

# Assessment of Bone Width for Implants in the Posterior Mandible

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**Purpose:** After implants are placed into mandibular molar sites, it is assumed that crestal bone width will not change considerably over time. The purpose of this retrospective study was to determine crestal bone changes for implants placed into mandibular molar locations. The hypotheses for all groups (immediate, delayed, and grafted) were that no major changes in bone width of the posterior mandible would occur in the long term.

**Materials and Methods:** This is a retrospective cohort study involving 3 groups of patients within the senior author's practice who had at least 4 years of follow-up cone-beam computed tomograms available for measurement. The primary outcome variable, crestal width, was measured at 3 intervals, namely at tooth removal, before implant placement, and 4 to 5 years after placement. Group A underwent tooth extraction with immediate implant placement; group B underwent tooth extraction with delayed implant placement; and group C underwent tooth extraction with socket grafting and implant placement 4 months after grafting. Standardized cross-sectional cone-beam computed tomograms were used to measure ridge width. Two-sample *t* tests and regression analysis were used to compare crestal width measurements at different periods among groups. Analysis of variance was adapted to check whether ridge widths among groups were confounded by variables, such as age, gender, and medical comorbidities.

**Results:** Age, gender, medical comorbidities, and smoking were not statistically related to the outcome. Long-term comparisons indicated small yet significant ( $P = .0124$ ) differences at the crestal level. The greatest change was for the grafted group, with width change from  $12.4 \pm 2.1$  mm before extraction to  $9.9 \pm 1.8$  mm 4 to 5 years after implant placement. Bone width changes 5 and 10 mm inferior to the crest did not change over time.

**Conclusion:** Within the time course and sample size evaluated, the thickness of the buccal bone seems to be maintained over time, regardless of method used, with small yet important changes from before tooth removal through the long-term.

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*J Oral Maxillofac Surg* 73:1715-1722, 2015

Patients who require mandibular molar extraction often desire implant placement to replace the extracted tooth. Amler<sup>1</sup> observed the healing patterns of extraction sockets and found osteoid formation 7 days after extraction that began to calcify at 20 days. Amler concluded that the extraction socket consisted of bone, connective tissue, and epithelium 40 days after extraction. In a systemic review by Dell'Acqua et al,<sup>2</sup> alveolar bone height changes ranged

from  $-3.75$  to  $1.2$  mm at the extraction sites. Araujo et al<sup>3</sup> found a 2.2-mm decrease of buccal bone height in the posterior mandible in dogs after 8 weeks. More dimensional alterations occurred on the buccal aspect, allegedly owing to the presence of bundle bone.

The use of cone-beam computed tomography (CBCT) provides an accurate means to measure bone levels, plan for implants, and evaluate alveolar bone

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Conflict of Interest Disclosures: None of the authors reported any disclosures.

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Received December 8 2014

Accepted March 9 2015

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 0278-2391/15/00287-6

<http://dx.doi.org/10.1016/j.joms.2015.03.036>

changes after implant placement in the posterior mandible. Braut et al<sup>4</sup> used CBCT to analyze bone dimensions of the dentate posterior mandible. The thickness of the buccal and lingual walls was measured 4 mm apical to the cemento-enamel junction (MP1) and at the middle of the root (MP2). They assessed alveolar bone thickness at the most coronal portion of the alveolar crest (BW1) and at the superior border of the mandibular canal (BW2). They found an increase in buccal bone wall thickness from the first premolar to the second molar at MP1 and MP2. BW1 was statistically thinner at the premolars than at the molars, whereas BW2 showed no statistical difference between teeth. In addition, they observed that alveolar bone height remained unchanged for the location of the teeth.

Song et al<sup>5</sup> used CBCT to measure various bone dimensions in the edentulous posterior mandible for use as a mandibular body bone graft. They found average alveolar bone widths increased as measurements were made more posterior in the mandible. This study provided comparative information on various bone measurements in the edentulous posterior mandible and the concurrent use of CBCT.

The clinician must decide whether the extraction site will require a graft based on the specific patient situation. A critical factor is whether the lingual and buccal walls are intact or whether an important amount of bone was removed with the extraction or was lost secondary to the pathologic process necessitating tooth removal. Grisi et al<sup>6</sup> observed buccal bone remodeling of the posterior mandible in dogs with and without synthetic bone grafting. After 12 weeks, they found minimal bone changes in width. They concluded that there was no loss of the buccal bone crest in relation to the lingual bone crest, especially in the test group. A contradictory study by Barone et al<sup>7</sup> examined the tissue changes of extraction sockets in humans who received a ridge preservation procedure compared with those without a graft. The test group received a graft of corticocancellous porcine bone and collagen membrane. Four months later, they found the test sites showed less bone resorption vertically and horizontally, and the keratinized gingiva was located more coronally than in the control sites.

Separate studies conducted in dogs have focused on the success of specific grafts in the maintenance of the posterior mandible after extraction when the buccal bone was compromised or deficient. Beolchini et al<sup>8</sup> evaluated the healing of autologous bone block grafts versus deproteinized bovine bone mineral (DBBM) block grafts in extraction sites with buccal deficient walls. They found that autologous bone grafts were vital and integrated (77%) after 6 months, whereas DBBM block grafts were embedded in connective tissue, with 5.9% of vital mineralized bone present at

its corresponding graft site. Horizontal bone loss ranged from 0.9 to 1.8 mm for the autologous bone and from 0.3 to 0.8 mm for the DBBM graft. The autologous grafts appeared superior owing to better bone incorporation to the graft compared to the DBBM, but crestal bone loss was not prevented. Botticelli et al<sup>9</sup> found similar results with the use of DBBM for buccal defects larger than 2.5 mm with implants installed immediately, which failed to preserve the buccal wall. Baffone et al<sup>10</sup> placed implants with no graft into healed sites with a width of the buccal bony wall measuring 1 or 2 mm and found similar results after 3 months of healing in relation to dimensions of hard and soft tissues. They estimated the buccal bone resorption ranged from 0.30 to 0.50 mm.

Another factor to consider when evaluating bone levels of the posterior mandible with implants is whether the alveolar ridge was allowed to heal after tooth removal compared with implant placement immediately after extraction. Liaje et al<sup>11</sup> evaluated marginal bone loss (MBL) with early loaded implants during the first year. They calculated an MBL of  $0.22 \pm 0.47$  mm after 1 year.

Araujo et al<sup>12</sup> determined that the resulting height of the buccal and lingual walls at 3 months was similar at implants and edentulous sites, and the vertical bone level change was more pronounced at the buccal than at the lingual aspect of the ridge. They concluded that placement of the implant did not influence the remodeling process after tooth removal. Araujo et al<sup>13</sup> further determined whether the decrease of the alveolar ridge after tooth extraction and implant placement was influenced by the size of the socket hard tissue walls. They found that bone loss was more pronounced at molar sites than at premolar sites, but these sites had similar buccal bone wall widths. The implants did not preserve the ridge dimensions. Buccal and lingual walls were resorbed, although MBL was noted on the buccal wall. In conclusion, immediately placed implants appeared to maintain stability and good osseointegration, but did not affect remodeling of the alveolar ridge.

What are the changes in the bone in the posterior mandible around implants that were not immediately loaded? Önem et al<sup>14</sup> found no statistical differences around implants and teeth. Baffone et al<sup>10</sup> focused on the influence of the width of the buccal bony wall on hard and soft tissue dimensions after installation of implants. They found a horizontal bone resorption at 1 mm apically to the margin at the control site with a 2-mm buccal wall ( $1.1 \pm 0.7$  mm) compared with the test site with a 1-mm buccal wall ( $0.3 \pm 0.3$  mm).

The literature does not report long-term cross-sectional crestal changes around implants placed into molar sites at the time of implant placement, at

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