CLINICAL RESEARCH

Interproximal contact loss in a retrospective cross-sectional study of 4325 implants: Distribution and incidence and the effect on bone loss and peri-implant soft tissue

David French, DDS, Dip Perio,[a] Mitchel Naito, BSc, DDS,[b] and Bernie Linke, DDS, MSD[c]

Dental implants are a successful means of replacing missing teeth but are not without complications, with both biological and technical complications reported.[1] Teeth suspended by the periodontal ligament can move in relation to force vectors related to the cusp angle and root tip, tooth wear, and other factors; in addition, the underlying alveolar bone structure itself can move. This can lead to relative malpositioning of an osseointegrated dental implant, which is in effect an ankylosed medical device.[2] Despite the potential for interproximal contact loss (ICL) between implants and adjacent teeth, few reports have been published. A review in 2015[3] found only 5 articles on the topic of open proximal contacts but reported complications in a reported range of between 34% and 66% of implant-supported crowns, occurring most often at mesial sites and soon after restoration.

The inherent mesial tipping of teeth may lead to ICL adjacent to implants,[4] in relation to mesial drift, root angle, and high occlusal forces as shown by a study

ABSTRACT

Statement of problem. Interproximal contact loss (ICL) is a common finding between implant restorations and teeth, yet few reports have been published on incidence or related complications.

Purpose. The purpose of this cross-sectional retrospective study was to measure the ICL of 4325 implants, including single and multiple splinted restorations.

Material and methods. Data on 4325 implants were extracted from patient records on ICL, time of follow-up, implant location, and sex of the participant for whom implants were placed in a private practice between 1999 and 2016. Periapical radiographs were used to evaluate the crestal bone level (CBL), whereas peri-implant soft tissues were evaluated with the implant mucosal index (IMI). Measurements (ICL, IMI, and CBL) were evaluated with an average follow-up of 4.5 years (range: 0.25 to 21 years). ICL was assessed in relation to the implant location and sex and grouped by the last clinical recall (1, 2-3, 4-5, 6-7, or 8+ years) to evaluate the effect of time. Data were analyzed by the chi-square test (α=.05).

Results. Overall, 17% of implants had ICL, and this significantly increased over time from 11% at 1 year to 29% at ≥8 years (chi-square: 123.8, *P*<.001). Mandibular implants had more ICL (20%) than maxillary implants (15%) (chi-square: 17.5, *P*<.001), whereas no difference was found between molar and premolar sites or male and female participants. There was no significant effect of ICL on CBL over time, but there was an increase in inflammation with higher IMI scores at ICL sites.

Conclusions. The incidence of implant ICL was found to be 17%, and ICL was found to increase over time up to 27% at ≥8 years of follow-up. ICL was more common in posterior and mandibular sites. ICL was shown to increase soft tissue inflammation but was not found to affect implant CBLs. (J Prosthet Dent 2019;122:108-14)

evaluating open contact in 28 participants with 55 prostheses using 3D occlusal imaging.[5] In one of the earliest studies on the topic, a 5-year study of 49 Brånemark single-tooth implants, 33% of implant sites had open mesial contact and 17% had open distal contact, suggesting that the cusp angle or other factors may also be involved.[6] A more recent cross-sectional retrospective

[a]Clinical Instructor, Faculty of Dentistry, Department of Periodontics, University of British Columbia Faculty of Dentistry, Vancouver, Canada; and Private practice, Calgary, Canada.
[b]Graduate Resident, School of Dentistry, University of Alberta, Edmonton Clinic Health Academy (ECHA), Edmonton, Canada.
[c]Director, Department of Prosthodontics, School of Dentistry, University of Alberta, Edmonton Clinic Health Academy (ECHA), Edmonton, Canada.

Clinical Implications

Interproximal contact loss increases with time and may demand increasing clinical time for correction. This complication was commonly found mesial to the implant and posterior in the arch. Interproximal contact loss did not affect the crestal bone level, but an increase in mucositis and the potential for caries adjacent to the fixed implant restoration were noted.

study of 174 single-implant posterior and anterior restorations, followed up between 3 months and 11 years, reported 52.8% open contacts with a distribution of 78.2% at mesial surfaces versus 21.8% at distal surfaces; the study also noted that participants were often aware of related food impaction.[7] Despite some reports noting that ICL can occur as early as 3 months after restoration, the effect of time has not yet been well established.[3] Given the range in results, further studies of ICL, including the relation to implant position and time, are warranted. Most studies report on proximal contact loss for single-implant crowns, so the inclusion of multiple splinted implants may reveal a different incidence. In addition, authors are unaware of studies on the consequence of ICL and its potential effect on proximal bone, mucosal inflammation, or adjacent tooth caries.

The purpose of this cross-sectional retrospective study was to report on the incidence of ICL from 4325 implant sites, including proximal contact sites at single-implant restorations and splinted multiunit restorations. The incidence of ICL was evaluated in relation to time, location of the implant, and sex of the patient. Furthermore, the impact of ICL on the implant crestal bone level (CBL), peri-implant mucosal status, and adjacent tooth caries was evaluated. The null hypothesis was that ICL is not a function of time and that no difference would be found between implants that have ICL and those that do not.

MATERIAL AND METHODS

This retrospective cross-sectional study selected 4325 implants where a potential proximal contact was present between teeth and implants from an open cohort of 8942 implants placed in private practice between March 1999 and January 2016 (Fig. 1). The study was reviewed and approved by the University of Alberta Institutional Review Board (HERO Pro00068903). Not all implants from the open cohort had data for the ICL parameter, and 4617 implants were excluded because the implants had not yet been restored or were not yet due for scheduled recall after restoration; because the patient did not return for any recall appointments or the most recent recall was before January 2005 (the date when ICL was first scored);

and because the implant-supported dentures or complete-arch prostheses or the implant restoration was adjacent to a diastema.

Data were extracted from the electronic patient chart and entered into a spreadsheet. Participant information was recorded with a unique identifier for anonymity. The data were evaluated for the effect of time, sex of the participant, and implant location on the incidence of ICL adjacent to dental implant-supported crown or fixed partial denture restorations. An analysis was also performed as to whether the tissue tone and bone level were affected by ICL. Statistical analysis was performed with the chi-square test and repeated measures ANOVA by using a statistical software program (IBM SPSS Statistics, v24; IBM Corp) (α=.05).

Implants were inserted according to manufacturer's guidelines and indications. All potential implant locations were used, and the location of each implant was determined based on individual participant's needs and prosthetic requirements; no set location or group of locations were planned or declined. All participants had a periodontal screening examination; if active periodontal disease was present, it was treated before dental implant surgery. Patient education and consent to implant surgery was obtained. All implant surgeries were completed by 1 periodontist (D.F.) in Calgary, Alberta, Canada, with surgical principles and protocols as described in a previously published study.[8] Restorations were completed by general dentists and prosthodontists in the Calgary region, and restorations included implant-supported single crowns and implant-supported fixed partial dentures. There were 1448 implants where proximal splinting was between implants, and in these situations, only the contact points adjacent to a natural tooth were evaluated.

Measurements of ICL, implant mucosal index (IMI), and CBL were made by the same examiner who placed the implants (D.F.), with no intraexaminer calibration performed. To study the relationship of ICL over time, data from the most recent recall examination were reported for each implant. For example, if an implant had a closed contact at the 1-year recall but subsequently developed ICL at the 5-year recall, then the contact would be recorded as open in this analysis. Follow-up visits after implant treatment were scheduled at 1-, 3-, and 5-year intervals. After 5 years, the follow-up was less structured, with participants returning either for routine follow-up visit or more extensive treatments (such as more than 4 or 5 implants), when an additional implant surgery was indicated, or if a concern was noted by the participant or by their referring dentist.

ICL was evaluated using satin floss (width: 0.05 mm × height: 0.004 mm; Oral-B). If no resistance was noted with the floss as it passed the contact, then the proximal contact was deemed an open contact (ICL).
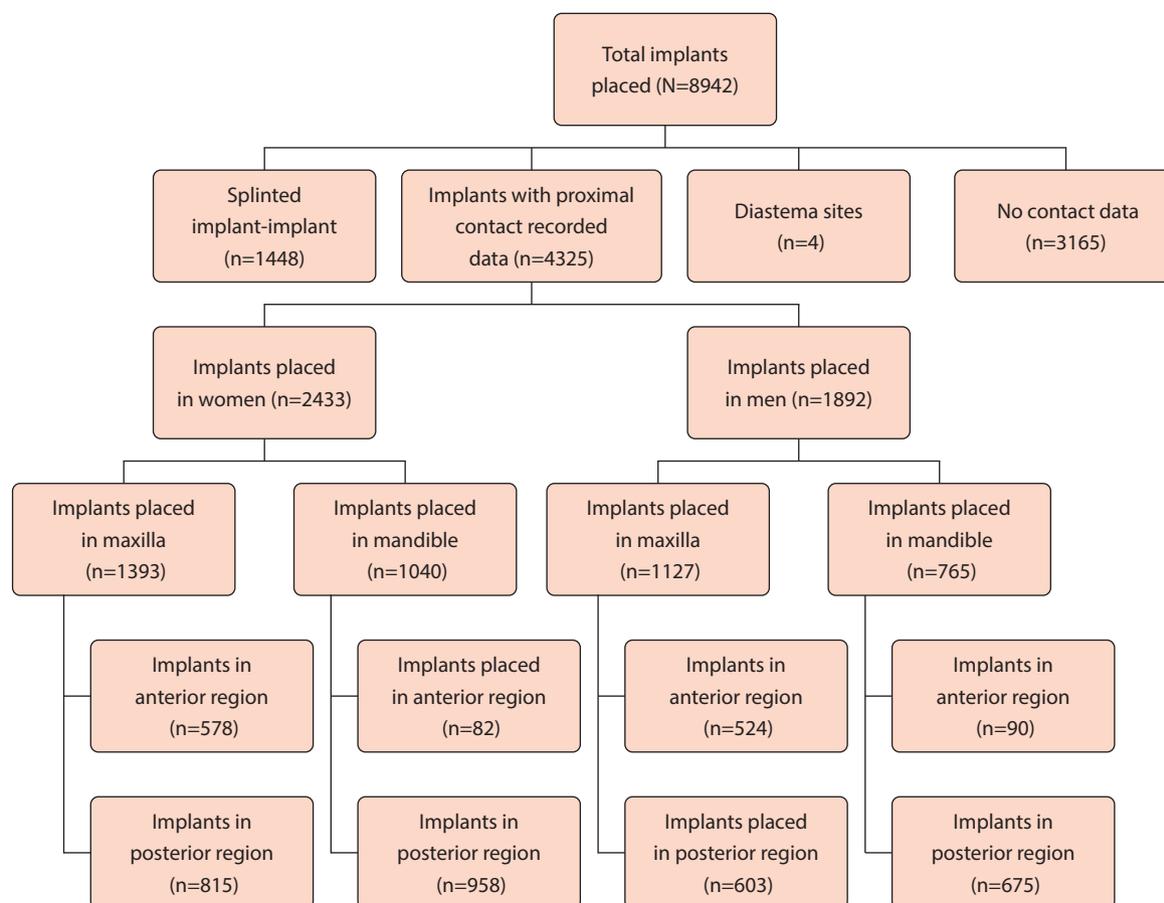
Figure 1. Flow chart of implant distribution.

Radiographs and clinical evaluation were performed at stage 2 (3 months), 1 year, 2-3, 4-5, 6-7, and 8-10 years after implant placement. Radiographs were made using a proprietary parallel film holder and software calibrated to sensor dimensions (DEXIS). In each radiographic image, the location of the implant-crown margin (implant shoulder), the first crestal bone-to-implant contact, and the apical border of the implant were identified as reference points. For each implant, the actual implant length served as the calibration value to derive the distance from implant shoulder to the first bone-to-implant contact. The CBL was then determined from the distance from implant shoulder to the first bone-to-implant contact minus the neck length of the implant (Fig. 2). The following standardization values were used to account for the different implant neck designs. For Straumann implants (Institut Straumann), values were 2.8 mm for Standard tissue level, 1.8 mm for Standard Plus tissue level and tapered effect, and 0 mm for Bone Level implants. For the Biocare implants (Nobel Biocare), the value used was 1.5 mm for both the Biocare Replace Select Ti-unite implants and for the machined external hexagon implants. For each implant, CBL was recorded as the greatest value from either the mesial or
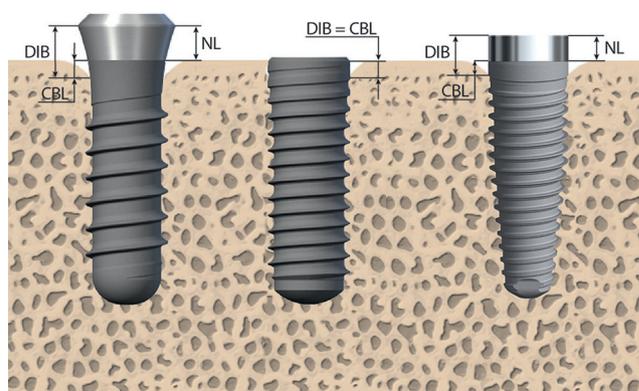

Figure 2. Reference used for crestal bone level analysis. CBL, crestal bone level; DIB, distance from implant shoulder to the first bone-to-implant contact; NL, neck length of machined or polished collar.

distal measurement.[9] During surgery, the border between the smooth and the microrough surface was positioned at the crestal level or slightly subcrestally, and CBL was thus an approximation for marginal bone loss (MBL) that occurred after implant placement (Fig. 2).

Table 1. Summary of implant mucosal index (IMI)

IMI	Bleeding on Probing*
0	No bleeding
1	Minimal, single-point bleeding
2	Moderate, multipoint bleeding
3	Profuse, multipoint bleeding
4	Suppuration

*Probing 6 sites, probe 0.17 N.

Table 2. Number of implants and proximal contact status relative to period of follow-up

Status	Year 1	Years 2-3	Years 4-5	Years 6-7	Years 8+	Total
Open	150 (11%)	147 (14%)	127 (16%)	102 (23%)	200 (29%)	726 (17%)
Closed	1194 (89%)	879 (86%)	675 (84%)	341 (77%)	482 (71%)	3571 (83%)
Total	1344 (31%)	1026 (24%)	802 (19%)	443 (10%)	682 (16%)	4297

Peri-implant mucosal status was measured by using controlled force probe and evaluated by using the IMI, an ordinal scale for evaluating soft tissue conditions incorporating graded bleeding on probing or suppuration (Table 1).[9] Teeth with caries adjacent to fixed implant restorations were reported, and a comparison of the caries rate when contact was open versus closed was performed.

RESULTS

There were 4325 implants evaluated, with an average follow-up duration of 4.47 years (range 0.25 to 21.6 years). Overall, most implants (83%) had closed contacts, whereas 17% had ICL at the date of the last examination (Table 2). ICL increased over time as seen by an ICL incidence of 11% by year 1, 14% by years 2-3, 16% by years 4-5, 23% by years 6-7, and 29% by ≥8 years. The chi-square statistic of 98.1 was significant (P<.001) (Table 2; Fig. 3).

ICL was more common mesial to an implant (N=484) than distal to an implant (N=66). A small number of implants were found with both mesial and distal ICL, N=17. More implants were placed in the maxilla (58%) than in the mandible (42%); however, a significantly lower incidence of ICL was noted in maxillary sites, with 15% of maxillary implants presenting with ICL compared with 20% of mandibular implants (Table 3; Fig. 4) (chi-square: 17.5, P<.001).

There were 1404 (46%) premolar implants and 1647 (54%) molar implants evaluated for ICL. Combining molar and premolar sites, 556 (18%) implants presented with ICL, of which 262 (19%) were at premolar implants and 294 (18%) were at molar implants. No statistical difference for ICL was found between premolar and molar sites (chi-square: 0.3, P=.56).

Of the 4325 implants placed and evaluated for potential ICL, 1274 implants were placed in anterior sites (incisors and canines), whereas 3051 were placed in
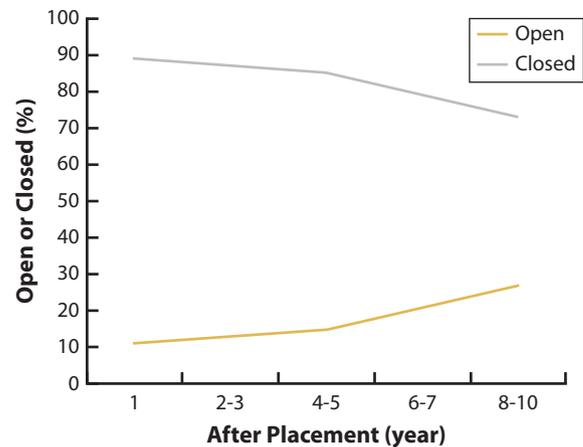

Figure 3. Interproximal contact loss relative to time of follow-up.

Table 3. Number of implants and proximal contact status as function of maxillary versus mandibular sites

	Maxilla	Mandible	Total
Open	374 (15%)	355 (20%)	729 (17%)
Closed	2146 (85%)	1450 (80%)	3596 (83%)
Total	2520 (58%)	1805 (42%)	4325

posterior sites (premolars and molars). ICL was significantly more common on posterior implants, with 18% of the posterior implants presenting with ICL versus 14% of the anterior implants (chi-square: 13.8, P<.001).

A subanalysis was performed on 4200 implants with recorded follow-up data as to whether the restorations were in or out of occlusion. This was determined by using a 24-μm-thick occlusal film, with the patient exerting a light occlusal force; if a single film was held, it was deemed to be in occlusion, whereas if it was pulled through, it was deemed to be out of occlusion. Of the 4200 implants, 1897 restorations were in occlusion, and of these, 358 (18.9%) had ICL, whereas 2303 restorations were out of occlusion, with 354 (15.4%) having ICL (chi-squares: 9.1, P=.003).

CBL results only included participants who had completed ≥8 years of follow-up. A significant trend of increasing CBL scores was seen with increasing time of follow-up (P<.001). Despite this overall increasing bone loss as a function of time, no significant difference was found for CBL comparing open proximal contacts (ICL) or closed proximal contacts over time (Table 4; Fig. 5).

Data on peri-implant tissue tone using the IMI scores of 0 to 4 were available and recorded for a subset of 4297 implants with proximal contact data, of which a total of 3572 implants had closed contacts and 725 implants presented with ICL. The majority (60%) of implants had IMI=0, whereas 28% had an IMI=1, 9% had an IMI=2, 2% had an IMI=3, and 1% had an IMI=4 (Table 5; Fig. 6). Of the closed contacts, 61% had an IMI=0, 27% had an IMI=1, 9% had an IMI=2, 2% had an IMI=3, and 1% had
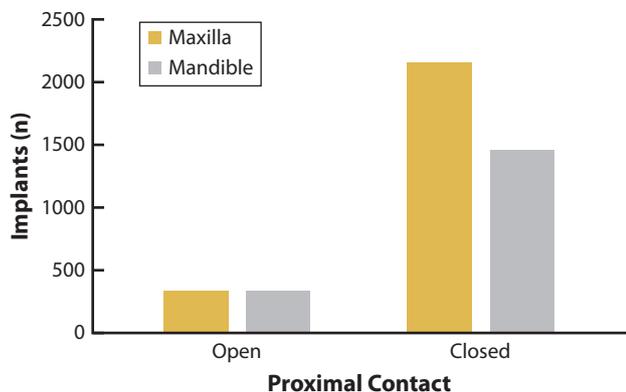
Figure 4. Interproximal contact loss relative to maxillary and mandibular sites.

Figure 5. Effect of interproximal contact loss on crestal bone level (mm).

Table 4. Mean crestal bone level (mm) over time as function of proximal contact status

Time	Open or Closed	Mean	Standard Deviation	N
		Descriptive Statistics		
Year 1	Closed	0.28	0.52	372
	Open	0.21	0.46	149
	Total	0.26	0.51	521
Year 2-3	Closed	0.40	0.71	372
	Open	0.28	0.51	149
	Total	0.37	0.66	521
Year 4-5+	Closed	0.40	0.65	372
	Open	0.43	0.74	149
	Total	0.41	0.68	521
Year 6-7	Closed	0.45	0.74	372
	Open	0.46	0.84	149
	Total	0.45	0.77	521
Year 8-10	Closed	0.48	0.79	372
	Open	0.44	0.81	149
	Total	0.47	0.80	521

Table 5. Proximal contact status and corresponding implant mucosal index

Tissue Tone	0	1	2	3	4	Total
Open	383 (53%)	228 (31%)	81 (11%)	20 (3%)	13 (2%)	725
Closed	2176 (61%)	962 (27%)	318 (9%)	74 (2%)	42 (1%)	3572
Total	2559 (60%)	1190 (28%)	399 (9%)	94 (2%)	55 (1%)	4297

DISCUSSION

Proximal contact opening adjacent to implant restorations is common, yet there remain few reports on the subject. Most studies report incidence or distribution in relatively small samples, and, to the authors' knowledge, no study has evaluated the effect of time on ICL or the effect of ICL on hard or soft tissues. The present retrospective study reported on the incidence of ICL from 4325 implants as a function of time, implant location, and sex of the participant. It further evaluated the effects of ICL on surrounding hard and soft tissues. The null hypothesis was rejected as significant differences in ICL were found over time as well as significant differences in implants with and without ICL. Overall, this retrospective study reported that 17% of the 4325 implants evaluated presented with ICL; this is lower than a recent review reporting between 34% and 66% of implants with ICL.[3] The difference may be due in part to the inclusion of single-tooth restorations and fixed partial dentures including implants in distal edentulous spans where no distal contact can be present, reducing the potential number of open contacts per implant. Furthermore, in this study, the contact was deemed to be closed if any resistance to flossing was found, which may differ from other studies. An important finding of this study was that the incidence of ICL increased with increasing time, and as such, the difference between various studies may also be due in part to the time of follow-up. Because the average time of follow-up was only 4.47 years, a longer term average follow-up may yield a higher incidence of ICL (Table 2; Fig. 3). Indeed, the incidence of ICL reported in this study was found to be lowest in the first

an IMI=4. At the open contact sites, fewer implants had an IMI=0 (53%), 31% had an IMI=1, 11% had an IMI=2, 3% had an IMI=3, and a higher percentage at 2% had an IMI=4. A chi-square test based on the number of open and closed contacts from each IMI score revealed a significant trend toward greater mucosal inflammation at implants with ICL, with a chi-square of 14.6 and P=.005 (Table 5, Fig. 6).

Caries adjacent to fixed implant restorations were evaluated for 39 implants where both caries and proximal data were recorded (Fig. 7). A total of 4286 implants placed with recorded interproximal data had no recorded adjacent dental caries. Of the 39 implants with adjacent caries, 14 implants had ICL, whereas 25 implants presented with closed interproximal contacts. This was compared with 715 open contacts with no adjacent caries versus 2571 closed contacts with no adjacent caries. The chi-square statistic was 10.2 and P=.001.
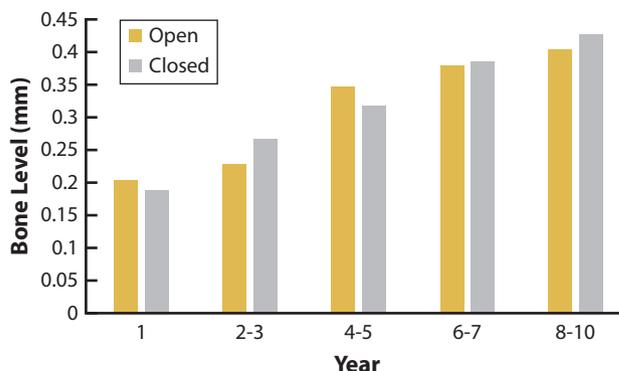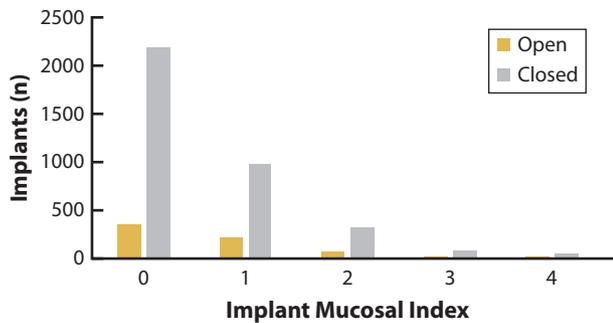
Figure 6. Effect of interproximal contact loss on implant mucosal index.

Figure 7. Example of dental caries adjacent to fixed implant restoration and interproximal contact loss.

year (ICL=11%) and nearly 3 times as common by 8 to 10 years (ICL=27%), which approaches the reported average of other studies on single teeth.[3]

The finding that ICL was more prevalent with longer periods of follow-up suggests the mechanism is not an instant response of the adjacent tooth in contact with an implant; this is in contrast to the suggestion that it occurs within 3 months of restoration.[3] ICL may instead be related to longer term occlusal changes such as mesial drifting of the teeth and root angle, which supports similar results from other studies.[4,5] This may also explain why most studies report a higher incidence in mesial contact and why the present study found higher rates in mandibular sites (maxilla ICL=15% and mandible ICL=20%) as lower teeth are typically tipped mesially (Table 3; Fig. 4).[5]

Molar and premolar implants had a similar incidence of ICL at 18% and 19%, respectively, whereas anterior implants had a lower incidence at 14%. The authors are unaware of a previous study that evaluated the effect of the position in the arch on the incidence of ICL.

The present study also found only slightly higher ICL rates in men than in women, but the difference was not significant. Men typically have a higher occlusal force, and the occlusal force is typically higher in molars than premolars.[10] The lack of significant difference as a function of sex of the participant suggests that occlusal force may not be so critical to the development of ICL, which is in contrast with the finding of a prior study that high occlusal forces were a factor in ICL.[5] Also important was the observation of a slight trend toward higher incidence of ICL when the restorations were in occlusion (ICL=18.9%) versus out of occlusion (ICL=15.4%). Where a restoration is kept out of occlusion, the adjacent tooth may sustain more occlusal force, and because these did not present with a higher incidence of ICL, this also suggests that occlusal force is not so critical in the development of ICL.

During surgery, the border between the smooth and the microrough surface was positioned at the crestal level or slightly subcrestally. CBL, in this study, was thus an approximation for the MBL that occurred after implant placement (Fig. 2). Although the implants in this study showed a trend toward more bone loss over time, no significant relationship was found between ICL and CBL over time (Table 4, Fig. 5). This is an important finding not previously reported in the literature as it may suggest that open proximal contacts, although common, are not a significant risk factor for peri-implantitis. However, peri-implant soft tissue IMI scores were higher at implants with ICL (P<.05), and higher IMI scores have been shown in another study to correlate with bone loss over time.[9] The follow-up period of this present study was relatively short, and over longer follow-up, the presence of ICL may yet relate to more CBL around implants.

The study by Varsith et al[7] reported that patients were aware of food impaction, which may predispose adjacent teeth to caries.[11] In this present study, dental caries adjacent to a fixed implant restoration rate doubled when contact was open versus closed at 2% and 1%, respectively (Fig. 7). Thus, when ICL is noted, the use of an interdental proxybrush with fluoride gel may be advisable. Indeed, this may be safer than flossing, which can leave shredded fragments trapped on microrough surfaces and thus increase the risk of peri-implantitis.[12]

The results of this present study on the incidence of ICL at implant restorations support other studies stating that patients need to be informed of the common potential for ICL.[7] More importantly, as the problem increases with time, management of implant ICL will increasingly be an issue that warrants further innovation, research, and discussion.

One limitation identified in this retrospective study was the potential for missing data. Not all implants had ICL recorded because, before 2005, this parameter was not assessed unless these patients were recalled after 2005. Another limitation was that all the sites were evaluated and recorded by the same clinician who placed the implants, thus introducing a risk of bias. In addition, dropouts, common to long-term clinical studies, were not fully accounted for due to practical limitations in an open-cohort private practice study. Notwithstanding, this study represents a unique private practice report on a large number of implants and their relation to the incidence of ICL. This study found that open contacts

increase with time, suggesting that the longer the clinician restores dental implants, the more the resources will eventually be required to address the open contacts. An effort toward the prevention of ICL through the use of a retainer and other treatment options warrants further investigation.

CONCLUSIONS

Based on the findings of this clinical study, the following conclusions were drawn:

1. From a large number of proximal contacts between implants and teeth followed up for an average of 4.47 years, 17% of sites had ICL, and the incidence increased over time with up to 29% implants having ICL by 8 or more years of follow-up.
2. No effect of ICL was found on MBL noted, but there was a trend toward higher mucositis in areas of ICL.

REFERENCES

1. Schmidlin K, Schnell N, Steiner S, Salvi GE, Pjetursson B, Matuliene G, et al. Complication and failure rates in patients treated for chronic periodontitis and restored with single crowns on teeth and/or implants. Clin Oral Implants Res 2010;21:550-7.
2. Andersson B, Bergenblock S, Fürst B, Jemt T. Long-term function of single-implant restorations: A 17- to 19-year follow-up study on implant infraposition related to the shape of the face and patients' satisfaction. Clin Implant Dent Relat Res 2013;15:471-80.
3. Greenstein G, Carpentieri J, Cavallaro J. Open contacts adjacent to dental implant restorations Etiology, incidence, consequences, and correction. J Am Dent Assoc 2016;147:28-34.
4. Dalstra M, Sakima MT, Lemor C, Melsen B. Drifting of teeth in the mandible studied in adult human autopsy material. Orthod Craniofac Res 2016;19:10-7.
5. Wei H, Tomotake Y, Nagao K, Ichikawa T. Implant prostheses and adjacent tooth migration: preliminary retrospective survey using 3-dimensional occlusal analysis. Int J Prosthodont 2008;21:302-4.
6. Gibbard LL, Zarb G. A 5-year prospective study of implant-supported single-tooth replacements. J Can Dent Assoc 2002;68:110-6.
7. Varthis S, Randi A, Tarnow DP. Prevalence of interproximal open contacts between single-implant restorations and adjacent teeth. Int J Oral Maxillofac Implants 2016;31:1089-92.
8. French D, Larjava H, Ofec R. Retrospective cohort study of 4591 Straumann implants in private practice setting, with up to 10-year follow-up. Part 1: multivariate survival analysis. Clin Oral Implants Res 2015;26:1345-54.
9. French D, Cochran D, Ofec R. Retrospective cohort study of 4591 Straumann implants placed in 2060 patients in private practice with up to 10-year follow-up: The relationship between crestal bone level and soft tissue condition. Int J Oral Maxillofac Implants 2016;31:e168-78.
10. Ferrario VF, Sforza C, Serrao G, Dellavia C, Tartaglia GM. Single tooth bite forces in healthy young adults. J Oral Rehabil 2004;31:18-22.
11. Hayes M, Da Mata C, Cole M, McKenna G, Burke F, Allen PF. Risk indicators associated with root caries in independently living older adults. J Dent 2016;51:8-14.
12. Van Velzen FJJ, Lang NP, Schulten EAJM, ten Bruggenkate CM. Dental floss as a possible risk for the development of peri-implant disease: An observational study of 10 cases. Clin Oral Implants Res 2016;27:618-21.

Corresponding author:
Dr David French
Department of Periodontics
University of British Columbia
Room JBM 366, 2199 Wesbrook Mall
Vancouver, BC V6T 1Z3
CANADA
Email: drfrench@shaw.ca

Noteworthy Abstracts of the Current Literature

Effectiveness of denture cleansers on removal of adherent Candida albicans cells from denture base acrylics of various roughness

Chatzivasileiou K, Kotsiomiti E, Vyzantiadis TA

Int J Prosthodont 2019 Mar/Apr;32:196-7

Purpose. To experimentally examine the effectiveness of a small sample of commercial denture cleansers in removing Candida albicans cells from denture surfaces.

Material and methods. A total of 216 specimens from three brands of denture base resins (72 for each acrylic resin) were divided into three groups of 24 specimens that each received a different surface treatment (Ra1, Ra2, and Ra3). The specimens were contaminated by the Candida albicans strain ATCC 90028, immersed for 15 minutes in one of two experimental denture cleanser solutions or in tap water, and placed in Petri dishes with culture medium.

Results. Candida albicans colonies were measured after 24-hour incubation at 37ÆC. There was a statistically significant difference in the cleansing result depending on the denture cleanser used.

Conclusions. The use of commercial denture cleansers may under certain conditions be effective in the removal of Candida albicans from denture bases.

Reprinted with permission of Quintessence Publishing.