Minimally Invasive Fixed Rehabilitation of an Extremely Atrophic Posterior Mandible Using 4-mm Ultrashort Implants: A Case Report with a 7-Year Follow-up

This case report describes the rehabilitation of an extremely atrophic posterior mandible using 4-mm ultrashort implants and reports clinical and radiographic outcomes 7 years after loading. The patient refused to undergo any other treatment, from the removable prosthesis to the reconstructive surgery, and asked for a fixed, minimally invasive solution in the shortest possible time. The residual bone height above the alveolar nerve was an average of about 5 mm, so it was decided to treat the patient with four 4-mm ultrashort implants. Within the limitations of this case report, this procedure appears successful at 7 years after loading in this specific case and could reduce invasiveness, rehabilitative times, and costs. However, longer follow-ups on a large number of patients coming from randomized controlled clinical trials are necessary before making more reliable recommendations. Int J Periodontics Restorative Dent 2020;40:e235–e240. doi: 10.11607/prd.4957

Fixed rehabilitation of the posterior mandible with vertical bone atrophy can be a common clinical problem. In these cases, due to insufficient height of the residual alveolar bone, it is difficult or impossible to place implants of adequate length. In situations where bone width is sufficient with poor bone height, possible solutions include vertically augmenting the bone or using short implants.1,2

If bone augmentation is selected, techniques such as guided bone regeneration,3–5 alveolar distraction osteogenesis,6 and onlay7,8 and inlay9 bone grafting can be used. However, these procedures are associated with postoperative complications, long rehabilitative times, and expensive costs.2

As an alternative solution, placing short implants could reduce complications, rehabilitative times, and costs, potentially increasing patient global satisfaction as a result.10,11 Nowadays, the results of several randomized controlled clinical trials (RCTs) with a minimum 5-year follow-up suggest that 5.0- to 6.6-mm-long implants can be a good alternative to augmentation procedures, especially in posterior mandibles,12–14 but the question remains: What will happen if the atrophy is advanced to an extent to allow only the placement of 4.0-mm-long implants? To the authors’ present
knowledge, no RCT has yet compared the long-term results of 4-mm ultrashort implants vs longer implants placed in augmented bone, but preliminary data from one RCT on 4.0-mm–long implants suggested good performances up to 1 year postloading in extremely atrophic patients.\textsuperscript{15}

The present case report describes a successful implant-prosthetic rehabilitation using 4-mm ultrashort implants with a concave collar for the treatment of an extremely atrophic posterior mandible with an average of 5 mm of residual bone height, avoiding the need for any bone augmentation. The present investigation reports data up to 7 years after loading. A previous publication reported data 1 year after loading.\textsuperscript{16}

**Materials and Methods**

A 62-year-old systemically healthy man was referred for a fixed prosthetic rehabilitation of his right posterior mandible. Clinical and radiographic (orthopantomography and CBCT) evaluations showed vertical posterior mandibular atrophy with an average of 5 mm of residual bone height above the mandibular canal (Figs 1 and 2).

The patient refused to undergo any surgery to vertically augment the insufficient residual bone and asked to be rehabilitated up to the third molar for functional reasons. Thus, in this clinical situation, it was proposed to place ultrashort (4-mm) implants to provide a subsequent fixed prosthesis, exploiting just the patient’s native bone. The surgical procedure was performed under local anesthesia. A crestal incision was performed, and a full-thickness flap was elevated in the mandibular right posterior area. Four implants (4-mm length and diameter; TwinKon 4.0,
Global D) were placed in the second premolar and first, second, and third molar zones (Fig 3). Implants were transmucosal, made of commercially pure titanium with a roughened surface. Flaps were then carefully sutured with 4-0 resorbable sutures. Radiographs and CBCT scans were taken after implant placement to verify the proper implant position. A 2-g dose of amoxicillin with clavulanic acid was administered preoperatively, followed by 1 g twice daily for 5 days. Ibuprofen (600 mg) was prescribed to be taken as needed.

A cold and soft diet and appropriate oral hygiene were recommended for 2 weeks. Sutures were removed 7 days after the surgical procedure, and the postoperative recovery was uneventful.

**Results**

The patient was examined once a week during the first month and twice in the following month with an uneventful healing process. Four months after implant placement, a provisional restoration was delivered, replaced by the final prosthesis after another 4 months. One year after loading the implants were stable clinically and radiographically (Fig 4a).

The patient was clinically examined and underwent professional oral hygiene sessions every 3 months. After 3 (Fig 4b), 5 (Fig 4c), and 7 years (Fig 4d), intraoral radiographs were also taken, and the implants did not show any clinical or radiographic issues.

![Fig 4 Intraoral radiographs at the (a) 1-, (b) 3-, (c) 5-, and (d) 7-year follow-ups after prosthetic loading. Peri-implant marginal bone levels were favorable throughout. Over time, some bone creeping occurred over implant shoulders, and there was an increase in inter-implant bone density.](image-url)
Seven years after implant placement, the 4-mm ultrashort implants showed very favorable peri-implant marginal bone levels as well as some probable degree of bone creeping over the implant shoulder. Moreover, no prosthetic or clinical problems were detected, and the patient is fully satisfied with the treatment.

Discussion

Recently, clinicians have to deal with patients asking for fixed prostheses in conditions of extreme atrophy. The posterior mandible is not an area of high esthetic demand, and many patients often refuse reconstructive surgery because it is considered invasive and expensive, and it requires long rehabilitative periods. According to a recent systematic review by de N Dias et al, 1 the median proportion of patients with complications when using standard-length implants placed in reconstructed bone was 39%. These techniques are even more complex in the posterior mandible, and in the literature it is still unclear which is the best option.2

As a consequence, when facing a vertical atrophy of about 5 mm with a patient asking for a fixed option, the clinician should first assess expectations and desires. If the patient asks for esthetics, a reconstructive approach could be proposed, explaining all the possible risks, treatment times, and costs. Nowadays, as there is still no literature evidence on the best reconstructive technique, the present authors suggest the interpositional block bone graft to vertically augment the atrophic posterior mandible.3 The “guided sandwich technique” can also be used for extremely atrophic mandibles.17 However, this approach requires expert surgeons, especially for these extreme cases in which surgical procedures become more tricky and can be associated with more severe complications.15

Nevertheless, the present patient refused reconstructive surgery in order to have a minimally invasive option. Given the degree of vertical atrophy, it was proposed to use the shortest implant available for the authors at that moment. All possible risks associated with the fact that there were no long-term data on 4-mm implants were discussed with the patient. The authors’ decision was made on the basis of literature evidence available at that time, which suggested that short implants (5 to 8 mm) could be a good alternative to reconstructive surgeries.

The present results were further confirmed by systematic reviews, RCTs, and other studies over the 7-year follow-up.18,19 Monje et al’s meta-analysis20 reported that the survival rate of short implants was 88.1%, compared to 86% of standard-length implants; short implants have therefore been shown to have a predictability similar to longer implants, and thus the crown-implant ratio does not affect the implant survival rate.21

Encouraging medium-term results on implants with 5- to 6-mm lengths were also reported in the literature. According to a recent systematic review by Esposito et al, the meta-analysis showed statistically significantly less complications and bone loss (mean difference: 0.60 mm) at short implants (5 to 6.6 mm long) in posterior mandibles after 5 years of loading.22 Moreover, an RCT by Bolle et al was published that compared 4-mm short implants to long implants in augmented bone on a group of 40 patients with extremely atrophic posterior mandibles with 5.0 to 6.0 mm of bone height above the mandibular canal, but with only 1 year of follow-up; 9 augmented patients were affected by complications vs 2 patients treated with short implants.15

However, in light of current knowledge, the present authors believe that some important factors should be taken into consideration when planning placement of short dental implants. Some literature shows more prosthesis complications related to a high crown-to-implant ratio,23 so to avoid this problem, the occlusal scheme in the prosthetic rehabilitation of short implants should be carefully planned; for instance, avoiding lateral loading and trying to reach a balanced and mutually protected occlusion.

Another factor is that proper hygiene care is very important, and the patient should be adequately motivated. Sessions of professional oral hygiene should be carried out every 3 months, as in the case of the patient of this case report.

Moreover, Souza et al described that implants placed in sites with < 2 mm of keratinized mucosa (KT) presented significantly higher plaque accumulation, more peri-implant inflammation, and higher bleeding on
probing. Therefore, it seems to be important to have more than 2 mm of KT and adequate bone tissue volumes, especially around short implants.

The stability of the results of the case described herein could probably be related to the characteristics of the implant as well, the concave collar of which may contribute to better bone stability. This could be confirmed by Bolle et al’s histomorphometric study in dogs: The transmucosal design seemed to allow bone integration on the implant shoulder, and it could also promote the convergence of the collagen bundle toward the implant collar.

In the present case, the clinical and radiographic results after 7 years can be considered satisfactory for the moment. Peri-implant marginal bone levels are stable, with crestal bone creeping over the implant shoulders. However, radiographs are not standardized, and therefore deviations in evaluating bone heights are possible.

The patient is fully satisfied with the treatment and would recommend this rehabilitation option for other possible cases with similar conditions.

Conclusions

After 7 years of observation, 4-mm ultrashort implants with concave collars have shown positive clinical and radiographic results in the rehabilitation of a posterior, extremely atrophic mandible. Thus, with an average bone height of 5 mm above the mandibular canal, placement of 4-mm ultrashort implants could be a good alternative to surgical bone augmentation. The 4-mm ultrashort implants are a less invasive option, require a shorter rehabilitation period, and are often much more acceptable for the patient. However, this case will continue to be observed to report any changes in the results. Aware of the limitations of a case report, further trials with longer follow-ups and larger samples are needed to confirm the authors’ results and to recommend this technique.

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References