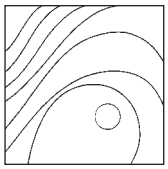
Short-Term Retrospective Case Series of Implant-Assisted Removable Partial Dentures with Locator Abutments



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The purpose of this retrospective case series was to report on the clinical performance of implant-assisted removable partial dentures (IARPDs) with Locator abutments in different partial edentulism situations, with a mean follow-up period of 28.6 months. Twelve consecutive patients were treated with IARPDs. A total of 24 implants were placed in the edentulous area. Minimum follow-up period was 12 months. Overall patient satisfaction, health of peri-implant tissues, survival of implants and abutments, and prosthetic complications were reported. Overall implant survival was 91.6%; two implants failed. No major complications were reported—only one IARPD metal framework broke. No Locator abutment loosening was reported. Within the limitations of this retrospective study, treatment with IARPDs can improve the patient's function, phonetics, and esthetics without the need for extensive bone regeneration surgeries and prosthodontic rehabilitations. However, well-designed prospective clinical studies on IARPDs are needed to support their long-term use. (Int J Periodontics Restorative Dent 2014;34: e121–e128. doi: 10.11607/prd.2052)

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Oral rehabilitation with implant fixed prostheses seems to be a good treatment option for the rehabilitation of people with partial edentulism, especially when a long edentulous distal span is encountered.[1,2] However, such treatment is not always a viable option for several reasons, including the need for extensive bone regeneration surgeries, the need for generalized prosthetic rehabilitation, compromised general health status, and economic reasons.[3,4]

A cost-effective alternative to implant fixed prostheses is a conventional removable partial denture (RPD).[5] However, RPD designs present some biomechanical limitations because two tissues with different viscoelasticity support the denture: teeth and mucosa.[6] Moreover, RPD treatment is associated with increased caries lesions on teeth, increased alveolar bone resorption, and psychologically less acceptable treatment.[2,7]

Several in vitro studies, case series, and retrospective studies[8–14] recommend the placement of distal implants in each edentulous ridge to deal with the biomechanical limitations of conventional RPDs.

Therefore, RPDs can be assisted with dental implants with the use of retentive systems, and the term *implant-assisted removable partial denture* (IARPD) is used.[15] Consequently, this treatment option not only increases the retention of the prosthesis and hence limits lateral and vertical displacement of the RPD, but it also distributes masticatory forces more effectively along the prosthesis and the adjacent teeth.[16] It also increases patient satisfaction and improves chewing ability, phonetics, and esthetics, since sometimes the unesthetic vestibular bracing arms can be removed.[6,11,13,15,17,18] Moreover, Keltjens et al[9] reported that this type of treatment can prevent bone resorption that occurs under a conventional RPD.

Many studies in the literature have reported the use of different retentive systems in IARPDs.[11,13,19–22] Locator abutments (Zest Anchors) are preferred because of their ease of use, repair, and replacement, and they offer different connections and heights that can adapt to different prosthetic situations.[14,23,24] To the authors' best knowledge, there are no studies in the literature that solely use the Locator abutment in IARPDs.

The purpose of this study was to report, retrospectively, through a series of clinical cases, the performance of implants and the Locator attachment system in IARPDs in Class I and II Kennedy arch configurations, with a mean follow-up period of 28.6 months.

Method and materials

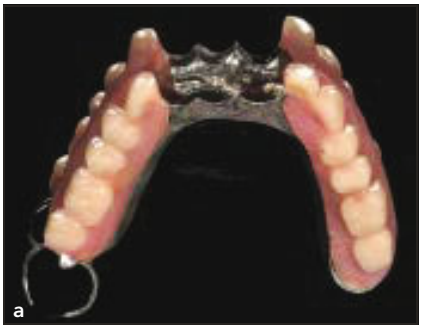
The study sample was drawn retrospectively from a private dental office between December 2009 and May 2012. Patients who were partially edentulous in the maxilla and/or mandible were selected. Patients were RPD wearers willing to improve their masticatory function. Several treatment options were presented to them, varying from removable partial prostheses to fixed prostheses with implants associated with bone regeneration procedures. Only those who chose the implant-assisted RPD with Locator attachments treatment option were included in the study. Therefore, a total of 12 patients were selected for this retrospective case series. Patients presented with unilateral or bilateral distal edentulism and were classified according to Kennedy classification. The same type of implant and retentive system was used for all patients, with a minimum follow-up period of 12 months.

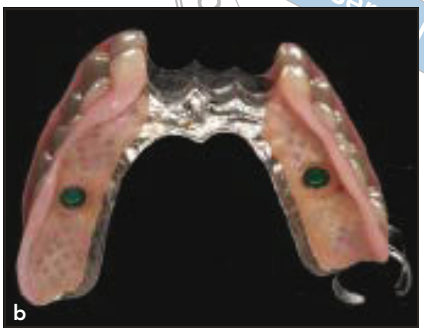
The Screwplant (Implant Direct) implant system was used. The plan was to place one implant in each edentulous area or two in the same edentulous ridge if the patient presented with a Kennedy Class II long distal span. A surgical drilling protocol was used following the manufacturer's recommendations. The widest and longest implants were inserted according to the bone availability of the residual alveolar ridge and avoiding, if possible, bone regeneration surgeries in order to keep a simple treatment for the patient. The implants were 3.7 or 4.7 mm in diameter and 8, 10, 11.5, or 13 mm long.

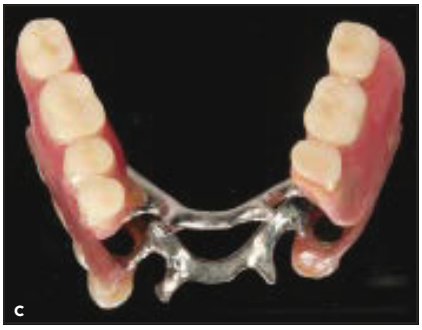
The maxillary implants were left 3 months for osseointegration and the mandibular ones were left for 2 months. Locator abutments were then inserted into each implant and torqued up to 30 Ncm following the manufacturer's recommendations.

A new RPD was fabricated after the osseointegration period. Its design was characterized by having no vestibular clasps placed in the anterior remaining dentition in order to improve the esthetics of the RPD (Figs 1a to 1d). The palatal plate major connector with a very reduced palatal coverage was designed for the maxilla (Figs 1a and 1b) and a lingual bar was used in the mandibular RPD (Figs 1c and 1d). Metal mesh in the ridge area was removed around the metal retentive element of the Locator abutment in order to resinate with Paladur denture resin (Heraeus Kulzer). The occlusal scheme was a mutual protection and balanced occlusion when the antagonist was a complete denture (Fig 2).

Follow-up visits were bi-annual for a total mean follow-up period of 28.6 months. In each visit, a clinical examination was performed to check soft tissue health around the implants, and the removable denture was checked for any prosthetic complication. At the end of the first 12 months, patients were given a questionnaire asking about their satisfaction before and after treatment with dental implants, similar to the one used in Bortolini et al.[22] Overall satisfaction was gauged using a visual analog scale (VAS) of 1 to 5 (1 being the worst) and focused on function, esthetics, and convenience of the







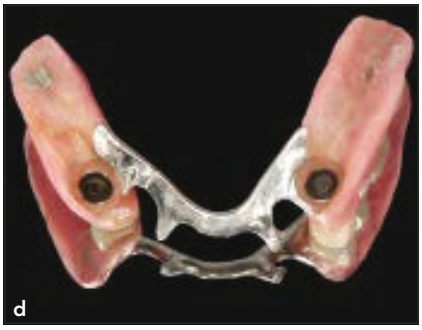
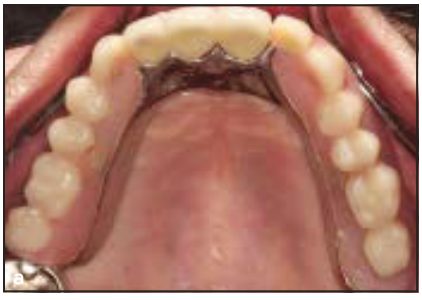
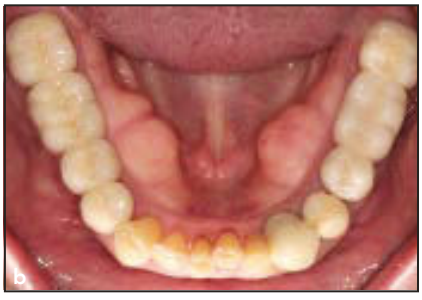
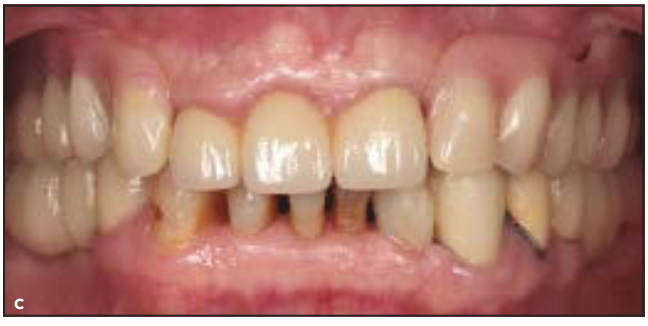


Fig 1 *Different IARPD designs.* (a) *Patient 6 with maxillary RPD design for a Kennedy Class II/I arch configuration, with no vestibular clasps in the anterior remaining teeth and palatal plate major connector.* (b) *Gingival view of the IARPD of the same patient.* (c) *Patient 1 with mandibular RPD design for a Kennedy Class I arch configuration, with no vestibular clasps and lingual bar major connector.* (d) *Gingival view of the IARPD of the same patient.*







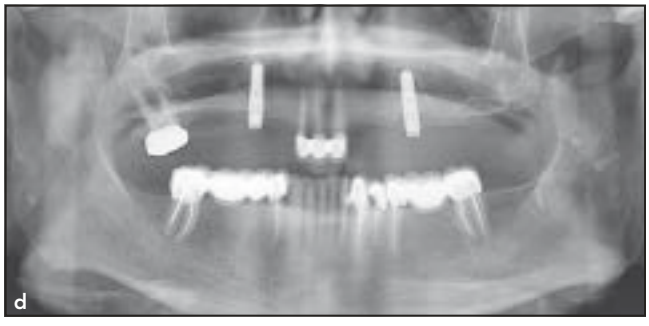


Fig 2 *Patient 6 IARPD.* (a) *IARPD inserted.* (b) *Antagonist arch rehabilitated with fixed partial prosthesis.* (c) *Occlusion in maximum intercuspation.* (d) *Panoramic radiograph.*

prosthesis. Marginal bone loss was evaluated using intraoral and extraoral radiographs. Also, peri-implant soft tissue health was evaluated by clinical observation. Implant failure was considered when an implant was removed due to clinical mobility or there were signs of peri-implant radiolucency, persistent pain, and/or infection attributed to the implant.

Prosthetic complications were recorded during the follow-up visits: mobility of the metal retentive cap, plastic retentive male change, Locator abutment loosening, denture teeth wear, repair of denture teeth, and status of the metal framework.

Table 1 Patient general information

Patient no.	Age/sex (y)	Smoker?	Arch configuration	Number of implants	Implant location	Opposing arch	Follow-up (mo)	Failed implants
1	81/female	No	Class I mandibular	2	2nd premolars	RPD	38	0
2	62/female	No	Class I mandibular	2	1st molars	Natural dentition and implant fixed prosthesis	39	0
3	67/female	No	Class I mandibular	2	2nd premolars	Natural dentition	43	0
4	84/female	No	Class I maxillary	2	2nd molars	Implant fixed prosthesis	35	0
5	82/female	No	Class I maxillary	2	Right 1st molar and left 2nd premolar	Natural dentition	30	1 (right first molar)
6	65/male	No	Class II/I maxillary	2	Right 1st premolar and left 2nd premolar	Natural dentition	27	0
7	71/male	No	Class I mandibular	2	1st premolars	Natural dentition	16	0
8	74/male	No	Class II/I maxillary	2	1st molars	RPD	26	0
9	84/female	No	Class II mandibular	2	Left canine and left 1st molar	Complete denture	21	0
10	72/male	No	Class II/I maxillary	2	1st molars	Implant overdenture	37	0
11	81/female	No	Class I mandibular	2	2nd premolars	Natural dentition	15	1 (left second premolar)
12	82/female	No	Class II/I maxillary	2	2nd premolars	Natural dentition	17	0
Mean age: 75.4 y				**24**		**Mean follow-up: 28.6 mo**		**2**

Results

A total of 12 patients were included in the study (8 women, 4 men; mean age: 75.4 years). Partial edentulism of the selected patients was classified according to Kennedy: maxillary Class I: 2 patients; mandibular Class I: 5 patients; maxillary Class II: 4 patients; and mandibular Class II: 1 patient (Table 1).

Two implants were placed in each patient; therefore, a total of 24 implants were placed in different locations along the edentulous ridge (see Table 1). No bone regeneration surgeries were required for the placement of the implants.

Two of 24 implants failed; therefore, the overall implant survival was 91.6% during a total mean follow-up period of 28.6 months (see Table 1).

Mean patient satisfaction before treatment was 1.19 ± 0.64. Mean patient satisfaction after 12 months of treatment was 4.55 ± 0.35 (Table 2).

Prosthetic complications were reported during the 28.6-month reporting period. The most frequent complications were mobility of the metal retentive cap (six times in six patients), and the plastic retentive

Table 2 Summary of patient satisfaction

	Satisfaction before (1–5)	Satisfaction after (1–5)
Mean	1.19	4.55
SD	0.64	0.35

Table 3 Summary of prosthetic complications

Mobility metal retentive cap	6 times in 6 patients, relining was needed
Plastic retentive male change	Changed in all patients at the 12-month visit
Locator abutment loosening	None
Denture teeth wear	Teeth wear in 7 patients; 1 patient requires change
Addition denture teeth	1 patient, maxillary left 2nd molar
Metal framework	1 patient's metal framework broke after 15 months

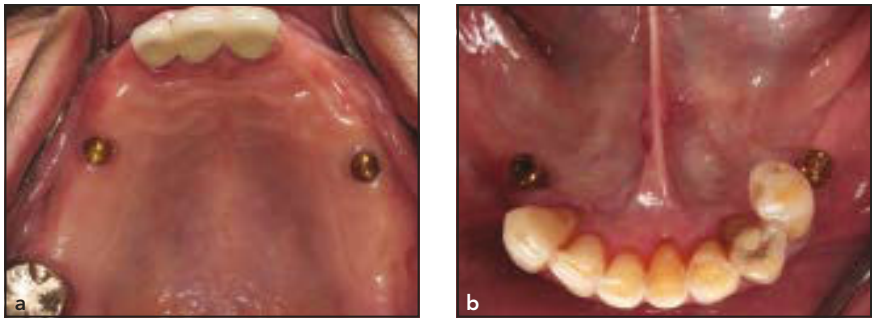


Fig 3 *Soft tissue health around dental implants.* (a) *Peri-implant soft tissue status of patient 6 at the 1-year visit. Note the absence of soft tissue irritation around the area of the denture base is in touch with the alveolar ridge.* (b) *Peri-implant soft tissue health of patient 1 after 38 months of service.*

male was changed in all patients at the 12-month visit. Other less frequent complications reported were denture teeth wear (1 patient), addition of denture teeth (1 patient), and fracture of the metal framework (1 patient). All prosthetic complications are summarized in Table 3.

Discussion

Patient satisfaction

All patients in the study experienced a significant change in satisfaction regarding function, esthetics, and convenience, according to VAS questionnaire results. The mean satisfaction score was 1.19 ± 0.64 before treatment with dental implants and 4.55 ± 0.35 after insertion of the new prosthesis with implants (Table 2). These results are in agreement with similar retrospective studies and case reports[8,9,11,17,21,22] analyzing patient satisfaction with IARPDs. This significant change in patient satisfaction was probably due to the fact that patients were asking for a more fixed solution to their partial edentulism before starting the treatment with dental implants.[22]

The patient satisfaction evaluation in the present study was done after 12 months of service. The score was probably biased because participants were asked to remember how they felt about their old prostheses after treatment. Nevertheless, the results were similar to those of Bortolini et al,[22] who used a similar VAS questionnaire given before treatment with dental implants: 1.31 ± 0.43 before and 4.59 ± 0.47 after treatment.

A multi-centric prospective evaluation of IARPDs with ball attachments was published recently. Several types of patient satisfaction questionnaires were used and they revealed significantly improved parameters of overall satisfaction, stability, chewing, and appearance after a period of 3 years.[25]

Implant, Locator, and denture evaluation

No bone regeneration procedures were performed in the current study; this led the implants to be placed in areas of sufficient bone availability that permitted the placement of standard implants in diameter and length. Such positions were generally located at the premolar area, adjacent to the most distal natural

tooth of the remaining dentition, since distally to that point extensive horizontal and vertical alveolar ridge resorption was frequently encountered.[13,22] However, such a position along the edentulous span was not the most favorable biomechanically for force distribution. According to clinical as well as in vitro studies, the most favorable position of the implants in IARPDs would be in the molar region in order to increase support and stability of the treatment.[13,26–28] But, if insufficient bone is encountered in such areas, placement of the implant adjacent to the remaining dentition is recommended and can provide a future treatment option such as an implant fixed prosthesis[13] and also relieve the tensions at the abutment tooth apex and alveolar edge, confirming the benefit of placing the implants closer to the abutment tooth.[27]

In three patients (patients 5, 6, and 12), implants were located in the middle of the edentulous ridge of the maxilla in order to seek the most distal position for ideal support of the prosthesis. This area was selected to avoid maxillary sinus augmentation, since distally to that point vertical bone resorption was found (see Fig 2d). In a finite element study, Cunha et at[27] showed that when implants were placed in a middle position, ie, first molar region, stress forces were distributed in a way that were less intense on the remaining dentition compared with more distally placed implants in the second molar region. Also, according to a recent in vitro study,[28] when implants were positioned in the middle of the edentulous ridge, the use of vertical reciprocal arms is recommended since they transmit less stress than horizontal reciprocal arms to the remaining dentition. Also, no statistical differences compared with more distally placed implants were found.

The present study was unable to investigate which was the best implant position in terms of providing the fewest prosthetic and implant complications. Further investigation is required to evaluate the most effective implant position for treatment with IARPDs.[28]

Slight inflammation of the peri-implant soft tissues was present in most patients, due to poor home maintenance. However, after a professional prophylaxis and oral hygiene instructions were given, peri-implant soft tissue inflammation was not present in the following visits (Figs 3a and 3b).

Radiographic evaluations showed no significant changes in marginal bone levels during the follow-up period (Fig 2d). However, due to the inconsistent radiographs taken during this period, implant success was not evaluated.

Two implants failed, one at the site of the maxillary right first molar after 16 months of service (patient 5) and the other at the site of the mandibular left second premolar after 13 months (patient 11). It was believed the implant failures were associated with peri-implant infection rather than biomechanical overload or due to a short healing period for osseointegration because failures were seen in the mandible and the maxilla more than a year after implant placement. Implants were removed and new implants were placed adjacent to the failed ones. After an osseointegration period of 3 months, relining of the existing IARPD with the new position of the implant was performed in order to insert a new Locator abutment.

Overall implant survival rate was 91.6%, similar to that found in Mitrani et al (93.75%), a retrospective study with a similar sample size (16 implants placed in 10 patients).[11] However, other studies with bigger sample sizes had an overall 100% survival rate.[11,19–22]

In the current study, the maxillary left second molar failed in one patient (patient 10) and had to be extracted. Therefore, a denture tooth had to be added to the RPD, changing the patient's status from a maxillary Class II/I to a Class I. However, no major modifications had to be done to the existing RPD design.

Mobility of the metal retentive cap of the Locator system was observed in six patients and, therefore, relining with resin was needed. In other studies, frequent resin relining also was needed when using different implant retention systems.[9,11,20,22] Therefore, it seems frequent maintenance procedures are required, independent of the retention system used.

Locator abutment loosening was not observed in any patient during the follow-up period, although it was observed in other studies in which ball attachments were used.[11]

Denture evaluations, including checking the status of the metal framework, resin base, and denture teeth, were performed at every visit. In seven patients, some slight wear

was observed, but it did not require replacement of denture teeth. Teeth had severe wear in one participant (patient 3), and the denture teeth had to be changed.

Consideration to framework design of the RPD must be taken when implants are placed close to neighboring teeth. It should be noted the metal framework completely fractured after 15 months in one participant (patient 7). The fracture was present between the distal area of the mandibular left first premolar and the mesial of the implant located in the area of the second left premolar. This fracture may have occurred due to improper framework design. Evaluation of the framework revealed areas between the tooth and implant that did not have sufficient metal thickness, thus causing the framework to fracture at a weak point.

One of the limitations of this study is the number of participants included (12 patients) and the short follow-up period (28.6 months). Bigger sample sizes and longer follow-up periods would better demonstrate the success of IARPD treatment, because more prosthetic and implant complications would appear in the long term. In the literature, the maximum mean follow-up period found was a retrospective study of 96 months[22] and another retrospective case series of 120 months,[13] and they also reported low rates of implant and prosthetic complications. To date, there are no prospective clinical studies focused on the overall long-term success of IARPDs. Some authors[22] have mentioned the use of IARPDs as a provisional treatment that can be transformed into a complete implant overdenture, if it is decided to extract the remaining dentition in that particular arch. Also, IARPDs can be used provisionally when extensive regeneration surgeries or complex prosthodontic procedures are being performed in order to provide a better masticatory function to the patient.

Well-designed prospective clinical studies on IARPDs should focus on long-term implant success, abutment longevity, and prosthodontic complications.[15]

Conclusions

Within the small sample size and short-term results of this retrospective case series, the following conclusions were drawn:

- An IARPD increases patient satisfaction.
- Peri-implant soft tissues and residual edentulous ridges remained stable during the mean 28.6-month follow-up period.
- Implant survival found in this study (91.6%) was similar to that of standard implants.[29]
- The use of the Locator abutment resulted in a good clinical performance because of its ease of changing the retention element and its resistance to wear, fracture, and abutment loosening.
- The treatment with IARPDs resulted in ease of repair and modification and a low complication rate. Proper metal thickness between remaining teeth and neighboring implants should be carefully checked during the metal framework try-in of the RPD.
- Regular maintenance visits of patients treated with IARPDs are recommended in order to prevent future implant failure and prosthetic complications.

Acknowledgments

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

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