

A Radiographic Review of Bone Levels Around Calcitek Dental Implants Supporting Mandibular Overdentures. Preliminary Results at 3 to 6 Years.

E.Patsiatzi*, N. Malden† and R. Ibbetson‡

Abstract - This retrospective study aimed to measure marginal bone resorption around cylindrical hydroxyapatite-coated implants retaining mandibular overdentures and compares this between two- and four- implant supported overdentures. Twenty three edentulous patients received 66 implants in their anterior mandible and were restored with overdentures. Panoramic radiographs one week post-operatively and at last recall were compared and marginal bone loss calculated. The mean recall interval was 51.22 months. The mean cumulative bone loss was 1.08mm and the mean annual bone loss 0.263mm. There was no significant difference between two- and four- implant overdentures. The results were comparable with other reports.

KEY WORDS: Hydroxyapatite-coated implants, Marginal bone loss, Overdentures

INTRODUCTION

Implant retained mandibular overdentures have several advantages over conventional dentures. There is increased patient satisfaction¹⁻⁴ and the ratings of quality of life are significantly higher⁵⁻⁷. There is emerging evidence that recipients of mandibular implant retained overdentures modify their diets, and improve their nutritional state⁸.

Implants reduce the rate of resorption of the residual ridge in the anterior mandible^{9,10}.

The survival rate of root form titanium implants is very high in the anterior mandible, they are simple to provide and low cost compared to other implant prostheses.

The Calcitek implant system is a hydroxyapatite (HA)-coated system. HA is a bioactive ceramic that has been shown to form strong ionic bonds with the bone mineral improving integration characteristics.

This implant has been used at the Edinburgh Dental Institute to retain mandibular overdentures on two or four implants. This study was undertaken in order to evaluate the long-term effectiveness of this implant system. The study also compared the peri-implant health in two- and four- implant supported overdentures.

Tinsley *et al.*¹¹ performed a study on mandibular overdentures supported mainly on three Calcitek implants. They found a high success rate by year four, but beyond this four-year period there was a significant change in the reliability of the coated implants. There is no study in the literature comparing the bone levels around the implants in two and four Calcitek implant overdentures.

The aims of this study were: 1) to analyse, retrospectively, the rate of marginal bone loss around Calcitek cylindrical HA coated implants retaining mandibular overdentures at between three to six years follow-up and 2) to compare marginal bone levels of two and four implant retained overdentures.

MATERIALS AND METHODS

The Calcitek dental implant system consists of a cylindrical titanium alloy core coated with a 50-to 70-µm layer of dense highly crystalline HA that extends the full length of the implant. The implant was developed in 1984, and is available in lengths of 8, 10, 13, and 15 mm and in diameters of 3.25 and 4.0mm.

A retrospective study was based on Calcitek implants placed at a Postgraduate Dental Institute in Scotland, between 1995 and 2000, in the anterior mandible to support overdentures. The implants were placed by one operator, an Associate Specialist in Oral Surgery, in a two-stage surgical procedure usually under local anaesthetic. No preoperative antibiotics were given. At implant insertion a surgical stent was mostly used to indicate optimal position of the implants. After a healing period of three to four months the implants were exposed and checked for osseointegration and the abutments were connected.

A panoramic radiograph (OPT), taken one week post-operatively, was compared with an OPT taken at the last recall visit three to six years later. There were no radiographs at the end of the first year. Calculations of marginal bone level were undertaken from a fixed reference point at the base of the internal thread of the implant (*Figures 1 and 2*). Radiographic images were traced and for each implant the distance from the reference point to the marginal bone contact of the buccal and lingual plates was measured at the mesial and distal surfaces. The distance was measured by one investigator, and the mean of the measurements

* BDS, MDSc, MFDS RCS(Ed).

† BDS, FDS RCS

‡ BDS, MSc, FDS RCS(Eng), FDS RCS(Ed), FFGP(UK).

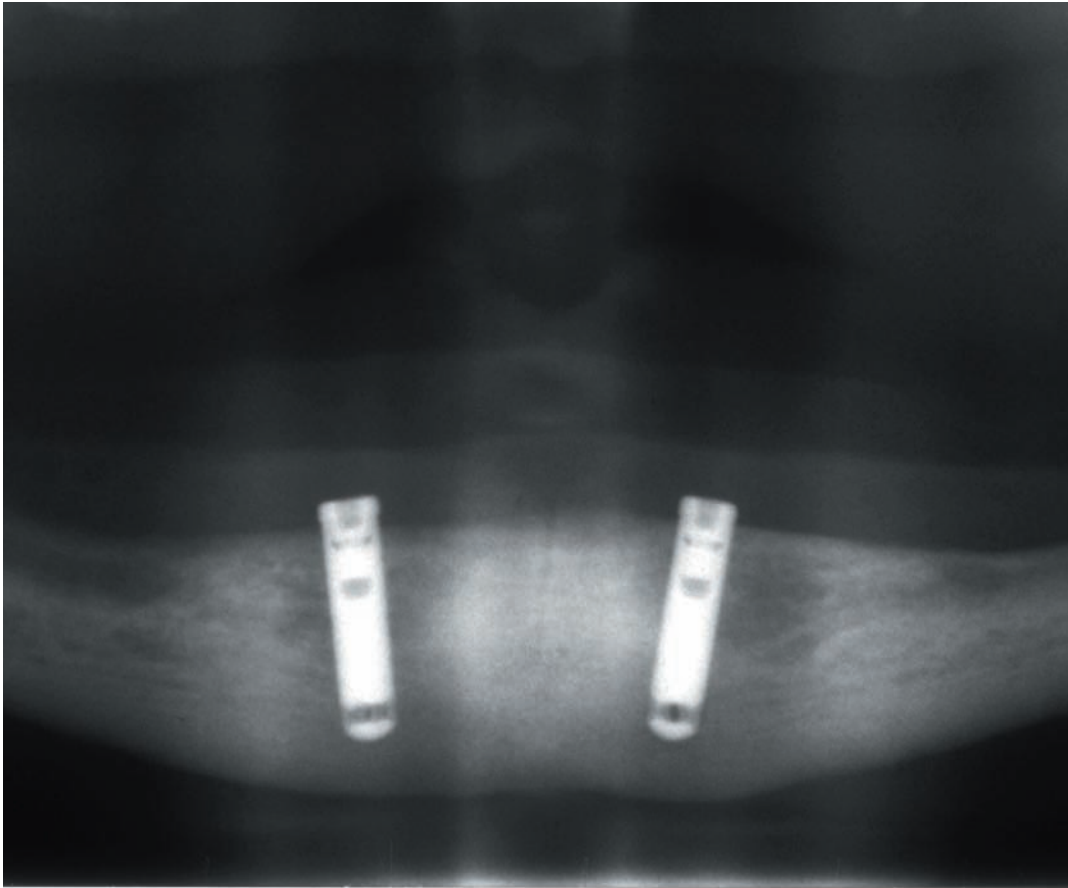


Figure 1. Panoramic radiograph taken one week postoperatively. Fixed reference points are indicated with arrows.

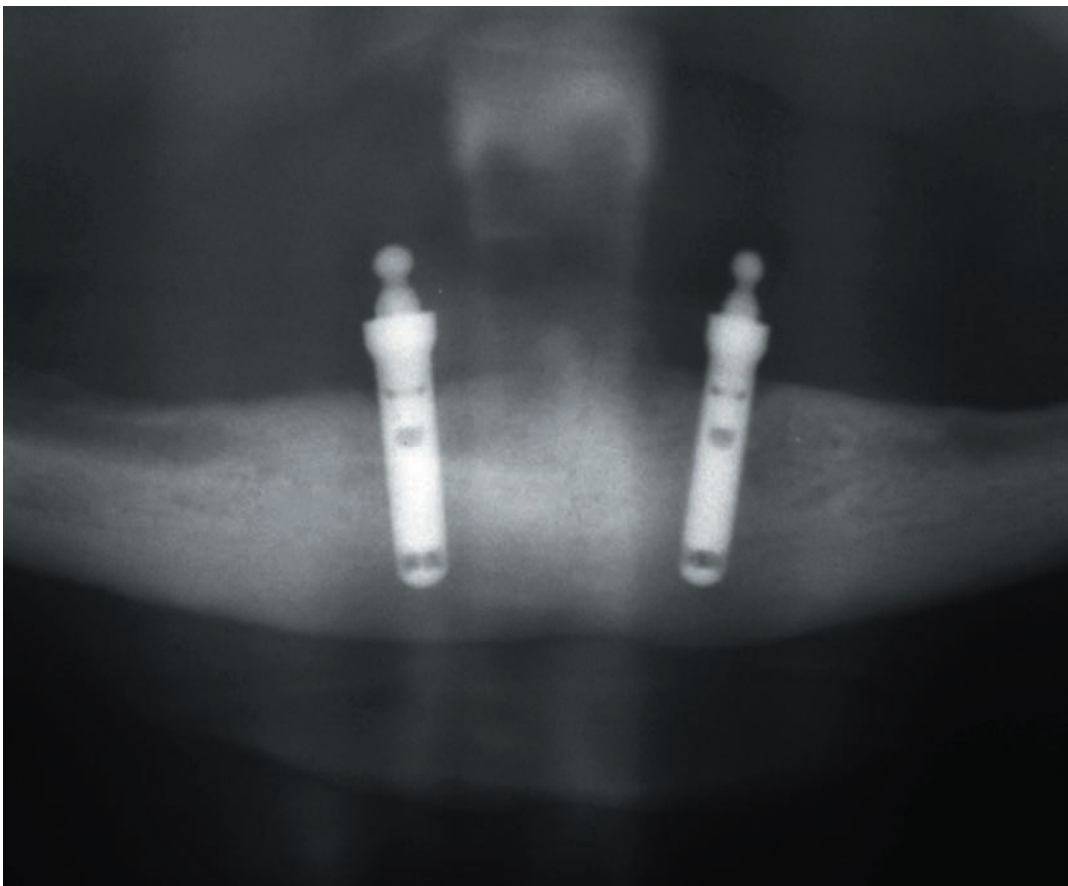


Figure 2. Panoramic radiograph taken at the last recall visit, four years later. Fixed reference points are indicated with arrows.

was calculated. A normalization ratio was used to correct for radiographic magnification. Bone levels in the two radiographs were compared and changes calculated. Annual and cumulative bone loss, were then determined. To test the reliability of the radiographic data, 10% of the radiographs were coded and reanalyzed. The distance between the fixed reference point and the marginal bone contacts was measured. The mean difference in the original and the repeat reading of the distance between the reference point and the marginal bone contact was less than or equal to 0.2 mm. The mean intra-observer variability in a percentage of the higher reading of the distance between the reference point and the marginal bone contact was 4.054% and the standard error of mean was 1.117%

The correction of radiographic magnification was made using the following method: Bone levels were measured from the base of the internal thread cavity. The distance of this reference point from the coronal margin of the implant was always 5mm. Magnification of the OPT was calculated by comparing the distance of the reference point from the apex of the implant on the radiograph, with the known implant length minus 5mm.

RESULTS

A total of 66 implants was placed in the mandible of 23 patients. 12 of the patients were female. The ages of the patients were 36 to 87 at the time of surgery, mean age was 62.5 years. Only one patient was a smoker (15 cigarettes a day and started again 4 years after the placement of his implants). Four of the patients had cardiac problems, one had Systemic Lupus Erythematosus and three had asthma.

The prostheses comprised 22 complete and one partial overdentures. Twenty-one of the prostheses were retained on ball abutments and two on a bar. In the antagonistic jaw, 20 patients had a removable full prosthesis and three patients had a removable partial prosthesis. According to the Cawood and Howell classification¹², 1 patient had a well rounded ridge form (III), 13 patients had knife edge ridge (IV), 8 patients had flat ridge form (V) and 1 patient had depressed ridge form (VI).

The recall interval was from 40 to 79 months with a mean of 51.22 months. None of the implants failed to osseointegrate. Three implants were lost later, two of these were in the same patient. The survival rate was 95.6%. The mean cumulative bone loss was 1.08mm (ranging from 0.75mm gain to 2.97mm bone loss). The mean annual bone loss was 0.263mm/year. Out of the 66 implants, 10 implants had bone loss over 2mm. It was not possible to calculate bone loss at one year post-op due to the lack of radiographs at the end of the first year.

Ten patients had a four-implant retained overdenture with a mean cumulative bone loss of 1.099mm and mean annual bone loss of 0.255mm/year. Twelve patients had a two-implant retained overdenture with a mean cumulative bone loss of 1.056mm and annual bone loss of 0.278mm/year. A 2-sample t-test was used to compare bone loss around two- and four-implant overdentures. There was no significant difference between the two types of overdentures ($P=0.8434$) (Table 1).

DISCUSSION

In this retrospective study the mean cumulative bone loss around Calcitek implants supporting mandibular overdentures over a four-year period was 1.08 mm, and the mean annual bone loss was 0.263mm. The survival rate was 95.6%. There were 10 implants with bone loss over 2mm. The results were encouraging and in agreement with other studies such as Tinsley *et al.*¹¹ and McGlumphy *et al.*¹³.

There is some controversy in the literature about the short and long-term predictability of HA-coated implants. This could be related to differences in chemical composition of the HA on the implant surface. McGlumphy *et al.*¹³, in a five-year prospective study of 429 HA-coated cylindric Omnilock implants in 121 patients, found that the mean combined mesial and distal bone loss was 1.2 mm in the mandible and 1.4mm in the maxilla. Morris HF *et al.*¹⁴ in a randomised controlled trial (RCT) of 2,900 HA-coated and non HA-coated implants in the anterior and posterior mandible and anterior maxilla, did not detect any clinically significant difference in probing depths, attachment levels and gingival recession for up to 36 months.

In an RCT, 120 patients had three types of 2-stage implants placed in their anterior mandible in a randomised design of five or six implants restored with screw retained prostheses¹⁵. At five years, 95.2% of the machined Ti implants, 97.9 % of the HA-coated threaded and 99% of the HA-coated cylindrical implants had bone loss less than 2 mm.

In a prospective study, three types of non-submerged 3I implants were placed in the anterior mandible of 14 edentulous patients¹⁶. After three years, standard threaded Ti implants had significantly less marginal bone resorption than Ti cylindric implants with plasma-sprayed HA coating and these had less than Ti plasma-sprayed cylindric implants.

Looking at the literature on other systems, it appears that reports on the Branemark implant system show very good results. Van Steenberghe *et al.*¹⁷ undertook a retrospective study of 158 patients with mandibular overdentures retained on 2 Branemark implants. Mean cumulative marginal bone loss was 1mm at four years and 1.7mm at 12 years. Naert *et al.*¹⁸, in a study on Branemark system implants retaining mandibular overdentures, recorded a maximum bone loss of 2 mm after five years of observation. In a prospective, multi-center study of 103 patients with mandibular overdentures supported by two Branemark implants, Jemt *et al.*¹⁹, found that the mean marginal bone loss was 0.5mm during a five-year period.

Reports on other systems

Hellem *et al.*²⁰, made a prospective study of ITI hollow screw implants in patients with implant overdentures, or fixed bridges, found a mean marginal bone loss of 0.5mm in the first year, and 0.1mm between one and five years. In a five-year longitudinal study of 340 ITI solid screw implants in 100 patients with mandibular overdentures, Behneke *et al.*²¹ found that median marginal bone loss was 0.5 mm during the healing period with an annual rate of 0.1 mm after loading. In a randomised controlled trial of mandibular overdentures on two IMZ or ITI implants, at two-years there was 1.1mm marginal bone loss around

Table 1. Results and statistical analysis.

	Number of patients	Number of implants	Mean bone loss (mm)**	S.D.	Range (mm)	Median (mm)	P value
2-implant overdentures	12	24	1.056	0.956	-0.75-2.97	0.9313	0.8434
4-implant overdentures	10	39	1.099	0.804	0-2.6	0.8	
Lost implants	2*	3					
Total	23	66	1.08	0.858	-0.75-2.97	0.93	

* 1 of these patients is included in the 4-implant overdenture data

** the difference between the means was 0.04 and the 95% confidence interval for the difference was -0.4 to 0.49

IMZ 1-stage implants, 0.8mm around IMZ 2-stage, and 1.2mm around ITI 1-stage²². In a 5-8 year retrospective study on mandibular overdentures stabilised by two IMZ implants, Heydenrijk *et al.*²³ reported an overall success rate of 94%.

Two versus more implants

In our study there was no significant difference in bone loss between the two- and four- implant supported overdentures. This is in agreement with Visser *et al.*²⁴, who compared the treatment outcome of mandibular overdentures on two or four IMZ implants in a five-year prospective study. They found no significant difference in clinical and radiographic findings during a five-year evaluation period. Patients of both groups were satisfied with their overdentures. Other studies by Batenburg *et al.*²⁵, Mericske-Stern²⁶, Fontijn-Tekamp *et al.*²⁷ also suggest that two implants are sufficient in most clinical cases.

A consensus statement developed by scientists and expert clinicians on May 2002 at the McGill University in Montreal, Quebec, Canada, suggests that the two-implant overdenture should become the first choice of treatment for the edentulous mandible²⁸. In the context of limited resources available in the NHS, the Scottish Needs Assessment Report on Dental Implants (March 2004), recommended that implant treatment should be made available on the NHS only for adult patients who cannot wear complete dentures because of severe alveolar ridge atrophy but who can maintain adequate standards of oral hygiene²⁹.

Limitations

The study was retrospective and not a randomized controlled trial. The sample sizes we used to compare bone loss around two- and four- implant overdentures were relatively small but the results were clear. Panoramic imaging has limited discrimination power in the symphyseal area, however in patients with severe mandibular atrophy standard periodic identical intraoral periapical radiographs can be difficult to obtain. Radiographs can provide only two-dimensional information. There were no radiographs taken at the end of the first year so we could not assess bone loss in first year/before loading. The intra-examiner variability was small. Some studies on implant-retained overdentures put an emphasis on bone loss at the posterior residual ridge^{30,31,32}. The present study aimed specifically to measure marginal bone loss around Calcitek implants supporting mandibular overdentures.

Our results are in agreement with other studies on HA-implants and comparable with other implant systems. It is of some concern that 10 implants in the study had marginal bone loss over 2 mm. Two of the lost implants were in same patient, who was 87 years old, non-smoker. The other lost implant was in a non-smoker, with three more implants that were symptom free. Is it acceptable to continue our practice? The data indicate that it is appropriate to do so. The Calcitek implant system is also significantly more economic than other systems and relatively simple to use. More long-term (at least 10 years), multicentre, RCTs are needed to compare Calcitek and non HA-coated implants to support mandibular overdentures. Life-table analysis could also provide useful information on the cost-effectiveness of Calcitek implants supporting mandibular overdentures.

CONCLUSIONS

The mean marginal bone resorption around Calcitek implants supporting mandibular overdentures over a period of 50 months, was comparable with other reports on HA-coated implants and other systems. The number of implants used did not have an effect on marginal bone resorption. Long-term, multicentre, RCTs are needed to compare Calcitek and other implant systems for this use.

MANUFACTURER'S DETAILS

Calcitek Inc.-A company of Sulzer Medica, 2320 Faraday Avenue, Carlsbad, CA, USA, 92008.

ACKNOWLEDGEMENTS

The authors wish to thank Mr Stewart Gairns at the Medical Illustrations Unit Princess Alexandra Eye Pavilion in Edinburgh, for preparing the illustrative material and Mrs Vicky Elliott for her advice on the statistical analysis.

ADDRESS FOR CORRESPONDENCE

Mrs. Eleni Patsiatzi, Honorary Research Fellow, Edinburgh Postgraduate Dental Institute, 4th Floor, Lauriston Building, Lauriston Place, Edinburgh, EH3 9HA, UK. E-mail: epatsiatzi@yahoo.com

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