

Peri-implant tissue responses were recorded by an experienced periodontist at the abutment connection stage with ISOD, 6 months after ISOD conversion, and subsequently at 1 year. Plaque scores were quantified on mesial, distal, buccal, and lingual aspects of all implants using the Waite et al Plaque Index[26] (0 = no plaque; 1 = thin plaque; 2 = moderate layer of plaque). Bleeding on probing (BOP) was assessed with the modified Bleeding Index[27] (0 = no BOP; 1 = slow BOP; 2 = confluent line BOP; 3 = profuse BOP). Peri-implant probing depths and gingival recession were measured on all four aspects of each implant, with the greatest abutment diameter serving as the reference line from which the measurements were made. Width of attached gingiva was measured from the gingival margin to the mucogingival junction on the buccal and lingual surfaces of the implant. Periotest values (PTVs) to evaluate the strength of the bone-to-implant interface were clinically determined after 1 year in function with ISOD with the Periotest device (Siemens). PTVs generally ranged between +7 (minimum rigidity) and –7 (most rigid).

### Statistical Analysis

Statistical analysis was completed using computer software (SPSS version 12.0, SPSS Inc), with the significance level set at $P < .05$. The scores for total OHIP (including individual domains), denture satisfaction, and MAI obtained at all three intervals with the CCDs and ISODs were compared with the Wilcoxon signed rank test. Repeated-measures analyses of variance and a paired *t* test were used to compare peri-implant soft tissue changes, while the mean PTVs between the left and right implants after 12 months with ISODs were compared with a paired *t* test.

## RESULTS

Of the 27 patients who originally agreed to take part and were provided with CCDs, 17 continued with the second phase of the study 3 months later. The other 10 patients declined to continue rehabilitation with implants after receiving the new CCDs; of these, 7 were satisfied with the new CCDs and 3 cited health reasons for declining implant surgery. The remaining 17 subjects (5 men and 12 women; mean age, 61.2 years; range, 48 to 79 years) each received two implants, which were followed for 1 year postconversion of CCDs to ISODs. In one male patient, both implants failed at different intervals before overdenture conversion. The implants were replaced and subsequently integrated.

Radiographic analysis of the subjects treated with ISODs in this study revealed that 10 (58.8%) and 7 (41.2%) subjects were categorized with low and moderate mandibular ridge height, respectively. Fourteen of the subjects (82%) had a tapered arch shape, and the remaining 3 subjects (18%) had ovoid arch forms.

Tables 1 and 2 show the medians, means, and standard deviations (SDs) of patient-based outcome measures and clinical parameters, respectively, at various time intervals with the CCDs and ISODs.

A significant decrease in the total OHIP scores and two of the domains (physical pain, physical disability) was observed 3 months after ISOD conversion (Table 1a). All other domains showed significant improvement only at 1 year after ISOD conversion, compared to the 3-month scores with CCDs, except for the domains of psychologic discomfort and handicap, which remained unchanged throughout the treatment period (Table 1a). With regard to patient satisfaction and MAI (Tables 1b and 1c), significant differences were seen between the CCDs at 3 months and the ISODs at the 3-month and 1-year intervals, with the ISODs performing better at both intervals. However, with the ISODs, no significant improvements were noted between the 3-month and 1-year follow-up appointments.

Peri-implant parameters were calculated on 30 implants in 15 patients at all time intervals. At the 6-month assessment, one patient failed to report; at another, the initial 4-degree conical tapered abutment caused excessive retention and was replaced with a 6-degree abutment to ease removal of the ISOD. The data from these two patients were not included in the analysis of peri-implant parameters. There were no significant differences in any clinical parameters except for gingival recession, which showed significant changes between baseline values (abutment connection/issue of ISOD) and the 6- and 12-month follow-up examinations (Table 2). The mean PTVs for the right and left implants at 1 year were within acceptable limits and did not reveal any significant differences.

## DISCUSSION

In this study, new CCDs were constructed for all patients, as the existing dentures might have been constructed by different operators and were of varying age and quality. The same prosthodontist also treated all patients to reduce variability with the new CCDs, prior to implant intervention. Earlier studies established that improvements in the technical quality of conventional dentures could lead to a decrease in the negative impact on OHRQoL.[28,29] Evaluation of subjects with existing dentures at the time of enrollment was not done, since provision of new CCDs was considered the baseline for outcome measures. According to Harris et al,[30] variability is higher in baseline measures

**Table 1a OHIP-14 Scores at Various Intervals of CCD-ISOD Treatment**

| Time/ denture type | Total score* | Functional limitation† | Physical pain† | Psychologic discomfort† | Physical disability† | Psychologic disability† | Social disability† | Handicap† |
|---|---|---|---|---|---|---|---|---|
| 3 mo CCD | | | | | | | | |
| Median | 11 | 2.0 | 3.0 | 2.0 | 2.0 | 0 | 0 | 0 |
| Mean | 13.9 | 2.5 | 3.4 | 2.4 | 2.5 | 1.2 | 0.9 | 1.1 |
| SD | 10.0[a,b] | 1.4[a] | 1.7[a,b] | 2.2 | 1.7[a,b] | 2.0[a] | 1.7[a] | 2.1 |
| 3 mo ISOD | | | | | | | | |
| Median | 6 | 2.0 | 1.0 | 2.0 | 1.0 | 0 | 0 | 0 |
| Mean | 8.5 | 1.8 | 1.6 | 1.8 | 1.5 | 0.6 | 0.5 | 0.6 |
| SD | 7.5[a] | 1.5 | 1.6[a] | 1.2 | 1.9[a] | 1.2 | 1.3 | 1.2 |
| 12 mo ISOD | | | | | | | | |
| Median | 5 | 1.0 | 1.0 | 1.0 | 1.0 | 0 | 0 | 0 |
| Mean | 6.4 | 1.5 | 1.5 | 1.7 | 0.8 | 0.2 | 0.1 | 0.6 |
| SD | 4.9[b] | 1.4[a] | 1.3[b] | 1.4 | 1.0[b] | 0.4[a] | 0.3[a] | 1.2 |

*Scale, 0 to 56; †scale, 0 to 5. Vertically, same superscript indicates significant difference between intervals ($P < .05$; Wilcoxon signed rank test).

**Table 1b Patient Satisfaction Scores at Various Intervals of CCD-ISOD Treatment**

| Time/ denture type | Mandibular prostheses* | Maxillary prostheses* | General satisfaction† | Appearance† |
|---|---|---|---|---|
| 3 mo CCD | | | | |
| Median | 4.0 | 3.0 | 1.0 | 1.0 |
| Mean | 4.5 | 2.9 | 1.0 | 0.7 |
| SD | 2.2[a,b] | 1.1 | 0.6 | 0.5 |
| 3 mo ISOD | | | | |
| Median | 3.0 | 3.0 | 1.0 | 1.0 |
| Mean | 2.6 | 2.8 | 0.9 | 0.8 |
| SD | 1.0[a] | 0.9 | 0.5 | 0.5 |
| 12 mo ISOD | | | | |
| Median | 3.0 | 3.0 | 1.0 | 1.0 |
| Mean | 2.6 | 2.9 | 0.8 | 0.9 |
| SD | 1.1[b] | 1.4 | 0.4 | 0.4 |

*Scale, 0 to 9; †scale, 0 to 3. Vertically, same superscript indicates significant difference between intervals ($P < .05$; Wilcoxon signed rank test).

**Table 1c MAI Scores at Various Intervals of CCD-ISOD Treatment**

| Time/denture type | MAI |
|---|---|
| 3 mo CCD | |
| Median | −0.8 |
| Mean | −0.20 |
| SD | 0.56[a,b] |
| 3 mo ISOD | |
| Median | 0.6 |
| Mean | 0.66 |
| SD | 0.44[a,b] |
| 12 mo ISOD | |
| Median | 0.9 |
| Mean | 0.86 |
| SD | 0.43[b,c] |

Vertically, same superscript indicates significant difference between intervals ($P < .05$); Wilcoxon signed rank test).

**Table 2 Mean & SD of the Peri-implant Parameters (Means ± SDs) and PTVs at Various Intervals After Abutment Connection (with ISODs)**

| Time | Plaque score | BOP | Probing depths (mm) | Attached gingiva (mm) | Gingival recession* | PTV | |
|---|---|---|---|---|---|---|---|
| | | | | | | Right | Left |
| Baseline | 0.32 ± 0.58 | 0.34 ± 0.42 | 1.46 ± 0.81 | 1.86 ± 0.58 | 0.37 ± 0.32[a,b] | | |
| 6 mo | 0.56 ± 0.43 | 0.47 ± 0.39 | 1.42 ± 0.69 | 1.94 ± 0.73 | 0.74 ± 0.60[b] | | |
| 12 mo | 0.54 ± 0.47 | 0.46 ± 0.44 | 1.46 ± 0.81 | 1.72 ± 0.43 | 0.84 ± 0.47[a] | -4.49 ± 0.72 | -3.68 ± 1.74 |

*Measured gingivally, using from the widest abutment circumference as the reference line.
Vertically, same superscript indicates significant difference between intervals ($P < .05$;) using paired *t* test).

when dentures have been made by different practitioners and worn for different lengths of time.

Just over one-third of the subjects (37%) enrolled in this study chose not to continue treatment with ISOD, with the majority citing satisfaction with their new CCDs. Because these dropouts were excluded from the study, no data on OHRQoL and denture satisfaction were obtained. The reduced number of patients completing the study as a result of high dropout rate can be considered a limitation.

The present results agree with another study[30] that showed significantly improved OHRQoL in edentulous patients after mandibular overdenture conversion. However, since treatment expectations and

preferences can affect patients' response ratings following treatment,[31,32] the observed improvement with the ISODs cannot be generalized to different groups of edentulous denture wearers. The pool of patients in this study consisted of those who were interested, willing, and clinically qualified to receive ISOD therapy.

Whereas the study of Harris et al[30] observed improvement in all domains of OHIP, the present study investigation showed improvement in all areas except the domains "psychologic discomfort" and "handicap." According to Awad et al,[33] these two domains, together with "social disability," seem to show the fewest changes following conventional or implant treatment, and issues such as depression, avoiding social interaction, difficulties with relationships, life satisfaction, and the ability to work are included in these domains. The current results may indicate either that these domains were more difficult to improve or the patients did not perceive themselves as disadvantaged in these areas.

Patients' ratings of satisfaction with the functional aspects of mandibular prostheses improved with implant treatment, in agreement with other studies.[34–36] However, satisfaction with the opposing maxillary CCDs did not differ before and after implant intervention at any of the intervals. A possible reason for this could be the "ceiling effect"; ie, because the level of dissatisfaction was already low for the maxillary denture compared to satisfaction with the mandibular denture at 3 months after the new CCDs were delivered, the degree of improvement was therefore not notable.[37] However, one study observed improvement in patient satisfaction with the opposing maxillary CCD after mandibular ISOD treatment, but the satisfaction level was lower than that achieved with the mandibular ISOD.[38] Another study also showed improved satisfaction with a maxillary CCD opposing a mandibular ISOD, but these were compared to a previous set of maxillary and mandibular CCDs.[39] With respect to overall satisfaction, no significant improvement was observed, and according to Mericske-Stern et al,[40] the distribution and number of interforaminal implants required to satisfy patient demand is dependent on the anatomical-morphologic condition of the mandibular arch. The majority of the patient sample in this study had tapered arches, and this configuration would best be managed with three implants to support the OD.[40]

Objective assessment of masticatory performance with the MAI test showed improvements at both time intervals after implant treatment. According to Kimoto and Garrett,[23] patients with advanced ridge resorption were more likely to benefit from ISODs, and from a systematic review,[41] the benefits in masticatory performance with ISODs were observed more readily in patients with resorbed mandibles. All patients in this study presented with either low or medium mandibular ridge height, which might explain the significant improvement in masticatory performance with ISODs. This finding also concurs with previous studies that demonstrated similar results with mandibular ISODs.[23,34,36] Further improvement in masticatory performance between 3 months and 1 year after ISOD conversion could be explained by the patients' adaptation to the ISOD as well as to the opposing maxillary CCD. Weak correlations, or none at all, were found between self-rated masticatory ability and functional test results,[42] leading to the conclusion that objective methods such as mixing ability tests should be used in conjunction with the subjective outcome measures to fully evaluate the effect of overdenture conversion.

Previous investigators found that patients preferred two unsplinted abutments over splinted bars for overdentures because of the ease of cleaning.[14,22] However, in this study, higher plaque scores were recorded 6 months after abutment connection, in spite of oral hygiene instructions given at baseline (abutment connection/issue of ISOD). Nevertheless, no significant differences were observed at any of the examinations. Implant hygiene compliance in overdenture patients is vital for plaque control, as plaque-induced reactions are generally more destructive in peri-implant tissues than in periodontal tissues.[43] The BOP scores, similarly, showed no significant differences between any of the intervals. This was reflected in the plaque scores, although the significance of BOP around implants is debatable.[44]

The mean keratinized mucosal width recorded for all implants ranged from 1.72 to 1.94 mm during the 1-year period and seemed compatible with peri-implant tissue health.[45] Earlier studies have shown the first 3 to 6 months after implant exposure and abutment connection to be the time during which most mucosal changes occur around implants. Similar observations were noted in this study, in which significant gingival recession was noted 6 months after abutment connection. Stabilization of the peri-implant tissues occurred during the following 6 months, leading to no significant changes at the 1-year exam.

All implants appeared to be well stabilized. The most recent PTVs obtained (right: –4.49 ± 0.72; left: –3.68 ± 1.74) were comparable to those reported by Liao et al[46] (–4.25 ± 0.93) at 1 year.

It has been noted that the small sample size was a limitation of the study; recruitment of completely edentulous patients was challenging within the time frame set for the study. A control group was also not available, since the intention was not to compare different implant and/or attachment groups but rather to evaluate changes in the outcomes after overdenture conversion. Further research comparing implants

restored with SynCone abutments with other solitary attachment systems is needed to assess the long-term success and survival of implants. Prosthodontic outcomes and the associated financial burden, which is also of relevance to clinicians and edentulous adults, require further evidence.

## CONCLUSIONS

Within the limitations of this study and the small patient sample size examined, the following conclusions can be made.

1. Edentulous patients who self-selected and were provided with mandibular telescopic crown attachment–retained implant overdentures showed significant improvement in oral health–related quality of life, mandibular overdenture satisfaction, and masticatory performance compared to mandibular conventional complete dentures worn for the same amount of time (3 months).
2. The peri-implant soft tissues showed no significant changes at any intervals during the 1-year observation period, except for gingival recession. Implant stability was found to be favorable after 1 year of follow-up.

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