

A COMPARISON OF FACIAL AND LINGUAL CORTICAL THICKNESSES IN EDENTULOUS MAXILLARY AND MANDIBULAR SITES MEASURED ON COMPUTERIZED TOMOGRAMS

Dennis Flanagan, DDS

Edentulous ridges suitable for implant treatment depend on cortical bone for implant stability, especially for ridge-expansion procedures. This study was done to find and compare the actual thicknesses of the facial and lingual edentulous cortices of the maxilla and mandible as measured on computerized tomograms. The collected computerized tomographs (CT) of one implantologist's practice (D.F.) were measured. The measurements taken demonstrated that the edentulous lingual cortex is almost always thicker than the facial cortex in the maxilla and mandible. The combined maxillary and mandibular facial cortices measurement sites average was 1.79 mm. The combined maxillary and mandibular lingual cortices measurement sites average was 2.33 mm. The average cortical thickness measurement of the maxillary facial cortices was 1.66 mm. The lingual maxillary average was 2.16 mm. The mandibular facial cortical sites averaged 1.83 mm, while the lingual cortical sites were 2.40 mm. These data confirm that the lingual cortex of the maxilla and mandible is thicker than the facial cortex at a ratio of 1:1.3. This ratio was consistent for maxilla and mandible.

Key Words: computerized tomogram, dental implant, ridge expansion, ridge split, osseous manipulation

INTRODUCTION

Implant stability depends mostly on cortical bone for stability and immobility, and implant length may be less important than cortical bone thickness.¹ After tooth removal, the alveolar bone undergoes reparative and healing resorption. The facial cortex usually resorbs first from the facial and crest directions. This resorption can result in a narrow or atrophic osseous edentulous residual ridge. Dental implants can be placed to support prosthetics that replace the teeth that were

lost, but bone needs to provide appropriate cortical thickness for initial and subsequent implant stability.

The residual ridge may be narrow. At times, it may be necessary to split and expand the edentulous ridge to increase the facial-lingual dimension for the bone to accept an implant.²⁻⁴ The osteotome ridge-splitting technique relies on the edentulous lingual cortex for a base or a brace for the osteotome to push against, to force the facial cortex facially to create space and thus expand the facial-lingual dimension of the edentulous ridge. There has been an assumption, based on clinical experience among many clinicians, that the lingual cortex is always thicker than the facial cortex to provide the base for this technique. It has been additionally assumed that the lingual cortex will

Dennis Flanagan, DDS, is in private practice in Willimantic, Conn. Address correspondence to Dr Flanagan at 1671 West Main Street, Willimantic, CT 06226. (e-mail: dffdds@charter.net)

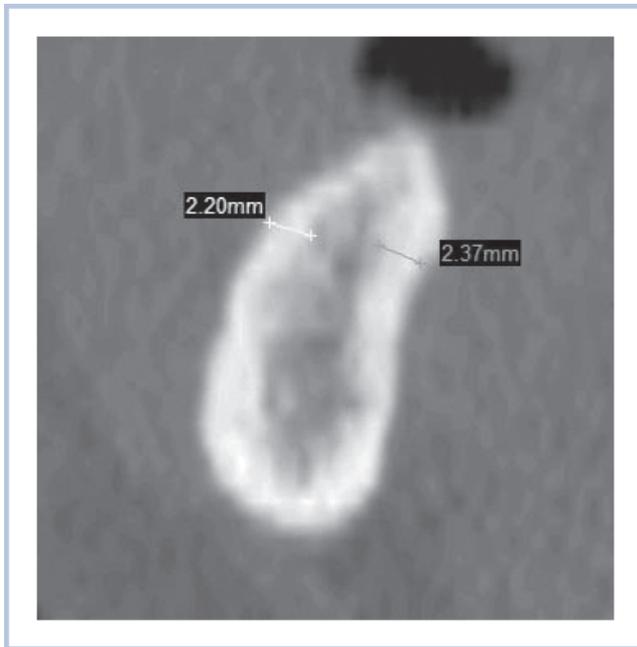


FIGURE. A computerized scan cut of a mandible with measurements.

usually provide adequate bracing for the osteotome without fracture. The purpose of this study was to find if the lingual cortex is indeed thicker than the facial cortex. This was done by examining collected computerized tomographic (CT) scans of edentulous ridges from the practice of one implantologist (D.F.) for the measurement and comparison of the cortical thicknesses of potential implant sites in the maxilla and mandible (the Figure).

MATERIALS AND METHODS

Seventeen collected CTs from one implantologist's practice (D.F.) were considered. Individually, 704 sites were measured. Patients' ages ranged from 47 to 68 years. Medical histories were insignificant. Complete and partially edentulous sites were measured. The edentulous sites were in various stages of postextraction healing and resorption, but none were in a recent postextraction phase. It was deemed impractical to ascertain the exact postextraction time of each site. All sites were at least 1 year postextraction and thus in later stages of osseous resorptive patterns. Each scan was viewed on a computer screen, and the radiopaque areas of the facial and lingual cortices were measured by the software measurement tools provided with the CT software (Materialise, Columbia, Md). Each measurement was made in millimeters to the nearest one hundredth

		Average, mm	Mean, mm	Mode, mm
Maxilla and mandible	Buccal	1.79	1.67	1.34
Maxilla and mandible	Lingual	2.33	2.22	2.22
Maxilla	Facial	1.66	1.36	1.30
Maxilla	Lingual	2.16	1.84	1.48
Mandible	Facial	1.83	1.73	1.57
Mandible	Lingual	2.40	2.30	2.22

millimeter. All measurements were made at sites that would be considered for implant placement. Each measurement was taken at 1-mm segments. The facial and lingual cortices were measured directly, via computer dimensional measuring, on the CT of each patient.⁵ The collected measurements were then reviewed and analyzed.

The data were compiled, and averages, medians, and modes were calculated (the Table).

RESULTS

The cortical thicknesses of the edentulous ridges were found to be thicker at the lingual than the facial in all sites, except for a very few (the Table). The complete list of 704 measurements are available on request. Combined measurements from both bones averaged 1.79 mm at facial sites and 2.33 mm for lingual sites. The average thickness of the maxillary facial cortices was 1.66 mm. The average thickness of the maxillary lingual cortices was 2.16 mm. The average thickness of the mandibular facial cortices was 1.83 mm. The average thickness of the mandibular lingual cortices was 2.40 mm. The measurements demonstrated that the averaged edentulous facial cortex is thinner than the lingual cortex at a ratio of 1:1.3.

$$2.16/1.66 = 1.3$$

$$2.40/1.83 = 1.3$$

DISCUSSION

The measurements confirm the assumption that the lingual cortex is almost always thicker than the facial cortex in various stages of later osseous resorption. No accurate determination as to the time of extraction for these edentulous sites could be ascertained, and no attempt was made at aging the edentulism for each patient.

The thicker lingual cortex may generally be able to act as a base or bracing for osteotome ridge splitting in cases in which the facial cortex is deformed in the facial direction. The facial cortex is generally the side that is moved or deformed to expand the facial-lingual edentulous ridge dimension. Edentulous ridge expansion can be accomplished with manual osteotomes, piezoelectric saws, circular saws, or burrs in a surgical dental hand piece.

The expansion of an edentulous ridge relies on the bone to deform by means of interpolymeric bond fracture of the collagen molecule.^{6,7} The interpolymeric atomic bonds are generally weaker than the atomic bonds of the main polymeric chain. Thus, during an osseous deformation, the weaker bonds are broken and the main chain polymeric bonds remain intact. This phenomenon gives bone its toughness and allows it to deform without fracturing.

One study directly measured facial and lingual dentate and edentulous cortices on a cadaver specimen with a digital Boley caliper gauge.⁸ This study found that the average maxillary and mandibular edentulous facial cortical plate thickness ranged from 1.0 to 2.1 mm. The maxillary facial and lingual cortical plate average measurements were 1.69 mm and 2.06 mm in the molar regions, 1.43 mm and 1.60 mm in the premolar regions, and 1.04 mm and 1.36 mm in the anterior regions, respectively. The mandibular facial and lingual cortical plate average measurements were 2.06 mm and 2.39 mm in the molar regions, 1.78 mm and 1.88 mm in the premolar regions, and 1.36 mm and 1.66 mm in the anterior regions, respectively. The thinner cortices were found in the facial anterior maxilla, and the thicker cortices were found in the lingual posterior mandible. Comparing these results by ratio found (2.06/1.69) 1.2 in the maxilla and (2.39/2.06) 1.2 in the mandible in the molar regions, (1.60/1.43) 1.1 in the maxilla and (1.88/1.78) 1.1 in the mandible in the premolar regions, and (1.36/1.04) 1.6 in the maxilla and (1.66/1.36) 1.2 in the mandible in the anterior regions. However, the average of all these ratios is 1.2. It may be that there is some consistency to the lingual cortical predomi-

nance to provide functional osseous strength and stability.

CONCLUSIONS

The measurements of 704 edentulous sites measured in 17 CT scans demonstrated that the averaged edentulous facial cortex is thinner than the lingual cortex at an average ratio of 1:1.3. The average thickness in the maxillary facial and lingual was 1.66 mm and 2.16 mm, respectively, whereas the measurements in the facial and lingual of the mandible were 1.83 mm and 2.40 mm, respectively.

ACKNOWLEDGMENT

The author acknowledges the statistical calculations by Yingmei Xi, Department of Statistics, University of Connecticut, Storrs, CT 06268.

REFERENCES

1. Miyamoto I, Tsuboi Y, Wada E, Suwa H, Izuka T. Influence of cortical bone thickness and implant length on implant stability at time of surgery: clinical prospective, biomechanical and imaging study. *Bone*. 2005;37:776–780.
2. Flanagan DF. Cortical bone spreader osteotome and method for dental implant placement. *J Oral Implantol*. 2002;28:295–296.
3. Summers RB. A new concept in maxillary implant surgery: the osteotome technique. *Compendium*. 1994;152:154–156.
4. Summers RB. The osteotome technique: part 2—the ridge expansion osteotomy (REO) procedure. *Comp Contin Educ Dent*. 1994;15:422–434.
5. Borgner RA, Kirkos LT, Gougloff R, Cullen MT, Delk PL. Computerized tomography scan interpretation of a bone expansion technique. *J Oral Implantol*. 1999;25:102–108.
6. Vashishth D, Tanner KE, Bonfield W. Contribution, development and morphology of microcracking in cortical bone during crack propagation. *J Biomech*. 2000;33:1169–1174.
7. Thompson JB, Kindt JH, Drake B, Hansma HG, Morse DE, Hansma PK. Bone indentation recovery time correlates with bond reforming time. *Nature*. 2001;414:773–776.
8. Katranji A, Misch K, Wang HL. Cortical bone thickness and edentulous human cadavers. *J Periodontol*. 2007;78:874–878.