University Library

A gateway to Melbourne's research publications

Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:
Dastaran, M;Bailey, D;Austin, S;Chandu, A;Judge, R

Title:
Complications of augmentation procedures for dental implants in private practice, Victoria, Australia

Date:
2019-09-01

Citation:
Dastaran, M., Bailey, D., Austin, S., Chandu, A. & Judge, R. (2019). Complications of augmentation procedures for dental implants in private practice, Victoria, Australia. Australian Dental Journal, 64 (3), pp.223-228. https://doi.org/10.1111/adj.12686.

Persistent Link:
https://hdl.handle.net/11343/285912

Complications of augmentation procedures for dental implants in private practice, Victoria, Australia

Authors - Name	Affiliations
Dr Mehrnoosh Dastaran- **First author** MBChB BDS BSc, MPhil, FRACDS(OMS) Melbourne Dental School 720 Swanston Street , Melbourne, Victoria 3053; Australia.	Melbourne Dental School, University of Melbourne Victoria and Tasmania Oral & Maxillofacial Training Programme
Dr Denise Bailey BDS MSc Melbourne Dental School 720 Swanston Street , Melbourne, Victoria 3053; Australia.	Oral Health Cooperative Research Centre Melbourne Dental School, University of Melbourne Chair, eviDent Foundation Australian Dental Council (ADC)
Dr Stephen Austin MBBS BDSc, MPhil, FRACDS(OMS) Melbourne Dental School 720 Swanston Street , Melbourne, Victoria 3053; Australia.	Melbourne Dental School, University of Melbourne Victoria and Tasmania Oral & Maxillofacial Training Programme
Associate Professor Arun Chandu MBBS (Hons), BDSc, MDSc, PhD, FDSRCS(Eng), FRACDS (OMS), FRCS(Eng) Melbourne Dental School 720 Swanston Street , Melbourne, Victoria 3053; Australia.	University of Melbourne Consultant and Head of Oral & Maxillofacial Surgery: Western Hospital, Footscray, Victoria
Associate Professor Roy Judge- **corresponding author** BDSc, MDSc, PhD Melbourne Dental School 720 Swanston Street , Melbourne, Victoria 3053; Australia.	Melbourne Dental School, University of Melbourne EviDent Foundation
Telephone number	+61 3 90358446
Fax number	+61 3 90359797
Email address	roybj@unimelb.edu.au

Author Manuscript

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/ADJ.12686

This article is protected by copyright. All rights reserved

FWYATT ARUN CHANDU (Orcid ID : 0000-0001-7182-8604)

Article type : Scientific Article

Complications of augmentation procedures for dental implants in private practice, Victoria, Australia

Abstract

Purpose

This paper audited complications associated with augmentation for dental implants, retrospectively over a five-year period in a variety of private dental practices in Victoria (Australia).

Methods

Complications were categorised as surgical or biological and compared to a group not requiring augmentation. Implant factors underwent univariate and multivariate analysis.

Results

The study assessed 8486 implants with 26.9% undergoing augmentation. Augmentation had no effect on implant survival, however, a significant increase in complications for those implants requiring augmentation was found (p=<0.001). The hard tissue augmented group had significantly more cases of insufficient bone/dehiscences at implant placement (p<0.001), and post-placement bone loss (p=0.0014). These implants were grafted simultaneously

This article is protected by copyright. All rights reserved

Author Manuscript

(p<0.05) with particulate autogenous bone and/or Bio-Oss (p<0.05) with resorbable xenograft membrane (p<0.001). There was significantly more bone loss in open sinus lifted cases than implants placed in native bone (1.90% v 0.30%; p=0.009).

Conclusions

The study demonstrated no increase graft complication that could be related to any specific augmentation technique, suggesting that routine grafting procedures used in private practice were safe and appropriate. Previously augmented sites were found to be more likely to require further augmentation at implant placement.

Introduction

Bone augmentation procedures are commonly performed as an adjunct to dental implant rehabilitation where native bone is lacking or soft tissue is deficient.[1] Augmentation may be required to increase the ridge width and/or height depending on the pattern of resorption and atrophy that has taken place, or to provide axial loading of implants and primary stability, which is an important predictor of implant success[2] and osseointegration.[3]

Augmentation procedures may include particulate grafting/Guided-Bone Regeneration (GBR), block grafting, and sinus lifts. Socket/ridge preservation is another adjunctive hard-tissue procedure that may preserve ridge volume by reducing post-extraction resorption, and thereby simplify subsequent augmentation or implant procedures.[4] Soft tissues may also be augmented using connective tissue grafts from the palate. Connective tissue grafting has been suggested to improve aesthetics and thickness of peri-implant tissues and reconstruct inter-dental papillae.[5] This may be particularly useful in patients

This article is protected by copyright. All rights reserved

Author Manuscript

with a thin biotype, where thinning of peri-implant tissues may compromise aesthetics and cleansibility, potentially contributing to implant failure in the long-term.[6]

There is also little in the literature regarding which augmentation techniques carry the lowest complication rates. Recipient site complications may be biological or surgical/technical. Biological complications include infection, bone loss, failure to osseointegrate, loss of implant integration and peri-implantitis. Surgical complications include neuro-sensory disturbance, pain, bleeding, swelling, bone perforation, insufficient bone quantity or quality or inadequate primary stability. Success rates of different augmentation protocols are often extrapolated from implant survival rates rather than directly measured. Further to this, there is little documentation specifically regarding the rates of complications of augmentation with respect to the different techniques, materials and timing of augmentation.

The aim of this study was to present and examine the complications recorded at the recipient site in relation to the augmentation procedures performed in conjunction with dental implants by a group of private dental practitioners and oral and maxillofacial surgeons in the non-university setting, who participated in a retrospective cohort study of implant treatment over a five-year period. Specifically the study wanted to describe and quantify augmentation complications and their risk factors directly. The efficacy of individual factors of augmentation such as techniques used, materials and timing of procedures were analysed.

Material and Methods

A retrospective cohort design, with methods previously described,[7] was used to

This article is protected by copyright. All rights reserved

Author Manuscript

review a population of patients receiving implant treatment at private dental practices within Victoria, Australia. Thirty-four practitioners participated in the main study; a combination of general dentists, specialist dentists, and oral and maxillofacial surgeons. The overall number of patient files that met the inclusion criteria was 4116. The total number of implants placed was 8486. Inclusion criteria were implants that were *placed* or *restored* within the study period of 1st of January 2005 to 31st December 2009 inclusive, by enrolled clinicians, qualified on or before December 2004 and registered in Victoria, Australia. Cases excluded were those with records missing or unavailable, patients who did not follow up on proposed implant treatments or who chose other restorative options.

Information collected included: Clinician demographics; Patient demographics; Patient co-morbidities/systemic host factors; Oral status/local host factors; Implant specifications; Surgical information; Restorations/prosthodontic information; and Complications, including biological complications, and surgical complications as mentioned previously: perforation/dehiscence, insufficient bone, trauma to adjacent teeth, bleeding, infection, failure of primary stability and neurosurgical complications. Details on augmentation practice were collated and assessed separately from other data and classified into surgery type, techniques, materials, timing, assessment and complications. Further clarification regarding the materials and techniques employed was obtained using an additional questionnaire and this was sent to seventeen practitioners. There were thirteen respondents. Information collected included: source of autogenous bone: intra- versus extra- oral; nature of 'sinus-lifting' practices; membrane use; materials used routinely for the different augmentation procedures; bone loss associated with augmentation, primary stability and soft tissue grafting practices.

The study was approved by The University of Melbourne Human Research Ethics Committee (approval number 1033122) and conducted and supported through

This article is protected by copyright. All rights reserved

Author Manuscript

the Evident Foundation. Evident is a Dental Practice Based Research Network (an initiative of the Australian Dental Association Victorian Branch and the Oral Health Cooperative Research Centre at the University of Melbourne) that facilities practice-based dental research by supporting relationships between dental practitioners and academic researchers.

Data were entered into a Microsoft® Access database, (Microsoft Corporation, WA, USA), created specifically for the study. The database was imported into SPSS™ Statistical Package for the Social Sciences (Version 21, SPSS Inc., Chicago, IL, USA) for analysis. Descriptive statistics and cross-tabulation were carried out using SPSS. For assessment of survival, those implants that had incomplete bone graft survival data (n=30) were excluded. Time to failure could not be used in the survival data as it was not recorded so cumulative survival analysis could not be performed. The complication rates in those implants that required bone/soft tissue augmentation was then compared to those that did not require augmentation in both a univariate (chi squares) and multivariate fashion (linear regression) using GenStat® (Version 14, VSN International). A $p<0.05$ was a considered a significant difference.

Results

Out of 8486 implants placed, 26.9% (2282) underwent a hard-tissue augmentation procedure, while 6204 were in the non-augmented group. Table 1 is a summary of the adjunctive procedures performed. Some implants underwent more than one hard-tissue procedure at a given site. Additionally, there were a small number of hard tissue procedures the nature of which were not described in detail by the practitioner, and were not included in the subsequent calculations.

This article is protected by copyright. All rights reserved

Author Manuscript

Table 1 Summary of adjunctive procedures by frequency and proportion.

Looking at the healing times of augmentation, the mean overall healing period following hard-tissue augmentation for delayed implants was 205.3 days or 6.7 months (SE 12.3; range 2-2127 days). There was a mean interval of 162.8 days (5.4 months): SE 16.9; range 12-2127 days) to implant placement from ridge-preservation. Regardless of whether an implant was placed as a single or two-stage procedure, there was no difference in mean delay to implant placement from augmentation.

There was no significant difference in the failure rate of those implants requiring augmentation and those that did not (2.28% versus 2.64%; p=0.36). The total complication rate, including surgical and biological complications, for implant sites requiring hard tissue augmentation was 17.3% (13.3% surgical; 3.9% biological). Using univariate analysis, there was a significant difference in the total complication rate between the augmented and non-augmented groups (17.3% versus 12.6%; p=<0.001). However, there was no significant difference in biological complications including peri-implantitis or mucositis if the implant site was soft-tissue augmented. For augmented cases, the post-operative infection rate was 1.3%, while for non-augmented cases it was 1.0%. No single surgical factor, including different graft materials, onlay grafting, ridge preservation and sinus lifting, affected graft complication in multivariate analysis.

The implant sites that required bone grafting prior to implant placement had more cases of insufficient bone and/or dehiscences at implant placement than the non-augmented group (2.10% v 0.58%; p<0.001). More implants were augmented at the same time as implant placement than delayed implant placement after grafting (p=0.02). Of those that were augmented at the same time as placement, the most common augmentation procedure was the addition of particulate bone/guided bone regeneration (0=0.03) with most commonly autogenous particulate bone, bio-oss and membrane used (p<0.01).

This article is protected by copyright. All rights reserved

Author Manuscript

Of these cases, there were significantly more implants that were placed and grafted simultaneously (p=0.02) with particulate material (p=0.03), or using a combination of autogenous (intra-orally harvested) particulate bone and Bio-Oss ™ in combination with resorbable xenograft membrane (p<0.001). 16.2% of ridge-preserved sites in this study subsequently underwent further grafting prior to implant placement. A significantly higher number of these were augmented with particulate material (p=0.003), or a combination of autogenous particulate bone, Bio-Oss ™ and a resorbable xenograft membrane (p<0.01).

For simultaneously particulate-augmented cases there was no statistically significant increase in rate of inadequate primary stability, or early or delayed problems with osseointegration. In regard to sites requiring open sinus lifting prior to implant placement, there was significantly more bone loss in these cases than in cases where implants were placed in native bone (1.90% v 0.30%; p=-0.009).

Author Manuscript

This article is protected by copyright. All rights reserved

Discussion

This study has demonstrated the potential for complications of grafting and augmentation amongst a group of private dentists, dental specialists and oral and maxillofacial surgeons. The high proportion of implants requiring hard tissue augmentation demonstrated the importance of this aspect of surgery in relation to treatment planning and the potential for complications.

In this study, augmentation significantly increased overall implant complications as compared to the non-augmented group. The 4.7% increased complication rate in the augmented group was similar to the published literature.[8] However, this study showed that, unlike other studes,[9,10] there was no difference in primary stability achieved, osseointegration or implant failure. The rate of infection in grafted cases in this study was actually quite low (1.3%). Other studies have also suggested that grafting may carry a higher 5-8% rate of infection at the recipient site,[11,12] while onlay block grafting has been associated with an increased (3.3%) infection rate,[13] but these were not found in the present study. Kaing's retrospective study of augmentation procedures in a smaller population suggested a higher graft complication rate than that which was found in this study of 27.9%, and a 12.7% graft failure rate.[14]

In the current study, augmented sites, had a significantly increased requirement for further augmentation at the time of implant placement. This is unsurprising, as cases requiring grafting might have a higher risk of insufficient bone at time of implant placement, due to increased risk of graft integration failure,[15,16] soft tissue dehiscence/exposure[17] and bone resorption.[16] However, the low rate of problems with integration after bone grafting in this study suggested that the case selection for augmentation was appropriate. Unfortunately the quantity or degree and location of deficiency was not obtained pre- or post-operatively.

This article is protected by copyright. All rights reserved

Author Manuscript

No one particular augmentation technique or material caused an increase in graft complication; there was no particular material that was found to be superior or inferior to another. This finding is consistent with a comprehensive review of the literature which demonstrated no superiority of xenograft over autogenous bone for grafting.[1]

The rate of bone loss in open sinus lifted sites was low at 1.90%. Increased bone loss at implant insertion in open sinus lifted sites was found as compared to implants placed in native bone. This finding was in keeping with another study, where the rate of excessive bone loss in sinus lifted maxillae was around 1.3%.[11] In open sinus lifting, major reported adverse events include sinus membrane perforation, graft infection and graft loss, precluding implant placement.[9] In this study, there was sufficient bone to place an implant and there was no significant increase in infection rate. There was also no influence of any particular material or of timing of implant placement on the complication rate, which is in keeping with the literature.[18,19]

The use of a membrane in this study did not alter the complication rate. Membrane usage has support because of its ability to provide space for in-growth of bone and to support local soft tissues,[20] and to reduce bone resorption.[21] However, there is a lack of consensus in the literature with respect to its benefit and any gain in bone has been suggested to be clinically questionable.[22] Some studies have suggested that e-PTFE membranes might be more prone to exposure and infection than resorbable membranes,[23] but others have suggested no difference between membrane types.[15]

Simultaneous augmentation did not alter the complication rate in this study. However, it has been previously shown that simultaneous grafting, particularly

This article is protected by copyright. All rights reserved

Author Manuscript

in single stage implant placement has a significant effect on survival.[24] Authors who have advocated a delayed approach have done so on the basis that a re-vascularised graft has a greater regenerative and healing capacity[25] and a greater contact area for the implant.[26] One study, with up to 59 months of follow-up after simultaneous implant placement and GBR to treat fenestration and dehiscence defects, demonstrated significantly increased marginal bone loss in the grafted group, but no significant difference in long-term implant outcome.[27]

Length of healing did not affect the rate of graft complication in this study. Implants may be delayed following augmentation; they may also be successfully placed at the same time as augmentation (simultaneous),[28,29,30] although long-term succes may vary.[28] Whilst there is no consensus regarding optimal timing of implant placement, the mean healing periods after augmentation and ridge preservation documented here were in keeping with previous published trials of four months for mandibular implants and six to eight months in the maxilla.[1,31,32,33]

Ridge preservation requied further augmentation prior to implant placement in 16.2% of sites, suggesting ongoing bone loss despite this 'preventative' procedure. There was no particular material or combination of materials, including use of barrier membrane that influenced this outcome. Ridge preservation has been hypothesized to improve the post-extractional bone loss by 1 to 3mm,[34] however, there is little evidence that socket (ridge) preservation improves ability to place an implant after tooth extraction,[35] and this is confirmed by the results of this study.

Neither soft tissue augmentation by connective tissue grafting nor hard tissue augmentation altered the soft tissue complication rate, in particular, of peri-implantitis. The integrity and width of peri-implant keratinised tissue and

This article is protected by copyright. All rights reserved

Author Manuscript

underlying bony may be essential for risk reduction by acting as a barrier to infection by way of resistance to attachment loss.[6] There is little in the literature examining peri-implantitis in bone or soft tissue grafted sites. A 2009 literature review of the local risk factors for implant failure found no studies demonstrating a relationship between soft tissue thickness or width of keratinised tissue and implant survival or peri-implant mucosal recession.[36]

This study gave a snapshot of the complications of a variety of practitioners, and is the second part of a previous study in this journal,[37] but it does have its limitations. This was a retrospective study, so data could only be obtained by accurate practitioner record keeping, and the retrieval of certain information, such as time to implant failure, was limited by proforma design. Thus, details that were not recorded included the size or nature of the defect that required grafting, the radiographic findings pre-or post-operatively and the follow-up period. Another example of this problem is that it was impossible to accurately determine who performed the grafting procedure so this was not reported. There was no standardization of procedures as this was an audit of a variety of practitioners in private practice, which is the main setting where these sort of procedures are undertaken in Australia. Thus, this study was unique it its coverage of the practices of independent private practitioners in large numbers and in a diverse group of patients, without the usual restrictions or exclusion criteria of controlled studies from academic institutions.

There is currently little similar data published in the literature and no single study that has such a large sample size. Whilst there appeared to be increased risk of bone loss or insufficient bone at bone-augmented sites, complication rates associated with augmentation were equal to or lower than those documented in the literature. It was demonstrated that such traditional practices such as GBR, onlay bone grafting, ridge preservation and sinus lifting procedures were safe and appropriate in the private dental practice setting. There were no materials routinely used that increased the risk of graft complication. There also appeared

This article is protected by copyright. All rights reserved

Author Manuscript

to be no significant or clinically important increase in risk of infection, loss of bone or ultimately problems with osseointegration of implants placed in augmented bone. These findings provide the basis of a prospective study in this area, which is planned for the future.

Author Manuscript

Conflicts of interest

There are no conflicts of interest to declare.

Legends

Table 1 Summary of adjunctive procedures by frequency and proportion.

References

1. Esposito, M. et al. The efficacy of horizontal and vertical bone augmentation procedures for dental implants - a Cochrane systematic review. Eur J Oral Implantol 2009; 2: 167-184.

2. Clementini, M. et al. Immediate versus delayed positioning of dental implants in guided bone regeneration or onlay graft regenerated areas: a systematic review Int J Oral Maxillofac Surg 2013; 42: 643–650.

3. Branemark, P. et al. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. Scand J Plast & Recons (Suppl.); 1977 16: 1–132.

This article is protected by copyright. All rights reserved

4. Hammerle, C. H. F. et al. On Behalf of the Osteology Consensus Group 2011: Evidence-based knowledge on the biology and treatment of extraction sockets. Clin Oral Implan Res 2012; 23(Suppl. 5): 80–82.

5. Esposito, M. et al. Interventions for replacing missing teeth: management of soft tissues for dental implants. Cochrane Database Syst Rev 2012; 2: CD006697.

6. Orsini, M. et al. Esthetic and dimensional evaluation of free connective tissue grafts in prosthetically treated patients: a 1-year clinical study. J Periodontol 2004; 75: 470-477.

7. Austin, S. et al. An analysis of commonly reported medical conditions amongst patients receiving dental implants in private practice. Aust Dent J 2014; 60: 343–352.

8. Meraw S. et al. Retrospective review of grafting techniques utilized in conjunction with endosseous implant placement. Int J Oral Maxillofac Impl 1999; 14: 744–747.

9. Tonetti M.S. et al. Advances in bone augmentation to enable dental implant placement: Consensus Report of the Sixth European Workshop on Periodontology. J Clin Periodontol 2008; 35(Suppl. 8): 168-172.

10. Galindo-Moreno P. et al. Marginal bone loss around implants placed in maxillary native bone or grafted sinuses: a retrospective cohort study. Clin Oral Implan Res 2014; 25: 378-384.

11. Lee, H-W. et al. A retrospective study of complications associated with 100 consecutive maxillary sinus augmentations via the lateral window approach. Int J Oral Maxillofac Impl 2013; 28: 860-868.

This article is protected by copyright. All rights reserved

Author Manuscript

12. Becktor J.P et al. The use of particulate bone grafts from the mandible for maxillary sinus floor augmentation before placement of surface-modified implants: results from bone grafting to delivery of the final fixed prosthesis. J Oral Maxillofac Surg 2008; 66: 780–786.

13. Chiapasco, M et al. Bone Augmentation Procedures in Implant Dentistry Int J Oral Maxillofac Impl 2009*;* 24(SUPPL): 237-259.

14. Kaing L. et al. Assessment of bone grafts placed within an oral and maxillofacial training programme for implant rehabilitation. Australian Dental Journal 2011; 56: 406-411.

15. Jensen & Terheyden Bone augmentation procedures in localized defects in the alveolar ridge: clinical results with different bone grafts and bone-substitute materials. Int J Oral Maxillofac Impl 2009; 24(Suppl): 218-236.

16. Katranji, A. et al. Sinus augmentation complications: aetiology and treatment. *Impl Dent* 2008; 17: 339-349.

17. Merli M et al. Vertical bone augmentation wit dental implant placement: Efficacy and complications associated with two different techniques. A retrospective cohort study. Int J Oral Maxillofac Impl 2006; 21: 600-606.

18. Esposito, M. et al. The efficacy of various bone augmentation procedures for dental implants: A Cochrane systematic review of randomised controlled clinical trials Int J Oral Maxillofac Impl 2006; 21: 696-710.

19. Esposito, M. et al. Interventions for replacing missing teeth: augmentation procedures of the maxillary sinus. Cochrane Database Syst Rev 2010; 3: CD008397.

Author Manuscript

This article is protected by copyright. All rights reserved

20. Rakhamita, Y. D. et al Current barrier membranes: Titanium mesh and other membranes for guided bone regeneration in dental applications. J Pros Res 2013; 57: 3-14.

21. Antoun, H. et al. A prospective randomized study comparing two techniques of bone augmentation: Onlay graft alone or associated with a membrane. Clin Oral Implan Res 2001; 12: 632–639.

22. Khojasteh, A. et al. The Effectiveness of Barrier Membranes on Bone Regeneration in Localized Bony Defects: A Systematic Review. Int J Oral Maxillofac Impl 2013; 28: 1076-1089.

23. Donos et al. (2008) Clinical outcomes of implants following lateral bone augmentation: systematic assessment of available options (barrier membranes, bone grafts, split osteotomy). J Clin Perio 2008; 35: 173-202.

24. Smith L.P. et al. Outcomes of dental implants placed during a surgical training programme. Aust Dent J 2009; 54: 361-367.

25. Shirota, T. et al. An experimental study of healing around hydroxylapatite implants installed with autogenous iliac bone grafts for jaw reconstruction. J Oral Maxillofac Surg 1991; 49: 1310–1315.

26. Nystrom E, Kahnberg K-E, Albrektsson T. Treatment of the severely resorbed maxillae with bone graft and titanium implants: Histologic review of autopsy specimens. Int J Oral Maxillofac Impl 1993; 8: 167–172.

27. Zitzmann, N.U. et al. Long-term results of implants treated with guided bone regeneration: a 5-year prospective study. Int J Oral Maxillofac Impl 2001; 16: 355–366.

Author Manuscript

This article is protected by copyright. All rights reserved

28. Vermeeren, J. I. et al. One-step reconstruction of the severely resorbed mandible with onlay bone grafts and endosteal implants. A 5-year follow-up. Int J Oral Maxillofac Surg 1996; 25: 112–115.

29. Nystrom, E. et al. 10-year follow-up of onlay bone grafts and implants in severely resorbed maxillae. Int J Oral Maxillofac Surg 2004; 33; 258–262.

30. Rapani, M. & Rapani, C. Sinus floor lift and simultaneous implant placement: A retrospective evaluation of implant success rate. Ind J Dent 2012; 3: 132-138.

31. Barone, A. & Covani, U. Maxillary alveolar ridge reconstruction with non-vascularised autogenous block bone: Clinical results. J Oral Maxillofac Surg 2007; 65: 2039-2046.

32. Vignoletti, F. et al. Surgical protocols for ridge preservation after tooth extraction. A systematic review. Clin Oral Implan Res 2012; 23(Suppl. 5): 22–38.

33. Hallman, M. et al. A clinical and histologic evaluation of implant integration in the posterior maxilla after sinus floor augmentation with autogenous bone, bovine hydroxyapatite, or a 20:80 mixture. Int J Oral Maxillofac Impl 2002; 17: 635–643.

34. Orgeas, G. V. et al. Surgical Techniques for Alveolar Socket Preservation: A Systematic Review. Int J Oral Maxillofac Impl 2013; 28: 1049–1061.

35. Darby, I. et al. Ridge preservation techniques for implant surgery Int J Oral Maxillofac Impl 2009; 24(Suppl): 260-271.

36. Martin et al. Local risk factors for implant therapy. Int J Oral Maxillofac Impl 2009; 24(Suppl): 28-38.

This article is protected by copyright. All rights reserved

Author Manuscript

37. Dastaran M, Bailey D, Chandu A, Austin S, Judge R: Retrospective assay of implant adjunctive procedures performed in private practice over 5-years in Victoria, Australia. Accepted to Australian Dental Journal 2018

Author Manuscript

Table 1 Summary of adjunctive procedures by frequency and proportion.

	Frequency (% of total implants placed)
Number of implants	8486
Total number of hard tissue procedures (specified)	2590 (30.5)
Number of implants that underwent at least one hard tissue procedure	2282 (26.9)
Particulate graft	1820 (20.4)
Cortico-cancellous onlay graft	183 (2.2)
Open sinus lift	98 (1.2) (3.7% in posterior maxilla)
Closed sinus lift	155 (1.8) (5.8% in posterior maxilla)
Socket (ridge) preservation	154 (1.8)
Hard tissue procedure not specified	61 (0.7)
Total number of soft tissue procedures	484 (5.7)

This article is protected by copyright. All rights reserved