Complications

1. **AK** Camps-Font O, Martín-Fatás P, Clé-Ovejero A, Figueiredo R, Gay-Escoda C, Valmaseda-Castellón E. Postoperative infections after dental implant placement: Variables associated with increased risk of failure. J Periodontol. 2018 Oct;89(10):1165-1173.
2. **TV** Bryce G, Bomfim DI, Bassi GS. Pre- and post-operative management of dental implant placement. Part 2: management of early-presenting complications. Br Dent J. 2014 Aug;217(4):171-6.
3. **DL** Cehreli MC, Kökat AM, Uysal S, Akca K. Spontaneous early exposure and marginal bone loss around conventionally and early-placed submerged implants: a double-blind study. Clin Oral Implants Res. 2010 Dec;21(12):1327-33.
4. **CM** Van Assche N, Collaert B, Coucke W, Quirynen M. Correlation between early perforation of cover screws and marginal bone loss: a retrospective study. J Clin Periodontol. 2008 Jan;35(1):76-9.
5. **VX** Tal H, Dayan D. Spontaneous early exposure of submerged implants: III. Histopathology of perforated mucosa covering submerged implants. J Periodontol. 2000 Aug;71(8):1231-5.
6. **RH** Kim TH, Lee DW, Kim CK, Park KH, Moon IS. Influence of early cover screw exposure on crestal bone loss around implants: intraindividual comparison of bone level at exposed and non-exposed implants. J Periodontol. 2009 Jun;80(6):933-9.
7. **NL** Bidra AS, Kejriwal S, Bhuse K. Should Healing Abutments and Cover Screws for Dental Implants be Reused? A Systematic Review. J Prosthodont. 2020 Jan;29(1):42-48.
8. **MS** Hertel M, Roh YC, Neumann K, Strietzel FP. Premature exposure of dental implant cover screws. A retrospective evaluation of risk factors and influence on marginal peri-implant bone level changes. Clin Oral Investig. 2017 Jul;21(6):2109-2122.
9. **AK** Han HS, Kim PJ, Kim KT, Kim S, Ku Y, Cho YD. Dental implant proximity to adjacent teeth: A retrospective study. Clin Implant Dent Relat Res. 2022 Dec;24(6):733-739.
10. **TV** Balaguer-Martí JC, Peñarrocha-Oltra D, Balaguer-Martínez J, Peñarrocha-Diago M. Immediate bleeding complications in dental implants: a systematic review. Med Oral Patol Oral Cir Bucal. 2015 Mar 1;20(2):e231-8.
11. **DL** Herranz-Aparicio J, Marques J, Almendros-Marqués N, Gay-Escoda C. Retrospective study of the bone morphology in the posterior mandibular region. Evaluation of the prevalence and the degree of lingual concavity and their possible complications. Med Oral Patol Oral Cir Bucal. 2016 Nov 1;21(6):e731-e736.
12. **CM** Katsumi Y, Tanaka R, Hayashi T, Koga T, Takagi R, Ohshima H. Variation in arterial supply to the floor of the mouth and assessment of relative hemorrhage risk in implant surgery. Clin Oral Implants Res. 2013 Apr;24(4):434-40.
13. **VX** Misch CE, Resnik R. Mandibular nerve neurosensory impairment after dental implant surgery: management and protocol. Implant Dent. 2010 Oct;19(5):378-86.

Topic: post op infections of dental implants

Authors: Camps-Font O, Martín-Fatás P, Clé-Ovejero A, Figueiredo R, Gay-Escoda C, Valmaseda-Castellón E
Title: Postoperative infections after dental implant placement: Variables associated with increased risk of failure
Source: J Periodontol. 2018 Oct;89(10):1165-1173
DOI: 10.1002/JPER.18-0024

Reviewer: Amber Kreko
Type: clinical study

Keywords: dental implants, post op complications, prognosis, surgical wound infection, survival analysis

Purpose: To determine factors that may increase the failure rate of dental implants that have present a post op infection during the osseointegration period.

Material and methods:
- Retrospective cohort study of 1322 patients with 2, 673 implants.
- Post op infections were defined as presence of pus or a fistula in the operated region, with pain or tenderness, localized swelling, redness, or heat or fever.

Results:
- 37 post op infections recorded 2.8% of patients affected and 1.38% of implants.
- Surgical therapy was required in 89% of infections and 24 of the infected implants were removed.
- Each week earlier in the appearance of post op infection multiplied the adjust risk of failure by 1.11
- Implants with rough surfaced collars increased the adjusted risk of failure by 2.35 times.

Conclusions: Post op infection after dental implant placement has a poor prognosis with a survival rate of 33.5%. Implants with a rough surfaced collar where an early post op infection develops seems to be more prone to suffer early failure.

Topic: Early Complication
Authors: Bryce, G et al
Title: Pre- and post-operative management of dental implant placement. Part 2: management of early-presenting complications
Source: British dental journal vol. 217,4 (2014): 171-6
DOI:10.1038/sj.bdj.2014.702
Reviewer: Tam Vu
Type: Review
Keywords: dental implants, early complication, management, bleeding, hemorrhage, infection, antibiotics

Purpose: review pre- and post-operative management of **early complications** associated w/dental implant placement

Discussion:

<u>Post-operative Hemorrhage</u>

- Hemorrhagic lesions
  - Petechiae (<2 mm)
  - Purpura (2 – 10 mm
  - Ecchymosis (>10 mm)
- Medical conditions (i.e. clotting factor disorders, platelet disorders, blood disorders)
- Local factors (size of flap, vasoconstrictor/epi, physical disruption of clot/infx)
- Post-op instructions
  - Avoid strenuous exercise
  - Maintain soft diet
  - Oral hygiene – limit brushing-induced trauma to surgical site
- Management of bleeding:
  - Chemical agents: (Adrenaline-containing local anesthetic, ferric sulphate, aluminum chloride/transexamic acid)

    - Clot-inducing sub-structures (Oxidized cellulose, fibrin mesh, collagen gauze)
    - Physical (Compression, pressure dressing, electrocautery, sutures)
        - Direct pressure w/damp gauze w/CHX for at least 30 min
        - Nose bleed: head-tilt + finger pressure to nasal area for up to 20 min or nasal compress

Post-operative Swelling

- Swelling = acute inflammation, can cause incr pain, loss of fxn, or neural damage
- Tx:
    - Prevent add'l trauma
    - Correct contour of immediate restoration
    - NSAIDs and steroids (some evidence of negative effect on osseointegration)
    - Cold compress (reduces vascular flow, cellular inflammatory response, and pain)
        - 10 min on, 20 min off for 1st 4 hours up to 48 hours

Post-operative Infection and Optimization of osseointegration process

- Osseointegration = direct interface btn implant and bone without intervening soft tissue
    - General factors contributing to implant failure
        - Systemic (diabetes, osteoporosis, vit D deficiency)
        - Medical (radiotherapy/chemotherapy, IV bisphosphonates > oral bisphosphonates)
        - Smoking
        - Plaque control
        - Excessive alcohol consumption
        - Malnutrition
    - Local factors
        - Site of implant placement (Maxilla, type 3 bone)
        - Bone augmentation
        - Poor oral hygiene
        - Operator factors: poor surgical technique, ineffective cooling of surgical bur)
- Post-op management: mouthwashes (i.e. saline, povidone iodine, cetylpyridinium chloride, CHX)
    - CHX – broad spectrum antimicrobial effect w/limited bacterial resistance and minimal side effects

Use of Antibiotics

- Cochrane review: 2 g pre-operative dose of amoxicillin may improve success rate of osseointegration
    - If Pcn-allergy: 600 mg clindamycin 1 hour pre-op
- Bone grafting or sinus augmentation ---- greater risk of infx
    - Amox 500 mg TID or Clindamycin 300 mg TID for 10 days
- Sinus floor elevation
    - Advise to not cause add'l pressure to Mx sinus (flying, swimming 2 weeks post op, no internal sneezing)
    - Rx: antihistamine and nasal spray

Neurosensory Disruption

- Due to direct dissection or indirect (nerve compression from implant or subsequent inflammation)
    - Prevalence: 0-44%
- Thorough pre-op assessment w/3D imaging to reduce neural trauma
    - Minimal safety margin: 2 mm from nerve to dental implant
- Mild neurosensory disruption
    - Rx: NSAIDs (600 mg Ibuprofen) and steroids (6-8 mg dexamethasone) to reduce inflammation and pressure on nerve
- Neurotmesis: early removal of implant, refer to neurosurgical speicalise

Topic: Complications-cover screw exposure
Authors: Cehreli MC, Kökat AM, Uysal S, Akca K.
Title: Spontaneous early exposure and marginal bone loss around conventionally and early-placed submerged implants: a double-blind study.
Source: Clin Oral Implants Res. 2010 Dec;21(12):1327-33.
DOI: 10.1111/j.1600-0501.2010.01952.x.
Reviewer: Daeoo Lee
Type: Retrospective-Comparative Case series
Keywords: exposure, cover screw, MBL

Purpose: To compare the frequency of spontaneous early exposure of cover screws (CSE) and marginal bone resorption in conventionally and early placed submerged implants before second-stage surgery.

Background:

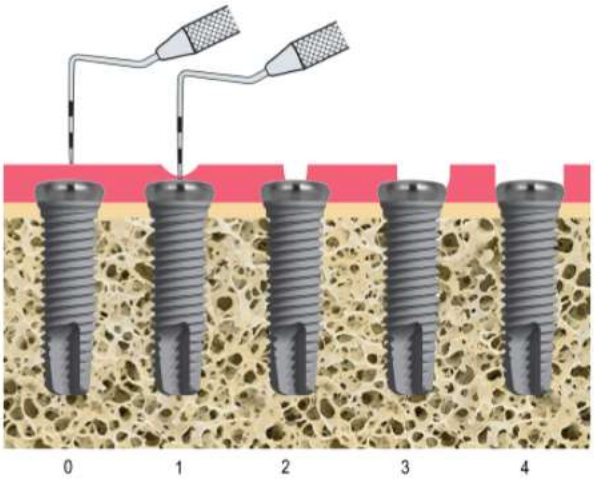


Fig. 1. Classification of cover screw exposures according to Tal (1999). Score 0: complete coverage of the implant by soft tissue; score 1: a probe can contact the cover screw covered by a breach of mucosa; score 2: a central perforation is observed, the cover screw is visible, but the borders of the perforation do not overlap the border of the cover screw; score 3: the cover screw is visible and the border of the perforation overlaps the border of the cover screw at some parts; score 4: complete exposure of the cover screw.

Material and methods:

- 46 pts
    - 103 Nobel Biocare Branemark implant
- Group 1: Conventionally placed implants (26 pts; 52 implants).
- Group 2: Early-placed implants (4-8 wks post-extraction) (20 pts; 51 implants).
- Exposure of implants scored
- MBL (radiograph)
- Plaque score

Results:

- The percentages of non-exposed implants in Group 1 were higher than Group 2 ($P < 0.007$).
- Group 1 had 7x greater score 0 than Group 2 (odds ratio = 7). Likewise, Group 1 implants had 11.5x greater PI score 0 than those in Group 2 ($P < 0.031$, odds ratio = 11.5).
    - ***Table 2.* Percentage distribution of CSEs and Plaque index scores in both groups**

	CSE		Plaque index		Total
	0 (none)	1–4 (exposed)	0	1–3	
Group 1					
Count	23	3	25	1	26
%	88.5	11.5	96.2	3.8	100
Group 2					
Count	10	9	13	6	19
%	52.6	47.4	68.4	31.6	100

CSE, cover screw exposure.

- Exposed implants in both groups had higher MBL than non-exposed implants.
    - Group 1: Higher MBL at mesial side but not at the distal side when CSE.
    - Group 2: the difference between MBL at mesial and distal sides with regard to CSE scores 0 and 1–4 was significant
        - CSE scores 1–4 had higher MBL at both sides
- Higher MBL in patients who used interim dentures only in Group 2
- MBL in Group 2 was higher than Group 1

Conclusions: Early-placed implants experience a higher frequency of spontaneous early exposure of implants in comparison with conventionally placed implants.

Topic: Cover screw exposure
Authors: Van Assche N., Collaert B., Coucke W., Quirynen M.
Title: Correlation between early perforation of cover screws and marginal bone loss: a retrospective study
Source: J Clin Periodontol 2008; 35: 76–79.
DOI: 10.1111/j.1600-051X.2007.01158.x.
Reviewer: Cyrus J Mansouri
Type: Retrospective study
Keywords: bone loss; cover screw; exposure; implant; perforation

Purpose: To compare early MBL changes between implants placed two-stage with or without cover screw exposure to implants placed one-stage.

Material and methods: Study population included 60 Astra Tech MicroThread implants placed equi- or sub-crestal in 23 patients. A one-stage surgical approach was elected unless the pt wished to use a removable prosthesis during healing for esthetic reasons or if primary stability was insufficient.

- 20 cover screw exposures occurred in 14 patients.
    - 7/14 patients had one other submerged implant heal uneventfully.
- Bone loss was measured mesially and distally on periapical radiographs to nearest 0.1 mm.

Results:
RBL after 3-4 mo was:
- 1.96 mm for two-stage implants with cover screw exposure (SSD).
- 0.01 mm for two-stage submerged implants
- 0.14 mm for one-stage implants

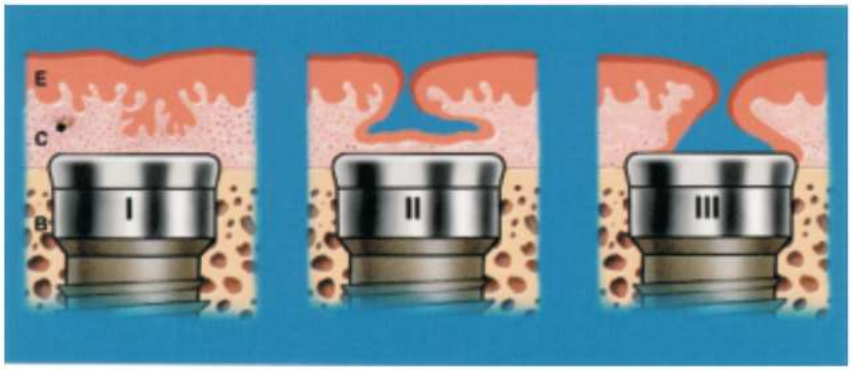
Conclusion: RBL of 2 mm can be expected when soft tissue integrity is not maintained during a two-staged approach. Placement of a healing abutment may prevent further bone loss if a cover screw exposure is recognized early.

Topic: Cover Screw Exposure
Author: Tal H, Dayan D.
Title: Spontaneous early exposure of submerged implants: III. Histopathology of perforated mucosa covering submerged implants.
Source: J Periodontol. 2000 Aug;71(8):1231-5.
DOI: 10.1902/jop.2000.71.8.1231.
Type: Clinical Study
Reviewer: Veronica Xia
Keywords: early perforation, histological findings, cover scrw exposure

Purpose: To examine histological characteristics of clinically perforated mucosa over submerged implants, effects of early exposure on peri-implant bone loss, and local factors that can lead to perforations

Materials and Methods:
- 148 patients with 372 implants
- At 2 weeks post-op, early exposures were noted, then classified at 8-10 weeks (51 implants)
    - Class 0: mucosal covering implant is intact
    - Class I: 9.8% of exposed implants
    - Class II: 56.9% of exposed implants
    - Class III: 25.5% of exposed implants (borers of perf partly overlapped borders of cover screw)
    - Class IV: 7.8% of exposed implants (completed exposed)
- At 8-10 weeks, any incomplete spontaneous exposures were complete exposed and mucosa was biopsied

Results:
- Sites more distant to exposure showed hyperplastic epi (hyperparakeratosis/acanthosis, and longer rete ridges)
    - CT infiltrated with chronic inflammatory cells (lymphocytes/plasma cells)
- Sites closed to perforation showed hyperplastic epithelium with gradual invagination (resembling cyst)
    - Inner area of invagination lost parakeratotic cover (cystic epithelium)
        - Some loose CT and necrotic material



Conclusion:

- It is common to have spontaneous early perforation (cover screw exposure)
- Areas closer to the perforation show epithelial invagination, leading to a cystic pattern
- Suggest Class I-III perforations are completely exposed to prevent marginal bone damage

Topic: Cover Screw Exposure
Author: Kim, et al.
Title: Influence of early cover screw exposure on crestal bone loss around implants: intraindividual comparison of bone level at exposed and non-exposed implants
Source: . J Periodontol. 2009 Jun;80(6):933-9
DOI: 10.1902/jop.2009.080580
Reviewer: Ryan Higgins
Type: Prospective Cohort
Keywords: alveolar bone loss, dental implants, infection/prevention and control, osseointegration, plaque, wound healing

Purpose:

- To evaluate the influence of early cover screw exposure on crestal bone loss around implants

Materials and Methods:

- 19 patients who were treated with dental implants via two stage approach with at least 1 exposed and 1 non-exposed implants (20 early exposure and 20 non-exposed implants)
- Crestal bone loss at exposed and non-exposed implants evaluated with PA radiograph at first surgery and at suprastructure insertion using computerized image-analysis system
- Second surgery was completed 3 months post-op for mandible ad 6 months post-op for maxilla
    - Suprastructure inserted 3-4 weeks after second surgery
- An uncovery surgery was performed immediately when cover screw exposure through mucosa was observed between first and second surgeries

Results:

- SSD in crestal bone loss:
    - Mean crestal bone loss of exposed implants = 0.40 ±0.53 mm
    - Mean crestal bone loss of non-exposed implants = 0.18 ±0.26 mm

Conclusions: In cases of early cover screw exposure there is an acceleration of early peri-implant crestal bone loss. Periodic follow-up after the first surgery may be critical for minimizing the influence of early exposure.

Topic: Reuse of Healing abutments and Cover Screw
Authors: Bidra, A et al.
Title: Should Healing Abutments and Cover Screws for Dental Implants be Reused? A Systematic Review
Source: Journal of Prosthodontics 29 (2020) 42–48
DOI: 10.1111/jopr.13106
Reviewer: Nicolas Lobo
Type: Systematic review
Keywords: Reuse; healing abutments; cover screws; sterilization.

Purpose: to review scientific evidence on whether healing abutments and cover screws used in dental implants can be effectively resterilized for reuse. Additionally, the review aimed to identify any reported adverse effects on implants or patient health from reusing these components.

Materials and methods: The inclusion criteria were English-language peer-reviewed studies related to this topic.

Results: 6 relevant observational studies were considered following the inclusion and exclusion criteria. No true clinical studies on the reuse of healing abutments were found, and no articles from the Cochrane database were identified. The studies primarily examined the decontamination of used titanium healing abutments.

- Over 300 healing abutments were analyzed, but no adverse effects, such as infections or implant failure, were reported from reusing them.
- Three studies found that routine cleaning (mechanical, chemical and steam) and sterilization methods were inadequate in completely removing contaminants.
- Two studies suggested additional cleaning methods, such as CO2 laser or sodium hypochlorite treatment, improved decontamination.
- One study found that routine methods alone could achieve sufficient cleaning.
- All studies involved titanium healing abutments, with no data on alternative materials like polymers or zirconia.
- **Browne et al. (2012)**: Reported that routine sterilization methods (steam autoclave and chemical) achieved sterility comparable to new components.
- **Cakan et al. (2015)**: Found residual contamination on healing abutments sterilized by dental dealers and recommended additional cleaning before reuse.
- **Wadhwani et al. (2016)**: Found 99% of healing abutments still showed protein contamination after sterilization.
- **Stacchi et al. (2018)**: Concluded that novel cleaning systems (automatic cleaning or chemical wiping and autoclave) were more effective than conventional methods.
- **Chew et al. (2018)**: Demonstrated that adjunctive decontamination methods like sodium hypochlorite significantly improved cleaning outcomes.
- No actual clinical studies were found. The literature did not reveal any studies reporting adverse effects, such as infections, bone loss, mechanical issues, implant failure, or harm to patients, resulting from the reuse of healing abutments or cover screws.

Conclusions: The systematic review found limited evidence suggesting that routine cleaning and sterilization methods for used titanium healing abutments may not fully remove contaminants. However, no studies reported adverse biological or mechanical effects on dental implants or patient harm from reuse. Despite the cost-saving practice of reusing abutments, the review advises against indiscriminate reuse until more supporting evidence is available. Clinicians are encouraged to evaluate each abutment individually before reuse to ensure patient safety.

Topic: Cover screw exposure
Authors: Hertel M, et al.
Title: Premature exposure of dental implant cover screws. A retrospective evaluation of risk factors and influence on marginal peri-implant bone level changes.

Source: Clin Oral Investig. 2017 Jul;21(6):2109-2122.
DOI: 10.1007/s00784-016-2001-2
Reviewer: Mahya Sabour
Type: Retrospective study
Keywords: dental implants, cover screw, exposure, risk factors, bone loss

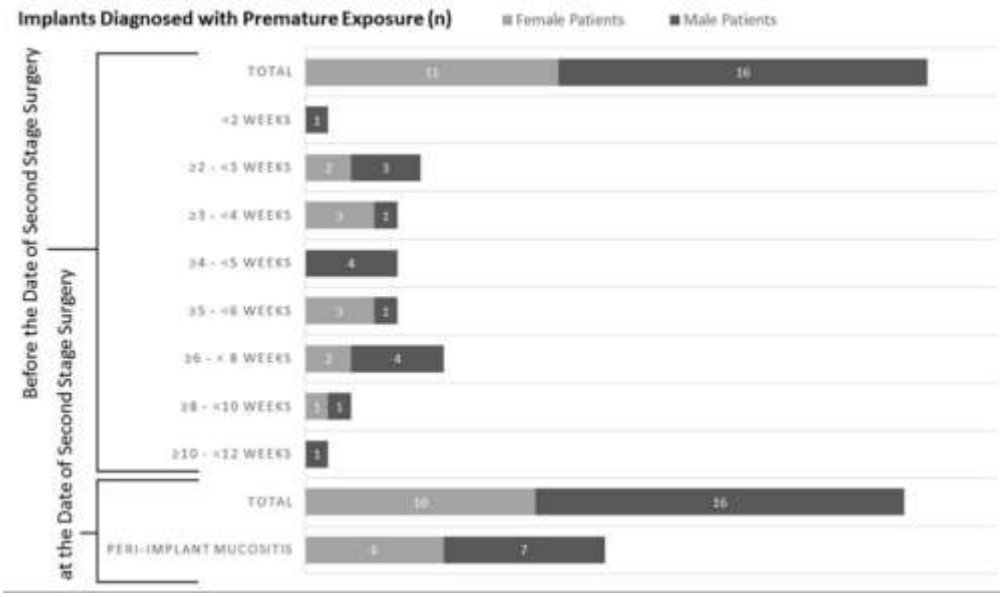
Purpose: to primarily detect factors that are associated with more frequent spontaneous cover screw exposure and secondarily assess the influence it has on marginal peri-implant bone level changes.

Material and Methods:

- 165 patients (January 2011 to October 2014) who received at least one primarily submerged implant and either had none or spontaneous cover screw exposure without immediate uncovery due to absence of infection (they were instructed to keep area clean until uncovery time)
- Patient demographics and health-related variables, intervention-related variables, as well as implant-level parameters were recorded
    - Implant system, dimensions, position of the platform (>/= 0.5mm above, <0.5mm above/below, or >/=0.5mm below the alveolar crest), implant site, and time between extraction and implant placement
- Standardized PAs and PANs were used to assess the marginal bone level changes (mesial and distal distances between the implant shoulder and coronal bone-to implant contact point)

Results:

- Total of 395 implants placed. None failed or required removal.
- 53 implants had premature cover screw exposure. Of those that were diagnosed at uncovery, 13 had peri-implant mucositis.



- Demographic factors significantly associated w/ higher premature cover screw exposure frequency:
    - Male gender (F: 18.8%, M: 36.2%)
    - Ages 60-69 years in males but not significant in the entire cohort
- Health-related parameters:
    - Entire cohort: no association between smoking and premature exposure (potentially due to low total number of smokers in the cohort).
    - Male cohort: weak association between smoking and premature exposure, specifically in those consuming more than 5 and up to 20 per day.

    - No association between systemic diseases or medications and premature exposure (for diabetes, potentially due to limited number of diabetic patients in the cohort)
- Implant-level variables:
    - Significant association between premature exposure and:
        - Posterior implants (16%) - hypothesized that could be due to lack of KT and presence of thin mucosa
        - Supracrestal implants(18.3%)
        - Platform-matching compared to platform-switching cover screws
        - Implants with diameters of 4.3mm and length of 11.5mm
    - NSD between premature exposure and maxilla and mandible location, site configuration, dimension of edentulous space, time between extraction and implant placement, incision and flap designs, duration of surgery, complication occurrence, antibiotic regimens, surgeon experience, augmentation procedures, duration of unloaded healing time, and type of temporary prosthesis.
- Marginal peri-implant bone level change:
    - Both exposed and non-exposed implants had significantly decreased mean bone height after the healing period compared to time of implant placement, but this value was significantly higher in exposed implants and mesial and distal sites.
        - Either due to biofilm formation, leading to chronic inflammation or apical migration of the ST, or
        - In this study, healing abutments were not placed once exposure was detected

Conclusion: Premature cover screw exposure is associated with male gender, posterior region placement in both maxilla and mandible, using a platform-matching cover screw, and supracrestal placement of the implant. There is significantly higher marginal bone loss around implants with prematurely exposed cover screws.

Topic: implant proximity
Authors: Han HS, Kim PJ, Kim KT, Kim S, Ku Y, Cho YD.
Title: Dental implant proximity to adjacent teeth: A retrospective study.
Source: Clin Implant Dent Relat Res. 2022 Dec;24(6):733-739.
DOI: 10.1111/cid.13132
Reviewer: Amber Kreko
Type: clinical study
Keywords: dental implant, dental pulp devitalization, iatrogenic, peri-implantitis, proximity, tooth

Purpose: To assess the occurrence and prognosis of dental implant proximity or direct contact with the adjacent tooth. Treatment modalities and prevention were discussed.

Material and methods:
- 43 patients with dental implants located close to the adjacent teeth were retrospectively evaluated. (31 were less than 1mm and 12 had direct contact with the tooth)
- Various clinical variables and radiographs were evaluated.

Results:
- Tooth symptom decreased by about 95% with every increase of 1.0mm distance between implant and tooth
- In anterior, OR of peri-implantitis occurrence was 30.4 fold greater than in posterior sites.

Conclusions: Close implant-tooth proximity and direct implant tooth contact are iatrogenic factors that cause various complication, including adjacent tooth symptom and peri-implantitis. Prevention with proper surgical skills and intra-operative periapical radiographs is important.

Topic: Bleeding complications after implant placement
Authors: Balaguer-Martí, José-Carlos et al.
Title: Immediate bleeding complications in dental implants: a systematic review
Source: Medicina oral, patologia oral y cirugia bucal vol. 20,2 e231-8. 1 Mar. 2015
DOI:10.4317/medoral.20203
Reviewer: Tam Vu
Type: Review
Keywords: dental implants, bleeding, complications, treatment, airway, ligation

Purpose: to review immediate or immediate postoperative bleeding complications with dental implants and identify areas of greatest bleeding risk, causes of bleeding, length of implants associated w/bleeding, and treatments provided

Material and methods: electronic database search through May 2014.

Results:

- 15 articles included, avg age = 60 yo
- Immediate bleeding complications most often found in mandibular canine region > incisor zone > premolar zone
- Most common cause of bleeding: **lingual plate perforation** → dmg to sublingual artery
    - Reported implants were 15 mm or longer
- Management:
    - Pressure w/gauze applied to bleeding zone, but only effective in one case
    - **Securing airway** = priority concern of tx
        - 41% of pts were intubated and 47% of cases needed tracheostomy
    - After airway, drainage of hematoma + ligation of bleeding artery
        - Some cases required ligation of facial and lingual arteries due to anastomoses
    - Some docs Rx'ed oral/IV abx
- One case of serious bleeding in Mx after immediate implant placement following indirect sinus lift
    - Tx: pressure w/gauze was ineffective → lateral window + cauterization of posterior superior alveolar artery

Discussion:

- **Mardinger et al**
    - Median distance from sublingual and submental arteries to alveolar crest = 15 mm in incisor and canine region
    - Distance from arteries to lingual cortical plate:
        - 4 mm in chin region
        - 2 mm in area of canines and molars
- Canine region most vulnerable to bleeding complications during implant surgery due to artery' proximity to lingual plate and alveolar crest
- High frequency of lateral and medial lingual canals present in canine area
    - Diameter of canals = 1.2 mm (enough to produce severe sublingual bleeding)

Conclusion: Bleeding complications after dental implant placement is infrequent. Most common in cause is lingual cortical bone perforation in the mandibular zone, causing damage to the sublingual artery. Treatment priority is airway management and control bleeding. Recommend using short implants in the anterior mandible to reduce risk of bleeding complications.

Topic: Lingual concavity-compliations
Authors: Herranz-Aparicio J, Marques J, Almendros-Marqués N, Gay-Escoda C.
Title: Retrospective study of the bone morphology in the posterior mandibular region. Evaluation of the prevalence and the degree of lingual concavity and their possible complications.
Source: Med Oral Patol Oral Cir Bucal. 2016 Nov 1;21(6):e731-e736.
DOI: 10.4317/medoral.21256.
Reviewer: Daeoo Lee
Type: Retrospective
Keywords: Anatomy, computed tomography, dental implants, intraoperative complications, mandible, panoramic radiography, radiographic examination.

Purpose: To evaluate a large series of CT images of mandibular first molar and to study the bone morphology, the prevalence and the degree of the lingual concavity (LC) in the first molar region.

Material and methods:

- 151 CTs from University of Barcelona
- Evaluation
    - Mesiodistally, if the second premolar and molar were present, the cross-sectional view of the middle of the edentulous ridge was selected, otherwise, it was selected the one 5 mm distal to the second mandibular premolar.
    - Cross-sectional morphology 2mm coronal to the inferior alveolar nerve was categorized into one of the following three groups
        - A ridge with a narrow base that expands bucco-lingually to wider crest with a prominent point on the lingual plate (point P)
        - Giving rise to a lingual undercut, was classified as an undercut ridge (U)
        - When no obvious lingual undercut was seen, the ridge was categorized into either the convergent ridge type (C) or the parallel ridge type (P)

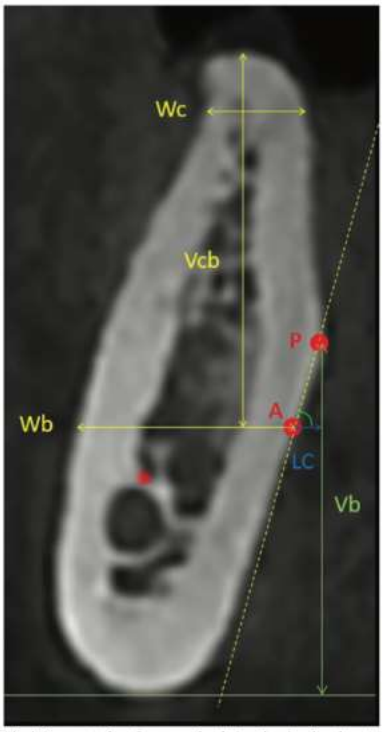


Fig. 1. Demonstration of cross-sectional view showing the relevant

- Statistical analysis

Results:

- The bucco-lingual width 2 mm apical to the alveolar crest (Wc) was 10.6± 2.1 mm (M) and 9.7±1.6 mm (F) and the difference between genders was not significant (p>0.05).
- The mandibular width 2 mm coronal to IAN (Wb) was 11.8±2.7 mm (M) and 11.49±2.1mm (F) (p<0.05).
- The vertical height from alveolar crest to 2 mm coronal to IAN (Vcb) was 14.6±2.8 mm (M) and 13.5±2.4 mm (F) (p>0.05).
- Types
  - **The U type was present in 64.2% (n=97)**
  - The second was the P group presented in 22.5% (n=34)
  - Type C was only present in 13.2% (n=20).
- Angle
  - The concavity angle was **66.6±8.9° (M) and 71.6±8.4°(F)**
- Linear concavity depth (LC)
  - 4.5±2.3 mm and 3.1±1.7 mm (p>0.05).
- The vertical distance from alveolar crest to line A (Vcb)
  - 14.6±2.8mm (M) and 13.5±2.4mm (F) (p<0.05)
- Distance from point P to the inferior mandibular border (Vb)
  - 21.4±3.6mm (M) and 19.5±3.1mm (F).
- A negative correlation was found between age and the bucco-lingual width 2 mm apical to the alveolar crest (Wc) and also between age and linear concavity depth (LC) (p<0.05)

Conclusions:

Lingual concavity with undercut is present in most mandibles which present a potential increased risk of lingual cortical perforation during implant placement surgery.

Topic: Arteries floor of the mouth
Authors: Katsumi Y., Tanaka R., Hayashi T., Koga T., Takagi R., Ohshima H.
Title: Variation in arterial supply to the floor of the mouth and assessment of relative hemorrhage risk in implant surgery
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Reviewer: Cyrus J Mansouri
Type: Cadaver study
Keywords: arteries, cadaver, dental implantation, dissection, humans, mandible

Purpose: To clarify arterial courses of the submental and sublingual aa. and their topographic relation to the mylohyoid m., sublingual gland, and the mandible.

Material and methods:
27 adult Japanese cadavers were used for the study (14 men and 13 women; 61-101 years of age).
- Submental a. was dissected from the facial a. to branches perforating the mylohyoid m. or taking a roundabout course to the floor of the mouth.
- Sublingual a. was dissected from lingual a. to branches supplying the floor of the mouth.
- The relationship was investigated between the submental and sublingual aa. and the mylohyoid m., sublingual gland, and mandible.
- Artery diameters were measured with a caliper and compared.

Results:
Course patterns of submental and sublingual aa.
Classified by their relationship with the mylohyoid m. and mandible (type I-IV) and subtyped (A and B) according to relationship with the sublingual gland.
- Subtype A: arteries ran medial to the gland.
- Subtype B: arteries ran lateral to the gland.

Type I: sublingual space supplied by a large branch of sublingual a (63%)
- Ratio subtype A:B was 31:3

Type II: sublingual space supplied by both sublingual and submental aa. (5.6%)
- Ratio subtype A:B was 3:0

Type III: sublingual space supplied by submental a. without the sublingual a. (29.6%)
- Ratio subtype A:B was 6:10

Type IV: sublingual space supplied by submental a. without the sublingual and deep lingual aa. originated from the lingual a. (1.8%)
- Ratio subtype A:B was 0:1

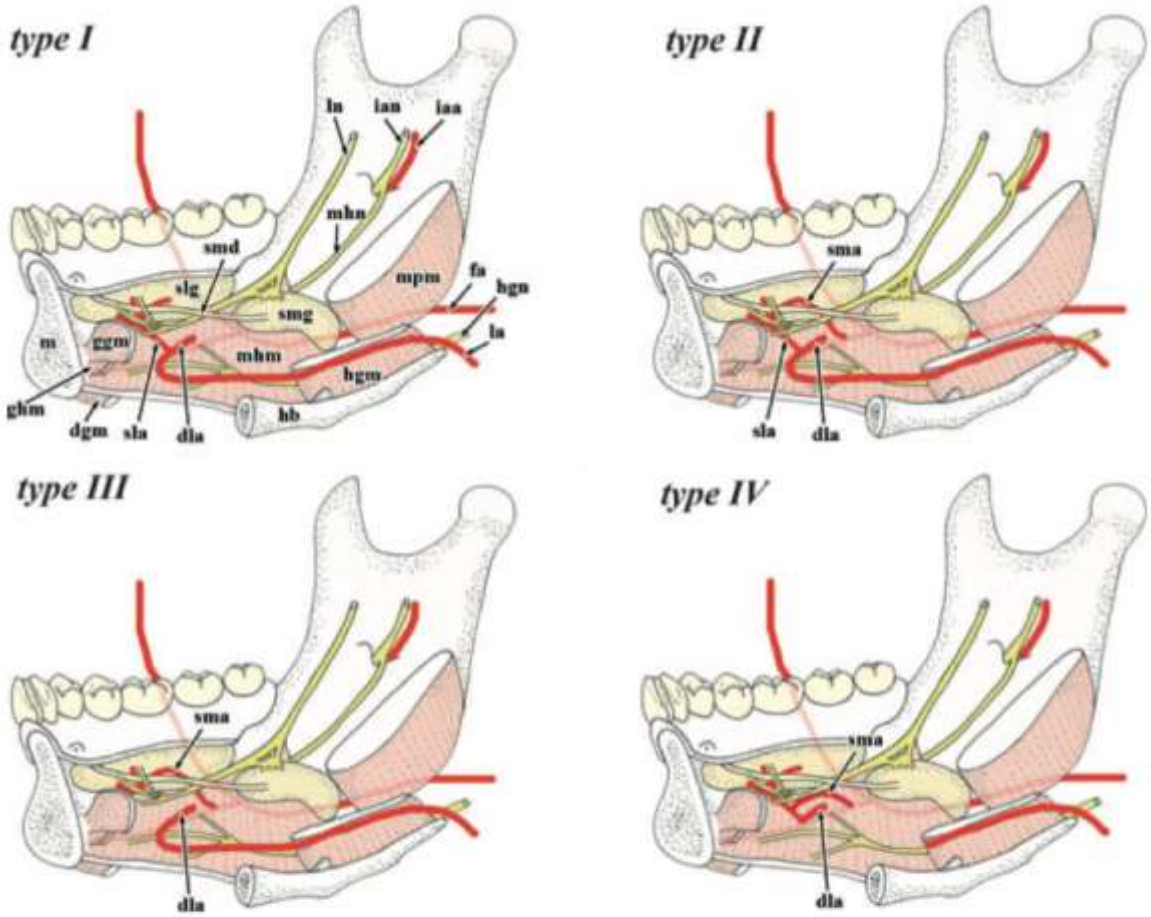

Fig. 1. Courses patterns of submental and sublingual arteries: the courses of submental and sublingual arteries are divided into four patterns: (1) the sublingual space is supplied by the sublingual artery (type I), (2) it is supplied by both the sublingual and submental arteries (type II), (3) it is supplied by the submental artery without the sublingual artery (type III), and (4) type III without the deep lingual artery originated from the lingual artery (type IV). dgm: digastric muscle, dla: deep lingual artery, fa: facial artery, ggm: genioglossus muscle, ghm: geniohyoid muscle, hb: hyoid bone, hgm: hyoglossus muscle, hgn: hypoglossal nerve, iaa: inferior alveolar artery, ian: inferior alveolar nerve, la: lingual artery, ln: lingual nerve, m: mandible, mhm: mylohyoid muscle, mhn: mylohyoid nerve, mpm: mesial pterygoid muscle, sma: submental artery, sla: sublingual artery, slg: sublingual gland, smd: submandibular duct, smg: submandibular gland.

In types II, III, IV, the submental a. perforates the mylohyoid m. or takes a roundabout route above the mylohyoid m. to travel rear the surface of the mandible.

Diameters of arteries and the branch patterns.

A significant difference was found between diameter of lingual artery and patterns, listed in tables below. Arteries were generally 1.6-2.3 mm in diameter.

Table 3. **The relationship between the diameters (mm) of facial and lingual arteries and the branch patterns of both arteries**

Both genders	Facial arteries	Lingual arteries
type I (n = 34)	2.21 ± 0.44	1.99 ± 0.37**
type III, IV (n = 17)	2.11 ± 0.42	1.67 ± 0.31**
Total (n = 51)	2.17 ± 0.43	1.88 ± 0.38

**$P < 0.01$

Table 4. **The comparison of the diameters (mm) of facial and lingual arteries between men and women**

Gender	Facial arteries	Lingual arteries
Males (n = 28)	2.28 ± 0.39*	2.02 ± 0.37**
Females (n = 26)	2.05 ± 0.45*	1.71 ± 0.31**
Total (n = 54)	2.17 ± 0.43	1.87 ± 0.38

*$P < 0.05$, **$P < 0.01$

Table 5. **The relationship between the diameters (mm) of facial and lingual arteries and the branch patterns of both arteries in men and women**

	Facial arteries	Lingual arteries
Men		
type I (n=22)	2.29 ± 0.42	2.07 ± 0.37
type III, IV (n=5)	2.36 ± 0.09	1.88 ± 0.38
Total (n=27)	2.30 ± 0.38	2.03 ± 0.37
Women		
type I (n=12)	2.06 ± 0.44	1.85 ± 0.35*
type III, IV (n=12)	2 ± 0.45	1.58 ± 0.24*
Total (n=24)	2.03 ± 0.44	1.72 ± 0.32

*$P < 0.05$

Table 6. **The relationship between the diameters (mm) of facial, lingual, and submental arteries and the branch patterns of facial and lingual arteries in nine human cadavers in 2011 (type II [n = 1] is excluded)**

Both genders	Facial arteries	Lingual arteries	Submental arteries
type I (n = 12)	2.35 ± 0.30	2.18 ± 0.34**	1.33 ± 0.30**
type III (n = 5)	2.10 ± 0.24	1.70 ± 0.24**	1.80 ± 0.22**
Total (n = 17)	2.28 ± 0.30	2.04 ± 0.38	1.47 ± 0.34

**$P < 0.01$

Discussion: In the context of implant surgery, the sublingual and submental arteries and susceptible to life-threatening hemorrhage in the floor of the mouth.

- 25.9% of the arteries traveling in the sublingual space were located between the sublingual gland and the mandible. Perforation of the sublingual fossa during implant surgery in these cases could result in injury to the artery.
- The submental artery is more susceptible to injury in types II-IV compared to the sublingual a. in type I.
- Several anastomosed veins were also present in the dissections and are susceptible to injury and delayed hemorrhage.
- Damage to the lingual foramen in the mandible has been suggested to be another risk of hemorrhage during implant surgery, however it is suggested the vessels are thin enough to not represent a significant risk.

Conclusion: The submental artery in type II, III, and IV is susceptible to injury during implant surgery. Enhanced CT is available to clinicians to understand the variation of submental and sublingual arterial supply.

Author: Misch CE, Resnik R.
Title: Mandibular nerve neurosensory impairment after dental implant surgery: management and protocol.
Source: Implant Dent. 2010 Oct;19(5):378-86.
DOI: 10.1097/ID.0b013e3181effa92.
Type: Guideline
Reviewer: Veronica Xia
Keywords: mandibular nerve damage, management

Purpose: To present guidelines for diagnosis and management of mandibular nerve neurosensory deficits (including referral) after dental implant surgery

Discussion:

Peripheral Nerve Anatomy/Histology

- Trigeminal nerve (CN 5) has 3 divisions
    - Ophthalmic (V1), maxillary (V2), mandibular (V3)
    - Mandibular is most common branch involved with neurosensory disturbances after implant surgery
        - Carries sensory info from lower lip, chin, lower teeth (and associated soft tissues), mandibular bone, and external ear
        - Also carries motor function (muscles of mastication, tensor tympani muscles of ear, and tensor veli palatine muscles of soft palate) → not affected since fibers separate from V3 before exiting skull
        - **INJURY occurs after nerve enters lingula of mand ramus and anywhere along path in mand body/at exit from mental foramen**
- Individual nerve fibers are grouped into fascicles, which is surrounded by thin, dense, multilayered CT sheath (perineurium), which protect the nerve from compressive/stretching forces
- **Main concern with injury of IAN is altered sensory function (touch, pressure, temperature, or pain) after implant surgery**

Terminology of sensory disturbances

- used to describe, diagnose, and treat nerve injury

Table 1. Description of Neurosensory Impairment Deficits[13]

Anesthesia	Total loss of feeling or sensation
Dysesthesia	Abnormal sensation which is unpleasant
Allodynia	Pain due to a stimulus that does not normally provoke pain
Hyperpathia	Abnormally painful reaction to a stimulus
Causalgia	Persistent burning pain
Anesthetic dolorosa	Pain in an area that is anesthetic
Paresthesia	Abnormal sensation that is not unpleasant
Hypoesthesia	Decreased sensitivity to stimulation
Hyperesthesia	Increased sensitivity to stimulation
Hypoalgesia	Decreased response to a stimulus that is normally painful
Hyperalgesia	Increased response to a stimulus that is normally painful
Synesthesia	Sensation felt in an area when another area is stimulated

Neurosurgery Classifications

- Helpful to determine type of treatment
- Difficult for dentist to predict amount of neural damage/resulting neurosurgery deficit

Table 2. Neurosensory Impairment Classification and Injury Response[14,15]

Sunderland	Seddon	Description	Causes	Responses	Recovery Rate
I	Neurapraxia	Temporary interruption of nerve transmission "conduction block."	Nerve compression, edema, hematoma, minor stretching, thermal	Neuritis, paresthesia	Fast (days–12 wk)
II	Axonotmesis	Endoneurium, perineurium, and epineurium remain intact. Some axon degeneration may occur.	Nerve compression, traction, hematoma, partial crush, edema, stretching	Paresthesia, episodic dysesthesia	Variable usually (2–4 mo) but may be incomplete
III		Disruption of axon and connective tissue (endoneurium) causing disorganized regeneration. Walter degeneration occurs.	Crush, puncture, severe hematoma, stretching	Paresthesia, dysesthesia	Slow (months, incomplete)
IV		Damage involves entire fascicle. Axonal, endoneurium, and perineurium changes occur. The epineurium is intact. Scar tissue formation.	Full crush, extreme stretching, high thermal, direct chemical trauma	Hypoesthesia, dysesthesia, neuroma formation	None
V	Neurotmesis	Complete transaction or tear of the nerve with amputation neuroma forming at injury site.	Complete transaction	Anesthetic, intractable pain, neuroma formation	None

Related Host/Local factors

- Type of injury is most significant local factor relating to neurologic response
    - areas at more proximal sites are more significant (ramus) than distal sites (mental foramen)
- less traumatic injuries associated with early paresthesia/dysesthesias
    - stretching >30% puts pressure on axon and lead to damage
- more severe injuries result in anesthetic lesions and poor orofacial function
- females and older patients are at greater risk of neurosensory deficits

Pharmacologic Therapy

- acute nerve injuries
    - corticosteroids
        - **adrenocorticosteroids (ie dexamethasone 8-12mg)** shown to minimize neuropathy after nerve injuries if administered in high doses within 1 week of injury
        - tapering dose of corticosteroid for 5-7 days used after trigeminal nerve injury
    - NSAIDS
        - Inhibit prostaglandin synthesis from damaged nerve endings (which normally sensitize nociceptive fibers)
        - **Use NSAIDS as adjunct to corticosteroids for 1-3 weeks**
    - **Initially altered sensation:**
        - **Start with steroid treatment, then high dose NSAIDS (ie 600-800 ibuprofen 3xday for 3 weeks)**

Initial Management of Neurosensory Impairment

- Cryotherapy applied to minimize secondary nerve injury from edema induced compression, decrease metabolic degeneration rate of trigeminal ganglion cells, slow neuroma formation

Table 3. Neurosensory Deficit Treatment Algorithms

Time	Documentation	Pharmacologic Intervention	Treatment	Referral to Nerve Specialist
During surgery				
Nerve injury suggested (*i.e.*, compression)	Radiographic evaluation	Dexamethasone (4 mg/mL) topically 1 mL Dexamethasone 4 mg 2 tablets AM for 3 d 1 tablet AM for 3 d Cryotherapy (1 wk)	Implant removal or reposition if impingement within mandibular canal	No
Nerve transection (observed)		Dexamethasone (4 mg/mL) topically 1 mL Dexamethasone 4 mg 2 tablets AM for 3 d 1 tablet AM for 3 d Cryotherapy (1 wk)	Implant removal or reposition if impingement within mandibular canal	Yes
1 wk Postoperatively	Neurosensory examination (testing should be continued every 2 wk)	High-dose NSAIDs (600–800 mg ibuprofen three times a day)	Palliative	Yes, if dysesthesia or complete anesthesia
12 wk Postoperatively	Neurosensory examination	PRN	Palliative	Yes, if no sign of improvement

Postop Management of Neurosensory Deficits

- Neurosensory testing
  - Comprehensive sensory evaluation completed when neurosensory deficit noted
  - Identify deficit, define/quantify extent, record baseline for recovery, determine whether referral necessary
- 2 categories of testing: nociceptive and mechanoreceptive
  - Compared to contralateral uninjured side (control)

- Nociceptive

Fig. 1. Pin-prick test: A 27-gauge needle is used to test for pressure detection and anesthesia/paresthesia/dysesthesia.

Fig. 2. Temperature sensitivity test: A heated or cooled mirror handle is used to evaluate hot or cold sensation.

- Mechanoceptive

Fig. 4. Direction of movement test: A soft brush is used (with patient's eyes closed) to determine sensation and direction of movement.

Fig. 5. Two-point discrimination test: A caliper is used to discriminate varying distances between 2 points.

Fig. 3. Static touch detection test: A cotton swab is used to determine absence or presence of sensation.

- If initial exam within 1 week from surgery

    - **Course of steroids (Decadron), then 3weeks from high dose NSAIDS (600-800mg 3xday for 3 weeks)**
        - **If necessary, add an additional 3 weeks of NSAIDS**
- If paresthesia present, neurosensory exam repeated every 2-3 weeks
- Improvement most often occurs by 2-3 months
    - If not improvement by 3-4 months, prognosis is poor
- Referral when:
    - Known transection of nerve (at time apply dexamethasone) and immediate referral to specialist for microsurgical repair
    - Patients with dysesthesia/complete anesthesia at initial exam after surgery
    - Paresthesia patients after 3 months if not improvement