

Implant Literature Volume 3

Anatomical aspects of sinus floor elevations.

Authors: van den Bergh JP, ten Bruggenkate CM, Disch FJ, Tuinzing DB.

DOI: 10.1034/j.1600-0501.2000.011003256.x.

Purpose: To review anatomy of sinus and considerations relevant to sinus elevation surgery.

Key Findings:

- *Anatomy of the maxillary sinus:*
- *Internal Lining: a thin mucosa of "ciliated" respiratory epithelium, Continuous with that of the nose*
- *Normal antral mucosa is thinner (approximately 1 mm thick) and less vascular than the nasal mucosa*
- *Ostium: situated at the cranial side and connects the maxillary sinus to the middle meatus of the nasal cavity*
- *Average dimension (adult)- Width: 25-35mm, Height: 36-45mm, Length 38-45mm*
- *Sinus extension in relation to tooth- Anteriorly: canine premolar region, Deepest point: first molar region*
- *Blood supply-From the infra-orbital artery, the greater palatine artery and the posterior superior alveolar artery.*
- *Anastomoses-Of the posterior superior alveolar artery and the infra orbital artery can be found inside the bony lateral antral wall. Also supplies the Schneiderian membrane as well as in the epiperiosteal vestibular tissues*
- *Lymph drainage*
 1. *Via infra-orbital foramen and ostium*
- *Walls of sinus: For elevation- Anterior or buccal wall, Internal or nasal wall*
- *Internal or nasal wall*
- *Maxillary sinus septa-16-58% incidence*
- *Hemorrhages- Three source of arteries: Infra orbital artery, Posterior superior alveolar artery, Greater palatine artery.*
- *Primary alveolar bone height and width*
- *One stage: at least 4 mm of bone height of the original alveolar process*
- *(Misch 1987; Watzek 1996; Ulm et al. 1995).*
- *Second stage: 4-6 mo after sinus floor grafting*

Conclusions: N/A

Maxillary sinus elevation by lateral window approach: evolution of technology and technique

Authors: Wallace SS., Tarnow DP., Froum SJ., Cho SC., Zadeh HH., Stoupe J., Del Fabbro M., Testori T.

DOI: 10.1016/S1532-3382(12)70030-1

Purpose: To review the evolution of technology and techniques available for use in sinus augmentation by the lateral approach. Specifically the trend in biomaterial usage (autogenous bone to bone substitutes) and the simplification of techniques.

Conclusions: Lateral sinus elevation is a predictable procedure, with a reported survival in the high 90th percentile. Rough implants, xenograft, and membranes over the window should be

used. Surgical techniques used in lateral sinus membrane elevation have evolved to reduce soft-tissue complications (bleeding and perforation). Piezoelectric surgery and DASK drills significantly decrease perforation risks.

Sinus augmentation procedure via the lateral window technique-Reducing invasiveness and preventing complications: A narrative review.

Authors: Valentini P, Artzi Z

DOI: 10.1111/prd.12443.

Purpose: Describe different surgical methods via lateral window osteotomy (LWO), decision tree in this approach, and anatomical structures

Key Findings:

- *STEPS:*
- *Surgical assessment*
- *Incision -Crestal incision with VRI FTF vs horizontal vestibular FTF. Vestibular incision favored (less swelling/pain). Numbness possible after VRI due to cutting infra-orbital nerve.*
- *Antrostomy-LWO: convert lateral bony wall of sinus into hinged/moveable door with bur or piezo. Rotated inward/upward with Schneiderian membrane to allow space for bone graft. No advantages to remove bony plate and reposition. Less risk of membrane perforation with piezo, but may have longer surgical time. When blood vessel diameter 2mm, recommend dissect artery with piezo.*
- *Full antrostomy: outlined bony lid completely removed with bur or piezo. NSSD in surgical time with traditional antrostomy. Sig superior mineral apposition/formation rates and higher% new bone with smaller diameter full antrostomy.*
- *Surgical decisions:*
- *Valtntini: late implant failures after LWO+immediate implant with RBH <3mm*
- *Grafting bio-materials-Autogenous bone: high resorptions rate, donor site limitation/morbidity. Allograft/xenografts: high osteoconductivity, resistance to resorption. Raghoobar: NSSD in implant survival rate in native vs augmented sinus, 1 vs 2 stage,*
- *Application of GTR membrane coverage in LWO = controversial. Membrane can reduce lateral graft displacement.*
- *Anatomical considerations-Schneiderian membrane preservation.*
- *Narrower sinus = increased risk of perforation. Esp in anterior area – place window as close to anterior wall as possible*

Conclusions: LWO is safe and predictable. Risk factor: septa, thin membrane, gingival biotype, smoking

Risk factors in lateral window sinus elevation surgery.

Authors: Testori, et al.

DOI: 10.1111/prd.12286

Purpose: To review how the anatomy, behavioral conditions, and pathologic conditions can have implications on maxillary sinus elevation via intraoperative and postoperative complications. Conclusions will be drawn and recommendations will be made based on the findings.

Key Findings:

- *Maxillary Sinus Anatomy and its Surgical Implications*
- *Overview- The medial and anterolateral walls are directly involved with the lateral approach. Anterolateral wall = Can be <1mm thick, contain nerves/vessels/septa/ridges*
- *The Schneiderian Membrane- Is made of pseudo-stratified columnar ciliated epithelium. Mean membrane thickness is 90 microns. Pathology and inflammation can cause thickening and when 4mm on CBCT a referral to ENT is needed*
- *Maxillary Sinus Septa- A risk factor for the perforation of the membrane are antral septa that originate on the sinus floor and extend up the lateral wall.*
- *Septa incidence is 16-58% with an average of around 30%.*
- *Maxillary Sinus Arterial Supply- 3 main arteries derived from maxillary artery= PSA, infraorbital, posterior lateral nasal. Alveolar antral artery vascularizes the anterolateral wall (intraosseous anastomosis between the infraorbital artery and PSA)*
- *Cutting the artery is not life threatening but can result in bleeding complications with limitation to complete the lift when antral artery is 2mm diameter*
- *Presurgical Sinus Assessment: Diagnosing Pathologic Conditions of the Maxillary Sinus*
- *Must look out for nasal obstructions, sinus infections, allergic symptoms, facial trauma, pressure-related discomfort, smell and taste dysfunction, previous nasosinus surgery, respiratory diseases, mouth breathing, facial deformities, scars. In cases with complications listed above and ENT consult is indicated prior to surgery*
- *Odontogenic Sinusitis- In 10% of sinusitis cases there is an odontogenic origin.*
- *Behavioral Conditions Impairing Maxillary Sinus Health Status*
- *Significant correlation is found with smoking 15 cigarettes a day and increased implant failure in grafted sinuses.*
- *Prevention and Treatment of Surgical Complications*
- *Intraoperative Complications- Though frequency is low they often occur due to inadequate assessment pre-operatively, difficult anatomic situations, and operator error. The number one complication is membrane perforation.*
- *Intraoperative Bleeding- Etiology and Incidence: Damaging or severing the vessels that supply the surrounding tissue and lateral wall.*
- *Prevention- Identifying arteries during 3D planning with CBCT to adjust location of the window. Damage to vessels can occur when creating vertical incisions if vessels are outside the lateral wall, when using rotary instruments and coming in contact with the membrane.*
- *Treatment- Direct pressure, bone wax, localized vasoconstrictor, hemostat, suturing vessel, electrocautery (must avoid hitting the Schneiderian membrane)*
- *Schneiderian Membrane Perforation.*
- *Etiology and Incidence- Incidence of 11-56% with rotary instruments. When membrane is <1.5mm perforation rate is higher (41%) compared to ≥ 1.5 (16.6%). An increase of 10% is noted in the presence of septa.*
- *Prevention- Ideal location of the window according to clinicians of great experience is 3mm superior to the sinus floor and 3mm distal to the sloping anterior wall. The use of different instruments like Piezoelectric surgical units or DASK (Dentium Advanced Sinus Kit) can decrease the perforation rate to as low as 5%. Graft containment is key with decreased bone formation (14.2% vs. 33.6%) and decreased implant survival (70% vs. 100%) when containment failure occurs*
- *Treatment of membrane Perforations. Elevate the membrane around the perforation and then place an absorbable collagen membrane to patch the membrane. Closure can also be completed with sutures, PRF, and lamellar bone sheets.*
- *Mucous Retention Cysts. Radiographic abnormalities are present in 38% of cases with 10% being mucous retention cysts. Depending on the size of the cyst it may need to be treated prior to or during surgery. Rule of thumb if 2/3 sinus volume is filled the ostium is likely blocked.*
- *Guidelines for best surgical practices.*
 1. *Extensive pre-op analysis via CBCT*
 2. *Place the window 3mm from the floor and anterior wall*
 3. *Elevate lateral to medial with elevator on bone at all times*
 4. *Use Piezo and DASK*

5. Use collagen membrane or PRF for perforation repair and ensure stability
 6. Remove mucous retention cysts
- Postoperative Complications- Bruising, edema, discomfort, minor epistaxis (nose bleed), mild congestion, minor bleeding from incisions
 - Major complications include sinusitis, graft infections, flap dehiscence, profuse bleeding, oroantral fistula formation, loss of containment of graft, cyst formation, inadequate volume for DI.
 - If complications are not managed properly it can lead to migration of implants, and intraorbital/intracranial abscess.
 - Postoperative Infections-
 - Etiology and Incidence of Sinusitis/Sinus Infections. Post-op infection rate of 2 – 5.6%.
 - Most often infection of the graft material. To avoid, prescribe antibiotics, rule out chronic/existing sinus conditions
 - Prevention of Sinus Graft Infections-
 - Start Augmentin (875/125 mg BID 7-10 days) a day prior to surgery. Avoid Clindamycin and use Levofloxacin or Moxifloxacin in penicillin allergic patients
 - Postoperative Sinusitis- Etiology: Inflammation post-op is common and minor short-term membrane thickening is normal. A reported rate of 3-20% is known for post-op sinusitis with most cases being mild

Conclusions: With proper planning lateral window sinus augmentation can be a highly predictable procedure. Using CBCT and knowledge of sinus anatomy + health can keep complication rates down. The common sources of complication can be reduced with proper case selection, good surgical technique, antibiotics (prophylactic and after).

Importance of ENT assessment in stratifying candidates for sinus floor elevation: a prospective clinical study

Authors: Torretta S, et al.

DOI: 10.1111/j.1600-0501.2011.02371.x

Purpose: To describe a preoperative ENT assessment for SFE, evaluating the sinus compliance by identifying potentially reversible (PREC) or presumably irreversible (PIEC) contraindications to SFE, and the impact on SFE success

Key Findings:

- Results:
- 34 patients (45 SFE). Most patients had absence of nasal conditions, 40% showed impaired middle meatal patency and 28.9% had OMC obstructions.
- PRECs: 38.2% of patients: Chronic sinusitis (20.6%). Foreign bodies with or without maxillary sinusitis (14.7% and 5.9%). Post-traumatic nasal deformities 2.9%. High prevalence of PRECs confirms that many SFE candidates have silent but clinically relevant sinus disease

Conclusions: A preventive/diagnostic ENT protocol for SFE, detecting and correcting PIECs/PRECs, confirming recovery, and assessing sinus compliance, appears effective in reducing complications that can affect implant survival, though larger studies are needed to confirm these results.

Cone-beam computed tomographic analysis of sinus membrane thickness, ostium patency, and residual ridge heights in the posterior maxilla: implications for sinus floor elevation

Authors: Shanbhag, S., et al.

DOI: 10.1111/clr.12168

Purpose: to assess the thickness of the sinus membrane, ostium patency, and ridge height using CBCT and verify if any associations exist between membrane thickness and osteum patency.

Conclusions: Membrane thickening 2mm has a 61% prevalence in partially edentulous patients. Osteum obstruction risks are increased in membranes thicker than 5mm. 50% of edentulous molar sites have a residual ridge height ≤ 4 mm (requiring SFE). CBCT exams evaluating the ostiomeatal complex are effective in sinus evaluation prior to SFE. Pre-op ENT referral might be needed in cases where membrane thickening and polypoidal . Lesions are seen due to their association with osteum obstruction (symptomatic pts and pts w/ a history of chronic sinusitis).

Sinus floor elevation or referral for further diagnosis and therapy: A comparison of maxillary sinus assessment by ENT specialists and dentists using cone beam computed tomography

Authors: Janner S, Dubach P, Suter V, Caversaccio M, Buser D, Bornstein M

DOI: 10.1111/clr.13582

Purpose: To compare ear, nose, and throat specialists' (ENTs') vs. oral surgeons' (dentists') assessments of CBCT scans of maxillary sinuses from asymptomatic patients, and to develop guidelines for ENT referral prior to sinus floor elevation (SFE)

Conclusions: When analyzing sinus CBCTs: If w/o pathology or w/ localized membrane thickness, SFE was deemed possible. If w/ bone resorption suggesting malignancy, bubble formation, or opacification exceeding 50% of antral volume or air-fluid level, ENT referral prior to SFE was recommended. Surgical risk factors: dome-shaped, isolated thickenings, intramural calcifications, or bone wall defects w/ irregular or flat but circumferential mucosal thickenings. SFE was considered challenging. Does not necessarily require ENT referral. May result in post-operative sinusitis. If w/ irregular or flat but circumferential thickenings, ENT referral may be recommended in cases where natural ostium is either not located w/in the FOV (no diagnosis possible) or the ostium appears obstructed. Documentation of ostium patency is needed. 23.6% to 53.6% of maxillary sinus CBCT images showed abnormalities (Havas et al. 1988, Chen et al. 2018); In asymptomatic patients, 55% had thickenings, with flat thickening accounting for most (37%) (Janner et al. 2011). Chronic sinusitis and mucocoeles are associated with SFE complications. If pneumatization and function of the sinus is preserved, implant success remains high despite mucosal thickenings up to 22.8mm (Maska et al., 2017). Drawbacks for increasing FOV: increased radiation dose (ALARA), reduced spatial resolution, and inappropriate training of dentists to assess extraoral structures. Increased FOV did not improve inter-specialist agreement. In all cases of SFE, perioperative preservation of the ostium patency w/ topical decongestants and antibiotics are recommended. ENT and oral surgeon consensus for sinus floor elevation was created, and risk factors for surgical obstacles & post-op sinusitis were identified.

A retrospective study of clinical and radiologic outcomes of 69 consecutive maxillary sinus augmentations associated with functional endoscopic sinus surgery

Authors: Falco A, et al.

DOI: 10.11607/jomi.3757

Purpose: To assess the outcomes of a single-stage surgical approach combining functional endoscopic sinus surgery (FESS) with lateral window sinus elevation (LWSE) in patients with reversible contraindications.

Conclusions: A combined single-step involving FESS and LWSE is a predictable method for managing pts with reversible sinus pathology who require post. Mx. bone augmentation while reducing overall treatment time and patient morbidity.

Does a Severely Resorbed Subantral Ridge Decrease Long-Term Implant Survival Rate with Sinus Floor Augmentation?

Authors: Niu, L., Yu, H., Wang, J., Tang, Y., Qiu, L.

DOI: 10.11607/jomi.9453

Purpose: To evaluate the impact of residual bone height on implants surviving 5 years and investigating prosthetic complication rates in patients who underwent a maxillary sinus grafting procedure.

Key Findings:

- 52 sinuses were included in the test group, 52 in the control
- Average residual bone height pre-operatively:
- Test: 1.8mm. Control: 4.1mm
- Surgical complications: no significant difference--
- Sinus membrane perforations - 3 in the test group and 2 in the control

Conclusions: Patients with a residual bone height of less than 3mm do not have an increased risk of membrane perforation, survival rate of implants, prosthetic complication rates, or change in grafted bone height after 5 years of functional loading.

Split-Thickness Flap for the Management of a Maxillary Sinus Wall Bony Fenestration During Lateral Window Sinus Augmentation: Case Reports and Technical Surgical Notes.

Authors: Testori T, Yu SH, Scaini R, Rosano G, Tavelli L, Del Fabbro M, Francetti L, Wang HL.

DOI: 10.11607/prd.5571.

Purpose: To present split-flap surgical technique to manage soft tissue adhesion b/t the sinus membrane and alveolar mucosa when doing lateral window sinus augmentation.

Key Findings:

- Risk factors for sinus membrane perforation during surgery: Sinus membrane thickness, maxillary sinus configuration, Sinus septa, Residual bone height, Surgical technique, Location and size of the alveolar antral artery. During reentry surgery following previous

aborted sinus augmentation, sinus membrane is more likely to heal with scar or fibrotic tissues. Increased difficulty to elevate the membrane.

Conclusions: Rentry Surgery more difficult due to adhesions. Use of barrier membrane helps to minimize the issue.

Maxillary Sinus Elevation Difficulty Score with Lateral Wall Technique

Authors: Testori T., Tavelli L., Yu SH., Scaini R., Darnahal A., Wallace SS., Wang HL.

DOI: 10.11607/jomi.8034

Purpose: To present a comprehensive pre-surgical maxillary sinus floor elevation difficulty (MSED) score based on comprehensive patient- and surgical-related, anatomical factors, and the author's experience.

Key Findings:

- *Sinus membrane thickness. Patients with membrane perforation had thinner membranes compared to no perforation (0.84mm vs 2.65mm). CBCT tends to overestimate membrane thickness compared with histologic findings by 2.5x.*
- *Presence of sinus septum. The presence of sinus septum poses increased incidence of membrane perforation.*
- *Direction of sinus septa. Mediolateral / transverse direction of septa is more common (59.2%-87.6% of septa).*
- *Mediolateral septa are significantly more easy to deal with surgically than anteroposterior septa. Residual bone height. Perforation risk is increased when residual ridge height is < 4 mm. Sinus width. Increased perforation rates are found when the angle between the lateral and medial walls is < 30 degrees compared with 30 and 60 degrees (28.6% and 0% respectively). Alveolar antral artery. The alveolar antral artery is estimated to be extraosseous in 44% of cases. Buccal wall thickness of the maxillary sinus. When buccal wall is 2 mm in thickness, increased risk of perforation is found when using rotating instruments.*
- *Patient-related factors.*
 1. *Smoking is associated with a higher incidence of perforation and postoperative complications such as sinusitis and wound dehiscence. Effect of smoking on implant survival in augmented sinuses is controversial. Pre-operative chronic sinusitis is a contraindication to lateral sinus elevation.*

Conclusions: The maxillary sinus floor elevation difficulty score offers a systematic and comprehensive method of assessing the complexity of maxillary sinus augmentation via a lateral approach prior to performing the procedure. It informs the clinician of the expected effort of the surgery and the expected risks of membrane perforation and other intrasurgical complications.

Piezoelectric surgery vs rotary instruments for lateral maxillary sinus floor elevation: a systematic review of and meta-analysis of intra- and postoperative complications .

Authors: Atieh MA , Alsa Beeha NH , Tawse-Smith A , Faggion CM Jr , Duncan W .

DOI: 10.11607/jomi.3895.

Purpose: evaluate use of piezo vs conventional drills with regards to intraop complications, operating time, and implant failure (posterior maxilla after lateral max sinus floor elevation-LMSFE)

Conclusions: Piezo and conventional rotary are equally viable techniques for LMSFE with similar perforations rates and risks of implant failure.

Influence of lateral window dimensions on vital bone formation following maxillary sinus augmentation

Authors: Avila-Ortiz, et al.

DOI: N/A

Purpose: To evaluate if there are differences in bone outcomes following sinus augmentation due to changes in lateral window dimensions.

Conclusions: The size of the window may have affect on bone grafting consolidation and maturation . Smaller window = more vital bone and Larger window = more residual particles. Smaller window size may allow for greater migration of osteogenic and osteoclastic cells from local native bone due to increased angiogenesis.

Low Window Sinus Elevation Technique: Bone Gain and Postsurgical Discomfort. A Retrospective Case Series.

Authors: Zaniol T, et al.

DOI: 10.11607/prd.5731

Purpose: To evaluate the correlation between osteotomy size and immediate bone gain, pain, hematoma, and swelling following sinus augmentation using the Low Window technique.

Key Findings:

- *Surgical protocol*
 1. *ATB prophylaxis*
 2. *FTF w/o vertical incisions*
 3. *Window prepared using piezoelectric tips using surgical guide*
 4. *Sinus membrane elevated and protected with a barrier membrane*
 5. *Cortico-cancellous bone graft inserted into sinus*
 6. *Membrane placed to protect graft*
 7. *In one-stage cases, implants placed before cavity fully filled*
 8. *Flap sutured with resorbable 4-0 sutures*
 9. *In two-stage cases, implants placed 4–6 months after grafting*
- *Technique advantages- Minimally invasive, reduces clinical trauma compared to traditional methods. Likely due to absence of vertical incisions, reducing postoperative swelling*

Conclusions: The Low Window technique is a minimally invasive sinus surgery approach that reduces clinical trauma and postoperative discomfort while achieving similar bone gains and medium-term implant and prosthetic success compared to traditional approaches.

Histological and clinical outcomes of lateral sinus floor elevation with simultaneous removal of a maxillary sinus pseudocyst

Authors: Yu, H., et al.

DOI: 10.1111/cid.12708

Purpose: discuss a new technique for maxillary pseudocyst removal and simultaneous sinus floor elevation.

Key Findings:

- *Surgery: Crestal and vertical releasing incisions completed, FTF elevated, small lateral window completed*
- *and the sinus membrane was intentionally perforated. Pseudocyst fluid was aspirated w/ a fine needle*
- *and the lesion was removed with tissue pliers . Additional*
- *standard size window created to elevate the sinus membrane. Absorbable collagen membrane placed over the membrane and grafted w/ large particle Bio-Oss. 17 pseudocysts from 15 pts completed the study with a survival rate of 97% (1 failed prior to loading).*

Conclusions: This technique is successful in the removal of a maxillary pseudocyst together with sinus floor elevation.

Title Prevalence and management of Schneiderian membrane perforations during sinus-lift procedures.

Authors: Hernández-Alfaro F, Torradeflot MM, Marti C.

DOI: 10.1111/j.1600-0501.2007.01372.x.

Purpose: To evaluate retrospectively the prevalence of surgical complications of the sinus graft procedure proposing a protocol to repair sinus membrane perforations intraoperatively using variety of technique and materials.

Key Findings:

- *Perforations treated by: Depending on perforation size*
- *<5 mm: direct suturing of the membrane with 6/0 Vicryl or patching with a collagen membrane (BioGide)*
- *5 – 10 mm: resorbable collagen membrane was used, and the lamellar bone from the sinus window was placed under perforation before insertion of the graft material*
- *10 mm: Covered with lamellar bone of the lateral sinus window. Or, Covered with a pedicled buccal fat pad flap, Or, Placement of a bone block graft harvested from the symphysis of the mandible or the retromolar area.Implants site prepared and placed.*
- *Summary: 272 DI placed under perforation. 247 survived (90.81%)*

Conclusions: Perforation of Schneiderian membrane is the most prevalent intra-operative complication associated with the sinus elevation procedure. Perforation may be addressed using various method with an overall survival rate of implant simultaneous placed (90.81%)

A Simplified Classification and Repair System for Sinus Membrane Perforations

Authors: Fugazzotto PA., Vlassis J.

DOI: 10.1902/jop.2003.74.10.1534

Purpose: To describe a simplified classification and repair system for dealing with sinus membrane perforations and achieve predictable sinus augmentation.

Key Findings:

- *Perforations of the sinus membrane:*
- *Membrane classifications may be classified according to location.*
- *Class I perforations – occur anywhere along the apical wall of the prepared lateral window.*
- *Class II perforations – at the lateral aspects of the window (but not the apical portion)*
- *Class III perforations – occur anywhere within the body of the window*
- *Class I repair- Poses no concern for therapy success if managed correctly. Clinician must not apply pressure to area of the perforation to avoid increasing the tear size. Surgery should otherwise continue without modification, as the Schneiderian membrane will “fold over itself” and “seal” the perforation. A collagen tape may be placed over the area to alleviate any concerns.*
- *Class II repair- Management of perforations at the periphery depend on the position of the perforation in relation to the bordering walls of the sinus cavity. If the window was designed to be precisely bordering the sinus cavity walls, repair is more difficult and may complicate the therapy.*
- *IIA perforations – when the outlined window is at least 4-5 mm from the borders of the sinus cavity. Care is taken to extend the osteotomy and expose the intact sinus membrane peripheral to the perforation. Collagen tape or membrane may be used to cover the perforation prior to placing biomaterials.*
- *IIB perforations – when the outlined window is approximately at the border of the sinus cavity. No space exists the extend the osteotomy. A bioabsorbable membrane may be used to create a pouch to act as a vessel for the grafting biomaterials.*
- *Class III repair- The same approach is used as class IIB perforations, creating a pouch using a bioabsorbable membrane.*

Conclusions: Sinus membrane perforations may be successfully managed during sinus augmentation to result in successfully augmented sinuses where implants may be inserted.

Maxillary sinus membrane repair: update on technique for large and complete perforations.

Authors: Pikos MA.

DOI: 10.1097/ID.0b013e318166d934.

Purpose: Report on modification of a previously published technique that can be used for predictable repair of large and complete sinus membrane perforations

Key Findings:

- *Max sinus membrane perforation and repair -*
- *Perforation is most common complication (10-56%). Management options: suturing, collagen membrane, fibrin sealants, freeze dried human lamellar bone sheets, and oxidized regenerated cellulose*
- *Surgical technique for large and total perforations -*
- *Use slow resorbing collagen membrane with adequate structural integrity . Outline bony window and remove to visualize membrane . After elevating sinus membrane, modify 30x40 biomend membrane with 1cm slits at each rounded corner. Place membrane and stabilize with external tacks . Important not to cover bony floor or inferior segment (10mm) of bony walls*

Conclusions: Application of slow resorbing collagen membrane can be used for repair of large/small sinus membrane perforations and instances where no membrane exists. External tacks allow for membrane fixation

Effect of maxillary sinus membrane perforation on vital bone formation and implant survival: a retrospective study

Authors: Froum, et al.

DOI: 10.1902/jop.2012.120458

Purpose: To evaluate the effect perforation of the sinus membrane has on vital bone percentage along with implant survival

Key Findings:

- *During augmentation 15 sinuses (37%) had perforation complications with 25 having non-perforated sinuses. Vital bone percentage was 19.1% in non-perforated cases and 26.3% in perforated cases. Vital bone was 28.25% for MCBA, 12.44% for ABBM, and 30.6% for BCP. Implant success rate was 100% (35/35) in perforated cases vs. 95.5% (43/45) in non-perforated cases.*

Conclusions: From the results of the study it is possible that increased vital bone formation can be found after perforation of the Schneiderian membrane during lateral window sinus augmentation. Higher vital bone formation is hypothesized to be attributed to the additional barrier used. This may help prevent migration of soft tissue and contain graft material. No significant difference was found in implant survival for perforation vs. no perforation cases

The impact of anatomic, patient and surgical factors on membrane perforation during lateral wall sinus floor elevation.

Authors: Pizzini A, et al.

DOI: 10.1111/clr.13698.

Purpose: to analyze how often membrane perforation (MP) is found in LWSFE, mean anatomical landmarks, and associations between MP and patient, anatomy and surgical procedure

Key Findings:

- *lateral wall thickness (LWT), lateral (L) and medial (M) , anterior wall (A) , angle of the lateral/medial walls in relation to the sinus floor (LFM), angle of the lateral/medial walls in relation to the anterior wall (LAM). Association with MP- Lowest MP with LWT <1.5mm (14%). Significantly higher when LWT 1.5-2mm (39.3% OR=4.0) and 2mm (34.1% OR=3.19). LFM angle: <90 degr. 29% - 90-100 35% - 100 degr 36% . When LFM angle <90 degrees higher MP 38% OR=2.36 . LAM angle average 68.2 degr when MP occurred. In LAM <70 degr OR=7.61. LM-5 distance, average width was 11.4mm when MP occurred . When <10 OR=3.29 times higher than 12mm or 2.54 times when 10-12mm. WSA average 78.6mm² associated with MP; when absence 63.1mm². Large window 80 mm² greater rate of MP 36.4%. More MP when pathology presence and septa and PSA/IOA was not related to MP*
- *MP risk increases with thick lateral walls (1.5 mm) and unfavorable anatomy. Narrow LFM (<90°) and LAM angles markedly raise perforation rates (≈38% and ≈60%). Placing the window close to the sinus floor facilitates safer membrane elevation.*

Conclusions: MP is significantly associated with thick LWT, narrow LAM/LFM angles, narrow sinus width, sinus pathology, and large window size. Extra caution is needed in these cases, with the window placed near the anterior wall and sinus floor to reduce perforation risk.

The influence of different forms of sinus membrane perforation on the prevalence of postoperative complications in lateral window sinus floor elevation: A retrospective study.

Authors: Krenmair, et al.

DOI: DOI: 10.1111/cid.13056

Purpose: to assess post-operative complication (PC) prevalence after lateral window sinus floor elevations (SFE) that either had sinus membrane perforations (SMP) or not.

Key Findings:

- *Maxillary sinusitis (MS), Sinus membrane biotype/thickness (BT), 4 subgroups: thick BT/small-mod (SMP1), thin BT/small-mod (SMP2), thick BT/large (SMP3), thin BT/large (SMP4).*
- *Risk factors: MS and GN did not significantly vary based on sex, smoking status, sinus side, presence of septa, surgical stage (1 vs. 2), previous surgeries, and SFE dimension (length). MS and GN significantly more frequent in group B vs. A (71.4% vs. 28.6% and 87.5% vs. 12.5% respectively). Thin sinus membranes significantly more frequent in MS and GN cases. Large SMP ($\geq 10\text{mm}$) was significantly related to a thin membrane (OR 18) and post-op complications*

Conclusions: PC prevalence is significantly influenced by the form of perforation – more likely in large perforations ($\geq 10\text{mm}$) and thin sinus membranes ($< 1.5\text{mm}$) vs. no or small perforations

Prevalence, risk factors, and repair mechanism of different forms of sinus membrane perforations in lateral window sinus lift procedure: A retrospective cohort study

Authors: Krennmair S, Gugenberger A, Weinländer M, Krennmair G, Malek M, Postl L

DOI: DOI: 10.1111/cid.13016

Purpose: To assess the prevalences, risk factors, and repair techniques for sinus membrane perforations (SMP) during lateral window (LWT) sinus floor elevation (SFE).

Key Findings:

- *Overall SMP incidence of 24% at SFE level (103/434) and 27% at patient level (94/355). SMP4 prevalence greater vs. all others ($p < .001$) (45.6%). SMP3 prevalence rarer vs. all others ($p < .001$) (4.8%). NSSD between large ($n=52$, 50.5%) vs. small-moderate ($n=51$, 49.5%) prevalences. Thin SMPs ($n=71$, 68.9%) thick SMPs ($n=32$, 31.1%) ($p < .001$). In SMP4 groups, residual ridge height (OR: 1.79), maxillary sinus septa (2.43), and previous oral surgery interventions (OR: 4.425) were identified as significant risk factors. 50% of all perforations were only of small-moderate size and were easy to repair.*
- *Larger perforations w/ thin membranes had the most complication incidence (47%), requiring unique repair technique.*

Conclusions: Perforation size along with thickness of the sinus membrane should be considered when attempting perforation repair. A thin membrane with a large perforation is challenging to repair and is associated with risk factors: sinus septa presence, reduced residual ridge, and previous surgical interventions.

The Effectiveness of L-PRF in the Treatment of Schneiderian Membrane Large Perforations: Long-Term Follow-Up of a Case Series

Authors: de Almeida Malzoni CM, et al.

DOI: 10.1563/aaid-joi-D-20-00044

Purpose: To assess the long-term clinical and radiographic outcomes of leukocyte- and platelet-rich fibrin (L-PRF) for repairing large Schneiderian membrane (SM) perforations during max. sinus floor aug (SFA).

Conclusions: Repair of large SM perforations using L-PRF membranes was successful, enabling stable implant osseointegration w/o signs of infxn over a 3-5 yr f/u period.

Clinical and radiographic outcomes of reentry lateral sinus floor elevation after a complete membrane perforation

Authors: Wang, D., Tian, J., Wang, Y., Wei, D., Lin, Y.1.

DOI: 10.1111/cid.12932

Purpose: To assess the long-term clinical outcomes of re-entry lateral sinus floor elevation (LSFE) and the associated radiographic changes following complete membrane perforation. Also, to clarify the technical aspects of the re-entry procedure and its surgical outcomes.

Key Findings:

- *Average residual bone height: 3.83 mm for 1st procedure and 3.73 mm at re-entry. Average thickness of lateral bone: 1.29 mm. Thickness of sinus membrane: 1.03 mm for 1st procedure and 1.91 mm at re-entry. Height of bone graft after re- entry: 9.73 mm*

Conclusions: The long-term outcomes of re-entry LSFE are predictable, making it a reliable option even after complete membrane perforation.

Perforation Risk Assessment in Maxillary Sinus Augmentation with Lateral Wall Technique.

Authors: Testori T, Yu SH, Tavelli L, Wang HL.

DOI: 10.11607/prd.4179.

Purpose: To describe presurgical sinus assessment score based on risk of perforation.

Key Findings:

- *Anatomy-Related Risk Factors for perforations*
- *Sinus Membrane Thickness- Average sinus membrane thickness: 1mm, CBCT overestimate 2.5x, Thicker membrane tolerates higher forces than thinner ones. Excessive thickness may represent a pathologic condition and may result in a higher chance of perforation.*
- *Presence of Sinus Septa- Presence frequency: 28.4% - 44.8%, Multiple septa: 4.2%*
- *Direction of Sinus Septa- Mediolateral direction (transverse): 59.2% to 87.6%*

Conclusions: N/A

Association Between Sinus Membrane Thickness and Membrane Perforation in Lateral Window Sinus Augmentation: A Retrospective Study

Authors: Lum AG., Ogata Y., Pagni SE., Hur Y.

DOI: 10.1902/jop.2017.160694

Purpose: To assess the association of sinus membrane thickness and perforation of the membrane during lateral window sinus surgery.

Conclusions: An associated was found between surgical Schneiderian membrane perforation and both RBH (Mean RBH in perforated sinuses: 2.78 mm, Mean RBH in non-perforation sinuses: 4.21 mm) and Schneiderian membrane (Perforated membranes were 0.84 mm in mean thickness vs Non-perforation membranes were 2.65 mm in mean thickness) Sinus artery

Anatomical Considerations on the Alveolar Antral Artery as Related to the Sinus Augmentation Surgical Procedure.

Authors: Valente NA.

DOI: 10.1111/cid.12355.

Purpose: Summarize studies analyzing the variability in anatomical position and dimension of the alveolar antral artery (AAA) to give clinicians a reference when planning for sinus augmentation surgery

Key Findings:

- *Arterial blood supply of max sinus-*
- *Three branches of max artery (MA)- Greater palatine A, infraorbital A (IOA), posterior superior alveolar A (PSAA). PSAA and IOA anastomoses inside/outside bony lateral antral wall à supply Schneiderian membrane/epiperiosteal vestibular tissues . Intraosseous constantly present. Extraosseous present 44% of cases.*
- *Course of AAA in relation to osseous wall-*
- *Kang: AAA intraosseous 64.3%, intrasinus 29.1%, superficial 6.6%*
- *Diameter of AAA-*
- *Overall mean diameter: 1.09mm (range 0.2-3.5mm), Most frequent range 1-2mm*
- *Distance of AAA from alveolar crest and sinus floor-*
- *Overall mean distances of AAA from alveolar crest 17.91mm vs sinus floor 8.39mm*

Conclusions: Need take into account: AAA 1.5mm diameter, lower course, intra/extraosseous course, dentate/edentulous . Use piezoelectric.

Management of a Large Artery During Maxillary Sinus Bone Grafting: A Case Report.

Authors: Basma, et al.

DOI: 10.1002/cap.10104

Purpose: To present a case that reviews a technique with piezo to elevate a larger posterior superior alveolar artery (PSAA) Background: The PSAA anastomoses with the infraorbital artery (IOA) which supplies blood to the anterolateral wall of the maxillary sinus and Schneiderian membrane On average the PSAA is 18.9-19.6mm from the alveolar margin

Conclusions: Using the piezo it is possible to elevate the artery when not fully encased in the lateral sinus wall. Biomaterials

Residual Bone Height and New Bone Formation after Maxillary Sinus Augmentation Procedure Using Biomaterials: A Network Meta-Analysis of Clinical Trials

Authors: Khijmatgar S, et al.

DOI: 10.3390/ma16041376.

Purpose: to analyze the effect of RBH and different grafting materials for LW SLE

Conclusions: Best performance for <4mm RBH was XG+AG, while for ≥ 4 mm RBH was Auto and Bio+XG. RBH is critical for material selection.

Bone Regeneration in Maxillary Sinus Augmentation Using Advanced Platelet-Rich Fibrin (A-PRF) and Plasma Rich in Growth Factors (PRGF): A Pilot Randomized Controlled Trial

Authors: Dragonas, P et al.

DOI: 10.11607/prd.5491

Purpose: Background: A-PRF & L-PRF are reported to have more growth factors and longer release patterns vs. PRGF. PRGF does not include any leukocytes in order to reduce the pro-inflammatory response and enhance healing and regeneration. The aim was to assess how A-PRF and PRGF together with deproteinized bovine bone mineral (DBBM) impact the results of regenerative maxillary sinus augmentation (MSA) procedures.

Key Findings:

- *NSD between A-PRF and PRGF in any parameter. NSD between A-PRF+DBBM and PRGF+DBBM compared to DBBM alone (despite lower %MT in the control).*

Conclusions: New bone formation is not enhanced when A-PRF and PRGF are added to DBBM in MSA procedures. None of the platelet concentrates is superior to the other.

Plasma rich in growth factors (PRGF) in intraoral bone grafting procedures: A systematic review

Authors: Dragonas P, Schiavo JH, Avila-Ortiz G, Palaiologou A, Katsaros T

DOI: 10.1016/j.jcms.2019.01.012

Purpose: Background: When using PRGF, high concentration of growth factors TGF- β 1, PDGF, VEGF, and IGF are theoretically introduced to enhance wound healing through stimulation of re-epithelialization, angiogenesis, and extracellular matrix formation. The aim was to assess new bone formation, soft tissue healing, and post-op pain & swelling in ridge preservation, ridge augmentation, and maxillary sinus augmentation using Plasma-rich Growth Factors (PRGF). Background: When using PRGF, high concentration of growth factors TGF- β 1, PDGF, VEGF, and IGF are theoretically introduced to enhance wound healing through stimulation of re-epithelialization, angiogenesis, and extracellular matrix formation. Its preparation, as introduced by Anitua (1999), excludes leukocytes to mitigate local pro-inflammatory effects.

Key Findings:

- *PRGF as bone grafting and/or barrier membrane substitute- (One study) CBCT scans 10-12wk post-op showed greater % of regenerated bone volume and increased bone density in PRGF-treated sites vs. natural clot (97% vs. 75%, 450 vs. 318 HU, respectively).*
- *Enhancement of bone quantity and quality- Sinus aug: One study found more new bone formation in PRGF-treated sites (31% vs. 21.3%). Two found NSSD in new bone %*
- *Soft tissue healing and pain reduction- Soft tissue healing: PRGF may be beneficial for ridge preservation and ridge augmentation (thicker KT, improved healing index in extraction sockets when with fibrin membrane and PRGF fibrin clot; improved horizontal and vertical bone augmentation outcomes), but evidence is limited.*
- *Reduction in post-op swelling and pain: Based on limited evidence, PRGF may have a marginally positive effect on swelling and pain during the first week post-op.*

Conclusions: The use of PRGF in bone augmentation, incl. ridge preservation and maxillary sinus augmentation, is questionable. Limited evidence suggests marginal benefit for soft tissue healing and post-op symptomatology.

Effects of leukocyte-platelet-rich fibrin (L-PRF) in different intraoral bone grafting procedures: a systematic review

Authors: Dragonas P, Katsaros T, Avila-Ortiz G, Chambrone L, Schiavo JH, Palaiologou A.

DOI: 10.1016/j.ijom.2018.06.003

Purpose: To study whether L-PRF improves outcomes in intraoral bone grafting procedures including ridge pres (RP), ridge aug (RA), and max sinus aug (MSA).

Conclusions: Conclusion- Evidence supporting L-PRF benefits in bone regeneration, soft tissue healing, and postoperative outcomes is limited, with modest improvements mainly observed in post-extraction sockets (reduced ridge remodeling and pain). No consistent or favorable outcomes are demonstrated for L-PRF use in MSA, and evidence for RA is insufficient.

Complications Associated With the Use of Recombinant Human Bone Morphogenic Protein-2 in Ridge Augmentation: A Case Report

Authors: Dragonas, P., Palin, C., Khan, S., Gajendrareddy, P.K., Weiner, W.D.

DOI: 10.1563/aaaid-joi-D-17-00101

Purpose: To report a complication associated with the use of recombinant human bone morphogenic protein-2 (rhBMP-2) combined with allograft and xenograft in ridge augmentation and subsequent case management. Case Presentation: 64-year-old woman, systemically healthy Simple extractions (#4, 5, 12, and 13 with no socket preservation) CBCT taken at 10 weeks post-extraction: Alveolar ridge width was adequate for implant placement, but the implants would be placed too far palatally (not in the optimal position for proper restoration) This indicated the need for simultaneous bilateral maxillary sinus and ridge augmentation procedures

Conclusions: A complication associated with the use of rhBMP-2 in combination with allograft and xenograft materials for ridge augmentation is rapid graft resorption. Currently, there is limited evidence describing the bone maturation process when rhBMP-2 is combined with other biomaterials.

Pivotal, randomized, parallel evaluation of recombinant human bone morphogenetic protein-2/absorbable collagen sponge and autogenous bone graft for maxillary sinus floor augmentation.

Authors: Triplett RG, Nevins M, Marx RE, Spagnoli DB, Oates TW, Moy PK, Boyne PJ.

DOI: 10.1016/j.joms.2009.04.085. PMID: 19686934.

Purpose: To compare rhBMP-2+absorbable collagen sponge (ABS) to conventional graft for staged maxillary sinus floor augmentation

Key Findings:

- *Bone Induction- rhBMP-2/ACS group: average change in bone height of 10.41 mm (baseline bone height of <4mm), 9.72 mm (<=6mm), and 5.25 mm (6mm). Bone graft group: average change in bone height of 12.74 mm (<=4mm), 12.11 mm (<=6mm), and 6.56 mm (6mm). Both had SS improvement but bone graft group was better*
- *Bone Density- At 6 mo after augmentation, in favor of the bone graft group (283 mg/cm³ vs. 200), However, at 6mo after functional loading, In favor of rhBMP-2/ACS (358 vs. 298)*

Conclusions: rhBMP-2/ACS is an effective product for augmenting maxillary sinus.

Efficacy of biologics for alveolar ridge preservation/reconstruction and implant site development: An American Academy of Periodontology best evidence systematic review

Authors: Suárez-López del Amo F., Monje A.

DOI: 10.1002/JPER.22-0069

Purpose: To analyze the effect of autologous blood-derived products (ABPs), enamel matrix derivative (EMD), recombinant human platelet-derived growth factor-BB (rhPDGF-BB), and recombinant human bone morphogenetic protein-2 (rhBMP-2) on the outcomes of ARP/ARR and ISD therapy (alveolar ridge augmentation (ARA) and maxillary sinus floor augmentation (MSFA))

Key Findings:

- *ARP: In general, investigations failed to demonstrate superior outcomes with additional use of biologics compared with conventional approaches. Attenuation of post-extraction resorption was found with the use of biologic.*
- *Two investigations reported no differences in socket closure/soft tissue wound healing.*
- *Increased mineralized bone tissue with use of biologics was supported by 5 studies.*
- *In general, test groups did not show superior outcomes of clinical, radiographic, or histologic parameters. Another study demonstrated decreased incidence of wound dehiscence with additional use of PRP covering titanium-mesh in ARA*
- *Clinical recommendations:*
 1. *ARP: Low level of certainty recommendation that additional use of ABPs, EMD, and rhBMP-2 fails to promote additional clinical benefits to conventional grafting. Addition may provide some benefits. Expert opinion supports use, but evidence is lacking.*
 2. *ARA: Low level of certainty recommendation stating uncertainty of additional clinical benefits. Expert opinion supports use of ABPs, rhPDGF-BB, and rhBMP-2 but evidence is lacking.*

Conclusions: Current evidence does not support use of ABPs, EMD, rhPDGF-BB, or rhBMP-2 to render superior clinical or radiographic outcomes. Histomorphometric results are favorably influenced by the use of these biologics. PROMs are underreported but seem to be minimally

influenced by biologics. It is not currently possible to establish recommendations for their use in daily practice in these applications.

Maxillary Sinus Floor Augmentation With or Without Barrier Membrane Coverage of the Lateral Window: a Systematic Review and Meta-Analysis

Authors: Starch-Jensen T, Deluiz D, Duch K, Tinoco EMB.

DOI: 10.5037/jomr.2019.10401

Purpose: To test the hypothesis of no difference in implant treatment outcomes after sinus floor augmentation (MSFA) with or without barrier membrane coverage of the lateral window.

Key Findings:

- *Bone Regeneration- NSSD in newly formed bone and nonmineralised tissue after MSFA with or without barrier membrane coverage of the lateral window. However, MSFA with barrier membrane coverage of the lateral window seems to be associated with an overall higher*
- *percentage of newly formed bone*
- *and diminish nonmineralised tissue compared with the use of no barrier membrane coverage.*

Conclusions: NSSD in implant treatment outcomes after maxillary sinus floor augmentation with or without barrier membrane coverage of the lateral window.

Bone Graft Displacement After Maxillary Sinus Floor Augmentation With or Without Covering

Authors: Ohayon L., Taschieri S., Friedmann A., Del Fabbro M.

DOI: 10.11607/jomi.6940

Purpose: To assess the stability of bone particulate after maxillary sinus floor augmentation with or without placement of a collagen barrier membrane over the window.

Key Findings:

- *At the 6-mo CBCT evaluation, significantly more graft dislodgement was found when the membrane was not used (mean 3.8 mm of graft dislodgement compared to 0.46 mm in control group).*

Conclusions: Post op edema represents a major risk factor for graft dislodgement into the buccal mucosa through the window. This also leads to increased patient morbidity. ADVOCATE IN FAVOR OF USING COLLAGEN MEMBRANES TO AVOID GRAFT DISLODGE

Comparative analysis of lateral maxillary sinus augmentation with a xenogeneic bone substitute material in combination with piezosurgical preparation and bony wall repositioning or rotary instrumentation and membrane coverage: a prospective randomized clinical and histological study.

Authors: Molnár B, Jung AK, Papp Z, Martin A, Orbán K, Pröhl A, Jung O, Barbeck M, Windisch

DOI: 10.1007/s00784-022-04494-x.

Purpose: Evaluate efficacy of piezosurgically retrieved lateral bony wall repositioning in lateral maxillary sinus floor augmentation compared to application of resorbable collagen membrane with addition of xenograft

Conclusions: No significant differences between closure of sinus access window with bony wall or collagen membrane

Repositioning of the bone window in lateral sinus floor elevation with simultaneous implant placement: A retrospective radiographic study.

Authors: Wang, et al.

DOI: 10.1111/clr.13963

Purpose: To investigate if better volumetric outcomes can be achieved when performing lateral sinus floor elevation (LSFE) with simultaneous implant placement with or without repositioning the bone window

Key Findings:

- *Repositioned wall group: Significantly higher buccal bone height (-2.50% vs. -7.10%) and significantly lower buccal augmentation volume reduction (15.51% vs. 27.15%). Rate of membrane perforation was 3/12 or 25% in the repositioned group and 0/22 or 0% in the removed window group*

Conclusions: When completing a LSFE with repositioning of the window it can contribute to better recovery of the antrostomy defect and provide superior dimensional outcomes at the buccal side of the window

On the Early Mechanisms of Bone Formation after Maxillary Sinus Membrane Elevation: An Experimental Histological and Immunohistochemical Study

Authors: Jungner M et al.

DOI: 10.1111/cid.12218.

Purpose: To examine early bone formation in primate maxillary sinuses 10 and 45 days after membrane elevation using histology and immunohistochemistry

Conclusions: The role of the sinus membrane in early bone formation during sinus elevation is unclear. Bone forms from the sinus floor along the implant, with woven trabeculae at 10 days and well-developed bone and marrow at 45 days, but the membrane itself shows no direct osteoinductive effect. Studies without grafts show bone grows from residual bone coronally, with apical implant portions often uncovered. Osteogenic markers (OC, OP) and macrophages (CD68) appear on new bone and partially on the membrane, suggesting a reactive rather than inductive role. Nongrafted sites may form bone faster, while membrane removal reduces submucosal glands, indicating surgical impact rather than intrinsic osteoinduction. Bone forms from the sinus floor into the elevated space along implants, but membrane removal reduces formation. The sinus membrane shows no clear osteoinductive potential.

Osteogenic capacity of the sinus membrane following maxillary sinus augmentation procedures: A systematic review

Authors: Dragonas P., et al.

DOI: N/A

Purpose: to review the osteogenic role that the sinus membrane (SM) plays in maxillary sinus augmentation (MSA) procedures.

Conclusions: Pluripotent cells that have the capacity for differentiation and stimulation of NBF are present in the SM but the evidence does not consistently support the hypothesis that the SM significantly contributes to NBF. NBF near the SM was inconsistently reported and less than the regions that are close to the surrounding bony walls. Local BMP-2 delivery augments the osteogenic capacity of SM cells and allows for NBF to be enhanced, mainly in the early healing.

Does new bone formation vary in different sites within the same maxillary sinus after lateral augmentation? A prospective histomorphometric study

Authors: Stacchi C, Rapani A, Lombardi T, Bernardello F, Nicolin V, Berton F

DOI: 10.1111/clr.13891

Purpose: To assess new bone formation 6mo after lateral sinus floor elevation (SFE) in different areas of the same sinus w/ different bucco-palatal sinus widths (SW)

Conclusions: %NFMT 6mo after lateral sinus floor elevation occurs at different rates in different anatomical areas of the same sinus. %NFMT is inversely correlated w/ bucco-palatal sinus width (w/ no influence of RBH). Clinicians should consider the bucco-palatal width of the sinus when treatment planning.

Prevention and treatment of postoperative infections after maxillary sinus elevation surgery: clinical consensus and recommendations

Authors: Testori T, et al.

DOI: 10.1155/2012/365809

Purpose: To establish expert consensus on prevention, diagnosis, and management of post-op infections following maxillary sinus elevation surgery.

Key Findings:

- *What is the normal postoperative patient response to sinus surgery?*
- *Swelling, bruising, mild discomfort, and minor nasal bleeding are expected. Symptoms typically resolve within 3 weeks. Spontaneous or increasing pain is abnormal and requires evaluation.*
- *What is the difference between early and delayed complications?*
- *Early complications - within 21 days post-op. Delayed complications - after 21 days.*
- *Which post-op infections can be managed with pharmacological treatment alone?*
- *Localized graft infections contained below the sinus membrane and minimal, non-purulent exudate with no graft displacement. Requires strict f/u. Augmentin*
- *Which post-op infections require a combined pharmacological and surgical approach?*
- *Persistent symptoms with pain, purulence, nasal obstruction, or fistula formation.*
- *Partial or complete graft removal indicated.*
- *Graft displacement into the sinus requires multidisciplinary management, often including FES surgery.*

Conclusions: Max sinus elevation has a low rate of post-op infection. Careful pt selection, standardized surgical protocols, and prompt multidisciplinary management is key to minimizing complications and ensuring predictable outcomes.

Human histologic and radiographic evidence of bone formation in a previously infected maxillary sinus graft following debridement without re-grafting; a case report

Authors: Khouly, I., Phelan, J., Munoz, C., Froum, S.J.

DOI: 10.11607/prd.2409

Purpose: To assess histologic and radiographic new bone formation after maxillary sinus re-entry surgery performed without bone grafting. **Case report:** A 61-year-old non-smoking woman presented with a failed sinus augmentation in the left maxillary sinus, requiring a re-entry procedure to manage the complication. **Initial procedure:** The sinus cavity was filled with 1–2 mm Bio-Oss particles and covered with a Bio-Gide membrane over the lateral window. **Postoperative complication:** One week later, a sinus infection with graft contamination was found. **Planned treatment:** removal of the graft via re-entry with sinus augmentation after a 6-month healing period and implant placement 5 months later. **Re-entry procedure (3 weeks after initial surgery):** Bone graft material was removed and the sinus was debrided. The sinus membrane, originally flexible, had become non-flexible with fibrotic thickening. Some graft particles adjacent to the membrane remained hard and were left in place to prevent membrane perforation. The membrane had lost its ability to fold. **Healing and follow-up:** Healing was uneventful. Panoramic radiograph and CBCT showed bone formation in the previous sinus procedure. **Implant placement** was performed without additional augmentation, and a bone core was collected. **Implants** were successfully placed, uncovered, and restored, with stable integration observed at 18 months. **Histologic findings:** New bone formation was observed in all sections.

Conclusions: This case report demonstrated that sinus re-entry without additional grafting was sufficient to stimulate new bone formation. Further studies with more cases are needed to confirm these findings.

Incidence, diagnosis, and treatment of sinus graft infection after sinus floor elevation: a clinical study.

Authors: Urban IA, Nagursky H, Church C, Lozada JL.

DOI: N/A

Purpose: To evaluate the occurrence of sinus graft infection and the results of a planned surgical and pharmacologic treatment regimen for any sinus graft infections.

Key Findings:

- 8/198 (4% patient) experienced sinus infection. @b/t 1 and 3wks: Severe pain, fistulous tract extending into the oral cavity, recurrent facial swelling. @2 to 3wks: abscess, elevated body temperature, or loss of bone graft particles through the fistulous tracts or through the borders of the flap ("popcorn sign"). **Results of systemic pharmacologic treatment-** After treatment, acute symptoms disappeared w/ 48 hrs, Total healing time prior to implant placement: 10.6mo, Infection eliminated, but moderate bone defect remains. 100% implant survival rate in the 8 pts.

Conclusions: Within the limitations of the eight patients reported herein, this cohort from a clinical study of 198 patients represents the successful use of a surgical and pharmacologic

regimen to treat the complication of sinus graft infection that salvages the graft and does not necessitate complete removal of the graft.

Long-term effectiveness of maxillary sinus floor augmentation: A systematic review and meta-analysis

Authors: Raghoobar GM., Onclin P., Boven GC., Vissink A., Meijer HJA.

DOI: 10.1111/jcpe.13055

Purpose: To assess long-term effectiveness (≥ 5 years) of maxillary sinus floor augmentation (MSFA). Possible differences in outcome between simultaneous and delayed implant placement, partially and fully edentulous patients and grafting procedures were discussed.

Conclusions: Sinus floor elevation and subsequent implant surgery is safe and predictable. The survival rate of implants is high and similar to other rates reported in implant dentistry.

actors influencing long-term survival rates of implants placed simultaneously with lateral maxillary sinus floor augmentation: a 6-20 year retrospective study.

Authors: Park WB, Kang L, Han JY.

DOI: 10.1111/clr.13505.

Purpose: Evaluate influence of residual bone height, sinus membrane perforation, and presence of voids on survival rates of implant simultaneously placed with maxillary sinus floor augmentation (MSFA) performed with lateral approach

Conclusions: Cumulative survival rate of implants placed in RBH $<3\text{mm}$ with simultaneous MSFA lower than those with RBH $\geq 3\text{mm}$ (92.4% vs 78.8%). Placement in RBH $<3\text{mm}$ still acceptable. No sig influence of sinus membrane perforation or presence of voids on survival rates of implants .

A new concept in maxillary implant surgery: the osteotome technique

Authors: Summers RB.

DOI: n/a

Purpose: To describe the osteotome technique explaining advantages, rational, and potential applications

Conclusions: OSFE is a less traumatic and safer technique for sinus floor elevation and ridge expansion than previous techniques. Heatless, good tactile sensation, control, and visibility. Osteotome deemed superior to drilling. Less than 4-mm bucco-palatal width, Sites with less than 10mm pre-op crestal bone height, Soft/spongy bone

Sinus floor elevation utilizing the transalveolar approach

Authors: Pjetursson B, et al

DOI: 10.1111/prd.12043

Purpose: to describe the transalveolar approach for sinus lift

Conclusions: For posterior maxilla with 5–8 mm bone, transalveolar sinus elevation is indicated. Implants should ensure high primary stability, moderately rough surfaces, and slightly conical or wide-neck designs for better support in soft or low bone.

Osteotome sinus floor elevation technique without grafting: a 5-year prospective study

Authors: Nedir et al.

DOI: 10.1111/j.1600-051X.2010.01610.x

Purpose: to review the long-term stability of the peri-implant bone after implant placement in sinuses augmented w/o grafting.

Conclusions: The OSFE technique w/o bone grafting and the placement of implants ≤ 10 mm showed peri-implant bone formation after 1y and increased to 3.2mm at 5ys. Grafting is not needed for new bone formation

Maxillary sinus floor elevation using the osteotome technique with or without grafting material. Part I–Implant survival and patient's perception

Authors: Pjetursson BE, Rast C, Bragger U, Zwahlen M, Lang NP

DOI: 10.1111/j.1600-0501.2009.01704.x

Purpose: To assess the survival and success rates, soft tissue parameters, marginal bone levels, and patient perception of treatment of implants placed using the osteotome technique

Key Findings:

- *Cumulative survival rate of the osteotome implants was 97.4% (f/u 3.2yrs on avg.). Residual bone height: 91.3% for ≤ 4 mm, 90% for between 4-5mm, 100% for ≥ 5 mm*

Conclusions: Especially at sites w/ ≥ 5 mm residual bone height, the osteotome technique results in reliable and favorable survival rates, soft tissue parameters, and patient satisfaction.

Maxillary sinus floor elevation using the osteotome technique with or without grafting material. Part II–Radiographic tissue remodeling.

Authors: Pjetursson BE, Ignjatovic D, Matulienė G, Bragger U, Schmidlin K, Lang NP.

DOI: 10.1111/j.1600-0501.2009.01721.x

Purpose: To evaluate tissue remodeling following trans-alveolar maxillary sinus floor elevation using the osteotome technique, comparing procedures performed with and w/o graft.

Conclusions: Trans-alveolar sinus floor elevation combined with grafting material results in more consistent and substantial bone formation than procedures performed without grafts.

An unusual complication of osteotome sinus floor elevation: benign paroxysmal positional vertigo

Authors: Vernamonte, S., et al.

DOI: 10.1016/j.ijom.2010.07.010

Purpose: To report a case of severe benign paroxysmal positional vertigo (BPPV) that occurred during osteotome sinus floor elevation (OSFE) and to review the diagnostic approaches, treatment options, and underlying pathophysiology of this complication. **Case report:** 50-year-old male No significant medical history Partially edentulous Scheduled for osteotome sinus floor elevation (OSFE) with simultaneous implant placement **Surgical procedure:** Osteotomy performed with a piezo followed by a 2 mm twist drill stopping 1 mm short of the sinus floor Percussion with a small diameter osteotome was used to fracture the cortical sinus floor, followed by light malleting A 3.5 × 11 mm implant was placed **Postoperative complication:** Immediately after anesthesia wore off, the patient experienced severe vertigo and nausea, with no prior history of dizziness **Betahistine** 8 mg twice daily for 2 days was prescribed, but symptoms persisted the following day **ENT evaluation:** **Diagnosis:** benign paroxysmal positional vertigo (BPPV) associated with cupulolithiasis of the right posterior semicircular canal **Treatment:** Epley maneuver, which was successful **Outcome:** The patient reported complete resolution of vertigo and nausea **Dix-Hallpike test** showed no nystagmus, confirming the absence of vertigo or nausea **Weekly follow-up** for 1 month confirmed complete symptom resolution

Conclusions: Diagnosis: vertigo and nausea. Dix-Hallpike maneuver is used to identify BPPV. Incidence: OSFE-related BPPV occurs in less than 3% of cases. Symptoms of BPPV: Brief episodes of vertigo and nausea triggered by angular head movements. Symptoms typically resolve within days to weeks but may persist chronically in some cases.

The effect of residual bone height and membrane thickness on sinus membrane perforation in crestal sinus grafting: A prospective clinical study.

Authors: Boyacıgil DU, Er N, Karaca Ç, Koç O.

DOI: 10.1016/j.ijom.2020.05.018. Epub 2020 Jun 26. PMID: 32600745.

Purpose: To evaluate perforation of the sinus membrane in patients undergoing crestal sinus grafting using CBCT images obtained immediately in the postoperative period and to determine the effects of RBH and membrane thickness on membrane perforation.

Conclusions: The hypothesis that the risk of sinus membrane perforation during crestal sinus grafting increases with smaller RBH and thinner sinus membrane, was rejected based on the statistical analysis. However, tendency for the membrane perforation rate to increase in the presence of a RBH of <5 mm and a membrane thickness of <1 mm.

Microscope and micro-camera assessment of Schneiderian membrane perforation via transcrestal sinus floor elevation: A randomized ex vivo study

Authors: Gargallo-Albiol J., Sinjab KH., Barootchi S., Chan HL., Wang HL.

DOI: 10.1111/clr.13453

Purpose: To evaluate effectiveness of microscope and non-invasive camera to assess Schneiderian membrane perforation and to evaluate how membrane elevation height (MEH) and residual ridge height (RRH) influences the incidence of perforations during crestal lift.

Key Findings:

- A total of 26 sites were analyzed with a mean membrane thickness of 0.64 mm, mean ridge height and width of 5.03 mm and 8.62 mm, respectively. Incidence of membrane perforation:
- Mean incidence of perforation was 40.62%.
- 23.07% for 3 mm of membrane elevation height. 76.92% for 6 mm of membrane elevation height.

Conclusions: Microscope and micro-camera may be used to detect perforation intra-op with high accuracy in the cadaver model. Membrane elevation height has a significant influence on perforation rate.

Osseodensified Crestal Sinus Window Augmentation: An Alternative Procedure to the Lateral Window Technique.

Authors: Salgar N.

DOI: 10.1563/aaid-joi-D-19-00288.

Purpose: Present case reports of 3 different clinical situations of max sinus augmentation with RBH <1.5mm

Conclusions: Crestal approach may be viable technique for sinus augmentation when RBH <1.5mm Can this be the norm in practice? No...

Osseodensification technique in crestal maxillary sinus elevation—A narrative review

Authors: Gaspar, et al.

DOI: 10.1111/cid.13399

Purpose: To review how preparation of implant sites has evolved and how osseodensification has become a leading technique especially in regard for sinus floor augmentation

Key Findings:

- *Osseodensification Drilling (OD)*
 1. This system utilizes burs with a negative rake angle that do not cut the bone but when spun in reverse compact the bone into the trabecular spaces.
 2. Protocol includes using the bur in counterclockwise direction at 800-1200 rpm for osseodensification
 3. This system can be utilized to complete crestal sinus lifts, and ridge expansion, as well as densify osteotomies in soft bone scenarios in order to increase insertion torque when placing due to the "spring back effect"
 4. Primary stability is increased and studies show that this continues into greater secondary stability with no negative effects on surrounding bone vascularity

Conclusions: OD system has shown to be a predictable and safe alternative for densification of the bone, ridge expansion, and crestal sinus lift procedures

Guided implant surgery risks and their prevention.

Authors: Tatakis DN, Chien HH, Parashis AO.

DOI: 10.1111/prd.12292. PMID: 31407433.

Purpose: To summarize information on the accuracy and efficacy of static guided implant surgery with associated risks.

Conclusions: Guided implant surgeries have many advantages but errors can occur (in each step and accumulate) so need to plan/use accordingly.

Reducing errors in guided implant surgery to optimize treatment outcomes

Authors: Chackartchi T., Romanos GE., Parkanyi L., Schwarz F., Sculean A.

DOI: 10.1111/prd.12411

Purpose: To provide protocols for guided implant surgery which may be used to achieved increased accuracy of surgery to avoid complications and improve implant success measures.

Key Findings:

- *Free-hand vs guided*
 1. *Working through the surgical guide workflow often forces a "crown-down" approach to implant planning.*
- *Dynamic vs static guides-*
 1. *Static guides are prefabricated surgical templates. Dynamic navigation provides real-time guidance during drilling by using sensors.*
 2. *The fit and accuracy of the guide is dependent on the accuracy of the collected patient data.*
- *Challenges in fully edentulous cases - Edentulous patient are not only more difficult to get an accurate intraoral scan. Edentulous tissues are mobile and compressive, which is not compatible with guide accuracy.*

Conclusions: Guided implant surgery may be optimized to improve implant success parameters. Avoiding errors in the collected patient data avoids complications and errors in the final implant position. Using a surgical guide does not replace the need for advanced clinical knowledge and experience.

Deviations of different systems for guided implant surgery.

Authors: Laederach, V., Mukaddam, K., Payer, M., Filippi, A., & K hl, S.

DOI: 10.1111/clr.12930.

Purpose: Compare deviation of different systems for guided implant surgery (GIS)

Conclusions: Regardless of system, significant difference in way of drilling (centric vs eccentric) on accuracy. Systems with parallel drills (SG/SIG) performed better than conical drill systems (NG/CG). Parallel shape more rigid/less movements during drilling. Max deviations as a result of eccentric drilling: Coronal: 1.6mm, Apical: 3.2mm, Angular: 5.6 degrees

Comparison of the accuracy of implant placement using different drilling systems for static computer-assisted implant surgery: A simulation-based experimental study

Authors: Sittikornpaiboon, et al.

DOI: 10.1111/cid.13032

Purpose: To compare various drilling systems of static computer-assisted implant surgery (sCAIS) in vitro to investigate accuracy of implant placement

Conclusions: With significant differences found in all three parameters investigated it can be concluded that design of guide and drilling protocol do influence implant placement. Least deviation found with sleeve-in-sleeve design with or without self-locking

Does guided level (fully or partially) influence implant placement accuracy at post – Extraction sockets and healed sites? An in vitro study

Authors: Chen, Z et al.

DOI: 10.1007/s00784-022-04512-y.

Purpose: To compare the accuracy of fully guided, partially guided (full drill sequence), and freehand implant placement, and to assess sCAIS deviation differences between post-extraction sockets and healed sites.

Key Findings:

- *Implant accuracy at extraction sockets. Both sCAIS methods FG/PG were significantly more accurate than FH. FH showed 2× greater crestal and apical deviations (1.21 and 1.91 mm) and 50–65% higher angular deviation. FG: 0.74 mm and 1.19 mm; PG: 0.91 mm and 1.37 mm. Angular deviation: FH 6.55 v/s PG: 3.20°; FG: 2.36°. Fully guided tended to outperform partially guided, with significantly better coronal accuracy.*

Conclusions: sCAIS is more precise than freehand, with full guidance notably improving accuracy, especially in post-extraction sites.

The accuracy of static computer-aided implant surgery: A systematic review and meta-analysis

Authors: Tahmaseb, et al.

DOI: 10.1111/clr.13346

Purpose: to assess the accuracy and survival rates of implants placed via static guided surgery.

Conclusions: Static computer-aided implant surgery has clinically acceptable accuracy. A 2mm safety margin should be respected. Partially edentulous cases have higher accuracy compared to fully edentulous.

Influence of implant macrodesign and insertion connection technology on the accuracy of static computer-assisted implant surgery

Authors: El Kholy, K., Ebenezer, S., Wittneben, J. G., Lazarin, R., Rousson, D., & Buser, D.

DOI: 10.1111/cid.12836

Purpose: To assess the effect of implant macrodesigns and insertion devices on sCAIS accuracy

Conclusions: Tapered implants demonstrated higher accuracy than parallel-walled macrodesigns in an in-vitro, sCAIS model.

The influence of guided sleeve height, drilling distance, and drilling key length on the accuracy of static computer-assisted implant surgery

Authors: El Kholy, K, et al.

DOI: 10.1111/cid.12705

Purpose: To evaluate how guided sleeve height (SH), free drilling distance (FDD), and guided key height (KH) affect the accuracy of implants placed using static computer-assisted implant surgery (sCAIS).

Conclusions: Minimizing FDD below the guided sleeve and increasing KH improves the accuracy of sCAIS

Influence of surgical guide support and implant site location on accuracy of static computer-assisted implant surgery

Authors: El Kholy, K., Lizarin, R., Janner, S.F.M., Faerber, K., Buser, R., Buser, D.

DOI: 10.1111/clr.13520

Purpose: To evaluate guide design factors and how they affect the accuracy of computer-assisted implant surgery (sCAIS), specifically the number of teeth supporting the surgical guide and the implant site location.

Key Findings:

- *Implants placed with a surgical guide supported by 4 teeth demonstrated 3D deviation values comparable to those achieved with full-arch guides. Implants placed using a guide supported by 3 teeth showed greater deviations than full-arch guides. Guides supported by only 2 teeth resulted in higher deviation values compared to 4-tooth-supported guides.*

Conclusions: The number and position of teeth supporting the guide can markedly affect the accuracy of sCAIS. In single-tooth scenarios, guides supported by 4 teeth achieved accuracy comparable to full-arch guides. Implants placed in distal extension sites showed greater deviations than those in areas with bilateral support.

Influence of Splint Support on the Precision of Static Totally Guided Dental Implant Surgery: A Systematic Review and Network Meta-analysis

Authors: Balaguer-Martí JC, Canet-López Á, Peñarrocha-Diago M, Romeo-Rubio M, Peñarrocha-Diago M, García-Mira B.

DOI: 10.11607/jomi.9796. PMID: 37099571.

Purpose: To evaluate the precision of totally guided implant placement with static surgical splints in humans in relation to the different types of supporting tissues (tooth, mucosa, or bone).

Key Findings:

- *Accuracy:*
- *Tooth Mucosa Bone. For tooth support, the splint is placed in a stable position by resting it on the hard tissues, and verifying windows can even be made to check correct fitting of the splint throughout surgery. Mucosal support, positioning is less stable due to the resilience of the soft tissues. Also, anesthesia influences mucosal morphology, altering correct positioning. Bone support, poorest accuracy due to need to raise a large flap in the case of bone-supported splints, which can interfere with their correct placement.*

Conclusions: Tooth support proved to be significantly more precise than bone support splints. NSSD horizontal coronal deviation, horizontal apical deviation, or vertical deviation according to the type of splint support used.

Patient satisfaction and survival of maxillary overdentures supported by four or six splinted implants: a systematic review with meta-analysis.

Authors: Di Francesco F, De Marco G, Capcha EB, Lanza A, Cristache CM, Vernal R, Cafferata EA.

DOI: 10.1186/s12903-021-01572-6.

Purpose: To compare maxillary overdentures supported by 4 or 6 splinted implants in terms of patient satisfaction, implant survival, overdenture survival, and prosthodontic complications.

Key Findings:

- *Patient satisfaction- Both 4 or 6 splinted implants had high scores. Survival rate of implants (4 vs. 6)- NSSD 97.7% vs. 98.3%. Survival of overdentures- NSSD 97.6% vs. 97.9%*

Conclusions: Within the limits of this systematic review, it is concluded that the bar-supported overdenture on 4 implants is not inferior to the bar-supported overdenture on 6 implants in terms of patient satisfaction, implants or overdentures survival rates, and prosthodontic complications.

Maxillary implant overdentures on two or four implants. A prospective randomized cross-over clinical trial of implant and denture success and survival

Authors: Kappel S., Klotz AL., Eberhard L., Bermejo JL., Rammelsberg P., Giannakopoulos NN.

DOI: 10.1111/clr.13800

Purpose: To determine implant survival and success rates with 4 conventional but asynchronously loaded implants for maxillary OVDs opposing mandibular OVDs. Prosthetic success and patient preference was also determined.

Key Findings:

- *21 patients completed study w/out any implant loss. Of these, 9 preferred anterior implants, 3 preferred posterior implants, and 9 had no preference when comparing 2 implants. The majority (23/24) patients preferred 4 implants. Survival rates: Implant survival after loading: 93.8% at mean 3.1 years. Implant success rate: 90.6% (3 implants developed peri-*

implantitis). One patients lost all 4 implants due to early failure and was excluded. Another 3 patients lost 2 implants each, and 6 patients lost 1 implant each. All 12 of these implants were replaced and patients were included in the study.

Conclusions: Implant survival and success rates were much lower in the maxilla compared to the mandible. Patients tended to prefer implants in the anterior regions when only 2 implants were provided, but nearly all patients prefer 4 implants to support the maxillary OVD.

Protocols for the Maxillary Implant Overdenture: A Systematic Review.

Authors: Sadowsky SJ, Zitzmann NU.

DOI: 10.11607/jomi.16suppl.g5.2.

Purpose: Evaluate pt based outcomes after maxillary implant overdenture treatment (IOD)

Conclusions: IOD offer stabilized removable solution for edentulous maxilla and improves pt satisfaction/oral health/ quality of life. Higher failure rate with machined implants . 4-6 implant widely used and showed success. With 4 or less implants, unsplinted have higher implant/prosthetic failure. Increased tissue inflammation under bars. Palateless offers better pt satisfaction. Guidelines: Need identify vertical space requirements. Max IOD needs to be made to be maintainable, retrievable, reparable, or replaceable. Minimum of 4 implants with wide anteroposterior distribution is recommended.

Prosthodontic complications with implant overdentures: a systematic literature review.

Authors: Andreiotelli, et al.

DOI: n/a

Purpose: To review prosthetic complications of implant-supported or implant-retained overdentures associated with different attachment mechanisms

Key Findings:

- *Implant Survival/Success and Type of Attachment. Implant success rates of maxillary OVDs using an implant-splinted bar on 4-6 implants was 72.4-84%. Cumulative survival rates for both maxillary and mandibular implants combined in studies was shown to be 96% in one study and 76.6% in another. Mandibular OVDs usually use bars/magnets as attachment systems with 1-4 implants. Implant survival ranged from 93-100% for mandibular implants*

Conclusions: When comparing maxilla and mandible the maxilla has lower implant survival and higher prosthetic complication rates. The attachment system with the implant is the most common source of prosthetic complications

Mandibular single-implant overdentures: a review with surgical and prosthodontic perspectives of a novel approach.

Authors: Alsabeeha N, et al.

DOI: 10.1111/j.1600-0501.2008.01666.x.

Purpose: To Review literature on mandibular single-implant overdentures (opposing complete max dentures) and present surgical and prosthodontic perspectives of a novel approach for this treatment option.

Conclusions: The use of mandibular single-implant overdentures opposing maxillary complete dentures is not recommended because of a lack of RCT evidence

The effectiveness of 2-implant overdentures - a pragmatic international multicentre study

Authors: Rashid, et al.

DOI: 10.1111/j.1365-2842.2010.02143.x

Purpose: to assess if two-implant overdentures (OVD) have higher satisfaction rates than conventional dentures.

Conclusions: 2-implant mandibular OVDs have higher satisfaction rates than CDs in edentulous pts. Longer term follow ups are needed.

A long-term study of implants supporting overdentures as a model for implant success

Authors: Schwartz-Arad D, Kidron N, Dolev E

DOI: 10.1902/jop.2005.76.9.1431

Purpose: To assess the success and survival rates of implants supporting overdentures in the maxilla and mandible as well as possible contributing factors.

Key Findings:

- *Survival: Survival rate was 96.1%. Cumulative survival rate was 95.4% for 10yrs (99.5% mandible, 87.3% maxilla). The following impacted survival rate Maxilla ($P < .0001$). Success: Total success rate was 70%. Cumulative success rate was 52% for 10yrs. Smoking: CBL increased in 56% of the implants in smokers vs. 24% in non-smokers ($P < .0001$),*

Conclusions: Survival rate of implants supporting overdentures was 96% w/ cumulative survival rate of 95% for 10yrs (99.5% in mandible and 83.5% in maxilla). Total success rate was 70.4% w/ cumulative success rate of 52% for 10yrs. CBL was mostly influenced by maxillary/mandibular location and f/u period. Smoking, HA coating, spontaneous exposure are correlated w/ enhanced CBL.

Mandibular implant-supported overdentures and oral function

Authors: Van der Bilt, A, et al.

DOI: 10.1111/j.1600-0501.2010.01915. x.

Purpose: To evaluate 10-yr effects of mandibular implant-supported overdentures on max bite force and masticatory performance.

Key Findings:

- *Implant tx more than doubled avg maximum bite force (from ~162 N to ~341 N). Chewing efficiency significantly improved; the # of cycles required to halve particle size decreased from 55 to 27. After 10 yrs, neither max bite force nor masticatory performance showed significant decline compared to early post-tx values. Oral function with implant OD remained significantly better than CD.*

Conclusions: Md implant-supported ODs significantly improve oral function which remain stable over at least 10 yrs.

Impact of implant support for mandibular dentures on satisfaction, oral and general health-related quality of life: a meta-analysis of randomized-controlled trials

Authors: Emami, E., Heydecke, G., Rompré, P.H., de Grandmont, P., Feine, J.S.

DOI: 10.1111/j.1600-0501.2008.01693.x

Purpose: To evaluate the effectiveness of mandibular implant-retained overdentures from the patient's perspective.

Key Findings:

- *Mandibular implant-retained overdentures were reported as more satisfactory than conventional dentures. Insufficient evidence to demonstrate an effect of mandibular implant overdentures on perceived general health.*

Conclusions: Mandibular implant overdentures show improved patient-centered outcomes, although the extent of the benefit remains uncertain.

Management of the edentulous patient.

Authors: Mericske-Stern RD, Taylor TD, Belser U.

DOI: 10.1034/j.1600-0501.2000.011s1108.x. PMID: 11168261.

Purpose: to review plans/options for implant prostheses for edentulous jaw.

Key Findings:

- *Indications for implants in completely edentulous jaws. Main objective: To avoid removable complete denture, To stabilize complete denture.*
- *Number of implants and choice of prosthesis-*
- *READ ABSTRACT*
- *Retention devices and design of prostheses. Overdentures- Rigid bar, Screw retained cantilever prostheses, Fixed bridgework: Screw-retained or cemented*
- *Occlusion- Occlusal conception of complete dentures. Bilaterally balanced occlusion. Freedom in centric.*

Conclusions: N/A

Interventions for replacing missing teeth: partially absent dentition

Authors: Abt E., Carr AB., Worthington HV.

DOI: 10.1002/14651858.CD003814.pub2

Purpose: To assess different prosthetic schemes for long-term success, function, morbidity, and patient satisfaction in the treatment of partial edentulism.

Conclusions: There is insufficient evidence to recommend one prosthetic rehabilitation over another for patients with partial edentulism.

Implants in conjunction with removable partial dentures: a literature review.

Authors: Mijiritsky E.

DOI: 10.1097/ID.0b013e3180500b2c.

Purpose: Review literature regarding use of implants with removable partial dentures in partially edentulous pts and to evaluate evidence of this clinical approach

Key Findings:

- *Considerations for Kennedy Class I and II situations*
- *Common complaints: lack of stability, minimal retention, unesthetic retentive clasping, discomfort on loading*
- *Combination syndrome (24% of population) - Mandibular Kennedy class I opposing maxillary complete denture → downgrowth of maxillary tuberosities, papillary hyperplasia, resorption of premaxilla, overeruption of mand anterior teeth, resorption of posterior mand*

Conclusions: Common RPD complaints: lack of stability/retention, unesthetic retentive clasping, and discomfort on loading → lead pts to not wear prosthesis. Placement of limited number of implants can reduce effect of reciprocal arm, improve fulcrum line position, and avoid unesthetic retentive clasps

Rationale for tilted implants: FEA considerations and clinical reports.

Authors: DE Vico G, Bonino M, Spinelli D, Schiavetti R, Sannino G, Pozzi A, Ottria L.

DOI: n/a

Purpose: To describe the clinical and biomechanical rationale for tilting implants and to evaluate the long-term prognosis of immediately loaded full fixed prostheses for the treatment of edentulous patients. Rationale for tilted implants: (based on stress analysis) Reduction of cantilever length - Better load distribution of the prosthesis support. Tilted implants in splinted rigid full fixed prostheses result in lower stress Single tilted implant demonstrated higher peri-implant bone stress than single straight implant Findings Larger the ratio cantilever/potency arm, the larger the compressive forces on the abutments The force on abutment adjacent to cantilever of the tilted model with loading at the maximum cantilever distance (20 mm) was even lower than the straight counterpart with loading at 10 mm. Peak stress points were always located on the neck of the distal tilted implant

Conclusions: Within the limitation of this study proposed surgical technique may reduce patient morbidity and extend the indications for immediate loading full fixed rehabilitations.

The All on 4 Shelf: Mandible

Authors: Jensen OT., Adams MW., Cottam JR., Parel SM., Phillips WR.

DOI: 10.1016/j.joms.2010.06.207

Purpose: To describe the all-on-4 technique in the mandible, where the shelf is created to define anatomy, establish implant positions and angulation, and maximize immediate loading potential.

Conclusions: Creation of the mandibular shelf for the All-on-4 implant rehabilitation increases predictability of the procedure. Implants may more easily anchored into cortical bone and optimal implant and prosthetic spacing may be achieved.

The All-on-4 shelf: maxilla.

Authors: Jensen OT, Adams MW, Cottam JR, Parel SM, Phillips WR 3rd.

DOI: 10.1016/j.joms.2010.05.082.

Purpose: Review all on 4 shelf and answer Can osseointegration occur without sig grafting? Can full arch prosthetic loading be obtained with only 4 implants placed at angulation? Can immediate load biomechanics be established using limited bone stock of ant max?

Conclusions: Use of shelf ensure implants placed at right level with optimal angles, max AP spread, with favorable insertion torque for immediate load restorations

Immediate versus conventional loading with fixed full-arch prostheses in mandibles with failing dentition: a prospective controlled study

Authors: Penarrocha-Oltra, et al.

DOI: 10.11607/jomi.3534

Purpose: To compare fixed full-arch mandibular implant supported prostheses with either immediate or conventional loading

Conclusions: NSSD were found when comparing immediate loading to conventional loading in regard to implant success or prosthetic outcomes Using an immediate loading protocol can benefit patients by avoiding removable prosthesis issues

The All-on-4 treatment concept for the rehabilitation of the completely edentulous mandible: A longitudinal study with 10 to 18 years of follow-up

Authors: Maló P, et al.

DOI: 10.1111/cid.12769.

Purpose: to report long-term outcomes of full-arch mandibular rehabilitations through the All-on-4 concept

Conclusions: The mandibular all-on-4 is a viable treatment option, due to implant and prosthetic survival and success rate, MBL, and incidence of biological and mechanical complications. Implant failure, biological complications, MBL 3mm, smoking and systemic conditions impact success of implant supported rehabilitations.

The All-on-4 concept for full-arch rehabilitation of the edentulous maxillae: A longitudinal study with 5-13 years of follow-up

Authors: Maló, et al.

DOI: 10.1111/cid.12771

Purpose: to review long-term (5-13y) outcomes for maxillary implants placed following the All-on-4 concept.

Conclusions: Maxillary rehab done with the All-on-4 concept showed good long-term results up to 13y w/ high success and survival rates, and low MBL. Implant success, biologic complications, and MBL were negatively influenced by smoking.

Immediate function dental implants inserted with less than 30N·cm of torque in full-arch maxillary rehabilitations using the All-on-4 concept: retrospective study

Authors: Maló P, Lopes A, de Araújo Nobre M, Ferro A

DOI: 10.1016/j.ijom.2018.04.008

Purpose: To assess the outcomes of the All-on-4 concept with implants placed at <30 Ncm of torque.

Conclusions: Implants inserted w/ <30Ncm of torque in an All-on-4 arrangement have similar short-term success vs. those placed w/ ³30Ncm.

Clinical outcome of dental implants placed with high insertion torques (up to176 Ncm)

Authors: Khayat PG, et al.

DOI: 10.1111/j.1708-8208.2011.00351.x

Purpose: To study how high implant insertion torque affects osseointegration and marginal bone levels (MBL).

Conclusions: High IT, even up to 176 Ncm, did not negatively affect implant integration or MBL during the first year of function.

A risk assessment treatment planning protocol for the four implant immediately loaded maxilla: preliminary findings

Authors: Parel S.M., Phillips, W.R.

DOI: 10.1016/S0022-3913(11)60147-9

Purpose: To identify potential risk factors that could increase the likelihood of implant failure when using a distally tilted 4-implant immediate function approach in the maxilla.

Key Findings:

- 285 patients included. 41 implants failed in 20 patients. The highest failure rates were associated with existing opposing natural mandibular dentition (80%) and poor bone density (85%). All failed implant sites had bone density measurements of 100 HU or less

Conclusions: Frequent factors associated with implant failure included opposing natural dentition, male gender, low bone density, distal implant location, and parafunctional habits. For high-risk patients, using additional implants, delayed loading, or providing a complete denture as an interim prosthesis may be more appropriate.

Immediate fixed implant rehabilitation of the atrophic edentulous maxilla after bilateral sinus floor augmentation: a 12-month pilot study.

Authors: Pieri F, Aldini NN, Fini M, Marchetti C, Corinaldesi G.

DOI: 10.1111/j.1708-8208.2011.00360.x. Epub 2011 Jul 11. PMID: 21745321.

Purpose: To evaluate treatment outcome and patient satisfaction with an immediately loaded full-arch fixed definitive prosthesis supported by dental implants placed in the atrophic edentulous maxilla after bilateral sinus augmentation. To compare the clinical and radiographic outcomes of the implants placed in sinus-grafted versus native sites in the same patients for up to 1 year of loading

Key Findings:

- *Surgery (2 stage). Performed bilaterally. Composite graft of 50:50 (Autogenous bone chips + Bio-Oss). Autogenous bone chip from ramus. Resorbable collagen membrane (Bio-Gide) for the window. Control group: implants placed in anterior region/native bone. Test group: implant placed in posterior sinus grafted sites.*
- *Cumulative 1-year success rate of 98.7%; the prostheses success rate was 100%. The mean MBR around control and test implants at the 1-year evaluation were similar.*

Conclusions: The present preliminary data suggest that patients with atrophic edentulous maxillae can be successfully treated with immediate fixed definitive restorations supported by a combination of dental implants placed in native premaxillary sites and in grafted sinuses.

Double Full-Arch Fixed Implant-Supported Prostheses: Outcomes and Complications after a Mean Follow-Up of 5 Years.

Authors: Papaspyridakos P, Bordin TB, Natto ZS, Kim YJ, El-Rafie K, Tsigarida A, Chochlidakis K, Weber HP.

DOI: 10.1111/jopr.13040

Purpose: To document long-term complications and outcomes of fully edentulous patients rehabilitated with double full-arch hybrids.

Key Findings:

- *A total of 19 patients were evaluated in the assessment with a mean follow-up of 7.4 years. 249 moderately rough Nobel and Straumann implants were inserted. Survival rate: 99.2% (2 implants failed after prosthesis delivery). The most frequent minor biologic complication was soft tissue recession with an estimated 5-year rate of 45.5%, while the most frequent major complication was peri-implantitis with an estimated 5-year implant-based rate of 9.5%.*

Conclusions: After 5-years, a high survival rate of the implants and prostheses were found (99.2% and 92.1%, respectively). Complication rates in this population at 5-years was 9.5% for major biologic complications and 8.0% for major technical complications. No significant differences in complications were found between screw- and cement-retained prostheses.

Trans-sinus dental implants, bone morphogenetic protein 2, and immediate function for all-on-4 treatment of severe maxillary atrophy

Authors: Ole T Jensen 1, Jared Cottam, Jason Ringeman, Mark Adams

DOI: 10.1016/j.joms.2011.03.045.

Purpose: Describe use of trans-sinus application of posteriorly angled implants for max all-on-4 immediate function by use of simultaneous BMP-2 grafting in sinus floor and around exposed implants. Alternative to zygomatic implants.

Key Findings:

- *94.8% implant success rate. 12mo postop scans shows good bone fill in trans-sinus grafting locations. Insertion torque was still relatively low but at least 15Ncm.*
- *Trans-sinus integration present radiographically.*

Conclusions: Use of BMP-2 as simultaneous sinus grafting material appears to show that a delayed implant placement strategy is not absolutely necessary even when implants have relatively poor insertion torque. Trans-sinus approach described in this report provides evidence that implants grafted in the sinus with minimal cortical fixation can still be immediately loaded with a minimum of 15Ncm.

Zygomatic implants: Indications, techniques and outcomes, and the zygomatic success code.

Authors: Apricio, C, et al.

DOI: 10.1111/prd.12038

Purpose: To review conventional grafting techniques which are the current gold standard for a resorbed maxillae as well as to discuss zygomatic implants as an alternative treatment while establishing criteria in order to evaluate zygomatic implant success.

Key Findings:

- *Good discussion article in Periodontology 2000. Should be reviewed.*

Conclusions: In the resorbed maxilla grafting is still the gold standard. Zygomatic implants can result in improved clinical outcomes compared to grafting. Success criteria for zygomatic implants differs from conventionally placed implants. CBCT needs to be used to plan and complete pre-op assessment.

Clinical outcome of 302 zygomatic implants in 110 patients with a follow-up between 6 months and 7 years

Authors: Goker F, et al.

DOI: 10.1111/cid.12909

Purpose: to evaluate the clinical outcomes on 110 patients with Zygomatic implants (ZIs)

Key Findings:

- *Implant survival rate of 98.34%. 5 implant failures in 4 patients. Implant survival was not influenced by gender, smoking, implant location, or implant design. Age over 60 was found to be favorable. ZIs are less invasive compared to conventional implant surgery w/BG or SLE, decreasing number of surgical steps, length of treatment and cost. Sinusitis is the most common complication.*

Conclusions: ZIs are an alternative to BG and SLE for severe atrophic maxilla. The procedure is safe, has a high survival rate, and is not associated with severe complications. However, it is technically challenging and requires specific training

Retrospective cohort assessment of survival and complications of zygomatic implants in atrophic maxillae

Authors: Vrielinck, L., et al.

DOI: 10.1111/clr.14027

Purpose: to review survival rates, complications, and implant loss risk factors for zygomatic implants (ZI).

Key Findings:

- *302 patients with 940 implants & a mean f/u period of 7.9y. 10.1% of the ZIs and 18.6% of the standard implants failed and were removed. 65% of ZIs failed w/in the first 5y. Techniques and survival rates: 83% for intrasinusals (total n = 308), 90% for extramaxillary (total n =170), 94% sinus slot (total n = 444). Complications that occur prior to ZI and are sig associated w/ ZI loss:*
- *sinusitis, standard implant loss, zygomatic region infection, peri-zygomatic infection, permanent oroantral communication, misfit of the suprastructure*

Conclusions: ZIs have a 5y survival rate of 89.9% w/ most losses happening w/in the first 5y. Sinusitis was the most common complication, usually occurring a few years after placement. Possible risk factors for ZI loss are sinusitis, zygomatic region infection, oroantral communication and previous standard implant loss.

Retrospective study of 68 implants placed in the pterygomaxillary region using drills and osteotomes

Authors: Peñarrocha M, Carrillo C, Boronat A, Peñarrocha M

DOI: N/A

Purpose: To assess the success rate of implants placed with osteotomes and drills pterygomaxillary region.

Key Findings:

- 45 patients, 268 implants: 68 in pterygomaxillary region (all 4mm diameter, 16mm length), 200 in anterior maxilla. Mean observation period was 34.5mo. Success rate of pterygoid implants after 1mo: 97.1%. None failed btw 12mo after loading and final appt (avg 35.5mo).
- Discussion: Blunt force tools for dense cortical expansion minimize risk of injury to the palatine artery and nerve and therefore hemorrhaging, allow cortical bone compaction and latero-apical consolidation of bone trabeculae, and permit direct manual contact and sense of touch feedback.

Conclusions: Pterygoid implant placement w/ combo of drills and osteotomes is an alternative treatment modality for patients w/ an atrophic posterior maxilla.

Modified surgical protocol for placing implants in the pterygomaxillary region: clinical and study of 454 implants

Authors: Rodríguez X, Méndez V, Vela X, et al

DOI: N/A

Purpose: Evaluate outcomes of pterygoid implants placed using a modified surgical protocol with a more vertical angulation than the traditional 45° approach.

Key Findings:

- 54 pterygoid implants, with f/u ranging from 2 mos-14 years. 96.5% successfully osseointegrated, at mean f/y period of 6 yrs. 16 implants failed, mostly before prosthetic loading. Smoking was associated with more failures, although statistical analysis did not show a significant relationship with implant survival.

Conclusions: Pterygoid implants placed with a more vertical orientation (~70°) showed high long-term survival and stable clinical outcomes. This angulation reduces non-axial loading forces; additional research is needed to confirm long-term outcomes.

Postoperative infections after dental implant placement: Variables associated with increased risk of failure.

Authors: Camps-Font, O., Martín-Fatás, P., Clé-Ovejero, A., Figueiredo, R., Gay-Escoda, C., & Valmaseda-Castellón, E.

DOI: 10.1002/JPER.18-0024

Purpose: to determine factors that may increase the failure rate of dental implants that have presented a postoperative infection during the osseointegration period.

Key Findings:

- 1322 patients (2673 implants). 37 post-op infection (37 pts) were recorded.
- Survival rate of infected DI: 33.45%.

Conclusions: Patients that suffer a postoperative infection after dental implant placement have a poor prognosis, with a cumulative survival rate of 33.5%.

Pre- and post-operative management of dental implant placement. Part 2: management of early-presenting complications

Authors: Bryce G., Domfim DI., Bassi GS.

DOI: 10.1038/sj.bdj.2014.702

Purpose: To provide recommendations on pre- and post-op management to reduce the risk of early complications of post-op hemorrhage, swelling, infection, neurosensory disturbance and to optimize osseointegration.

Key Findings:

- *Post-op bleeding-*
- *Spontaneous post-op hemorrhage can be influenced by medical conditions (clotting factor disorders, platelet disorders, blood dyscrasias), prescription medications (oral anticoagulants), and local factors (size of the flap, vasoconstriction, physical disruption of the wound, infection). In-office management of bleeding:*
- *Chemical agents – adrenaline-containing local anesthetic, ferric sulphate, aluminum chloride, 4.8% tranexamic acid, Wound dressings – oxidized cellulose, fibrin mesh, collagen gauze,*
- *Physical management – compression, pressure dressing, electrocautery, sutures.*
- *Post-operative Swelling-*
- *Swelling is an expected response to tissue trauma following surgery. As a part of inflammation, it results in increased pain, loss of function, or neural damage. Cold compress is highly effective. Should be applied 10 min on then 20 min off for the first 4 hours, up to 48 hours.*
- *Use of antibiotics - A Cochrane review concluded that 2 g amoxicillin pre-surgically improves success rates of osseointegration.*
- *Neurosensory disruptions- Implant surgery can result in damage of the maxillary and/or mandibular branches of CN V. likely outdated based on current and anecdotal evidence*

Conclusions: A detailed pre op assessment and strict adherence to proper protocols decreases all typers of complications.

Spontaneous early exposure and marginal bone loss around conventionally and early-placed submerged implants: a double-blind study.

Authors: Cehreli MC, Kökat AM, Uysal S, Akca K.

DOI: 10.1111/j.1600-0501.2010.01952.x.

Purpose: Compare and correlate frequency of spontaneous early cover screw exposure (CSE), plaque accumulation at implant sites, and MBL in conventionally and early-placed submerged implants

Conclusions: Early placed implants experience higher frequency of spontaneous early exposure of implants in comparison with conventionally placed. Direct correlation exists between CSE and plaque accumulation and MBL

Correlation between early perforation of cover screws and marginal bone loss: a retrospective study.

Authors: Van Assche, et al.

DOI: 10.1111/j.1600-051X.2007.01158.x

Purpose: To investigate consequences on peri-implant bone loss in cases of early cover screw exposure

Conclusions: In cases of cover screw exposure (lack of soft tissue integrity) approximately 2mm RBL can be expected. When cover screw exposure is found replacement with healing abutment may prevent further RBL

Spontaneous early exposure of submerged implants: III. Histopathology of perforated mucosa covering submerged implants.

Authors: Tal H, et al

DOI: 10.1902/jop.2000.71.8.1231.

Purpose: to histologically examine clinically perforated mucosa over submerged implants. and how these spontaneous exposures affect bone loss and what factors cause them.

Key Findings:

- *Class I: Morphologic patterns varied by proximity to the perforation. Distant sections: Showed hyperplastic epithelium with wider, elongated rete ridges and chronic inflammatory cell infiltration (lymphocytes/plasma cells). Near-perforation sections: Displayed epithelial invagination resembling a cyst, with the inner layer shifting to non-parakeratotic stratified squamous epithelium. Spontaneous early perforation occurs in 4.6% to 13.7% of cases, though rates reach 16.1% for implants with external hexes and supracrestal cover screws. Primary causes include flap tension, loose cover screws (75% correlation), mucosal irritation, bone sequestra, and inflammatory fibro-epithelial hyperplasia.*

Conclusions: Radiographic or biometric study is needed to assess how early exposure affects bone healing. Until then, Class I–III perforations should be fully exposed immediately to prevent bone damage. Untreated perforations may damage the coronal bone-to-implant interface as epithelium and inflammation migrate beyond the biopsy borders.

Influence of early cover screw exposure on crestal bone loss around implants: intraindividual comparison of bone level at exposed and non-exposed implants

Authors: Kim, et al.

DOI: 10.1902/jop.2009.080580

Purpose: to assess how spontaneous early cover screw exposure impacts peri-implant bone loss.

Key Findings:

- *SSD in mean crestal bone loss: 0.40mm for exposed vs. 0.18mm for unexposed implants. Due to plaque accumulation w/ exposure, making adequate OH difficult and leading to tissue destruction.*

Conclusions: Early cover screw exposure can lead to the loss of the mucosal seal and accelerate peri-implant bone loss. Close follow-ups are critical for early detection.

Should Healing Abutments and Cover Screws for Dental Implants be Reused? A Systematic Review

Authors: Bidra AS, Kejriwal S, Bhuse K

DOI: 10.1111/jopr.13106

Purpose: To understand whether healing abutments and cover screws for dental implants can be re-sterilized effectively for use. **PICO Question:** In patients with dental implants, does a reused healing abutment or cover screw compared to an unused new healing abutment result in adverse clinical outcomes or harm to patients? **Background:** The United States Food and Drug Administration (FDA) classifies and defines reusable medical devices; healing abutments and cover screws are in-situ interim devices ("in-dwelling"). The Centers for Disease Control and Prevention (CDC) outlines disinfection and sterilization categories based on infection risk, incl. critical and semi-critical items; instruments with bone contact are critical and must be heat sterilized.

Conclusions: Despite no literature reports of biological or mechanical consequences to implants or harm to patients, reuse of healing abutments should be avoided, as limited evidence shows routine methods for their cleaning and sterilization may not result in the complete removal of contaminants.

Premature exposure of dental implant cover screws. A retrospective evaluation of risk factors and influence on marginal peri-implant bone level changes.

Authors: Hertel M, et al.

DOI: 10.1007/s00784-016-2001-2

Purpose: Assess risk factors for premature implant cover screw exposure and its effect on peri-implant marginal bone loss (MBL).

Key Findings:

- *Premature cover screw exposure-*
- *Premature exposure in 43 pts (26.1%) and 53 implants (13.4%). 13/26 with exposures at uncover, peri-implant mucositis was present at the time of detection. Smoking and the #cigarettes/day were not significantly related to exposure.*

Conclusions: Premature cover screw exposure is associated with male gender, posterior sites, supracrestal placement and platform-matching. MBL was significantly higher around exposed cover screws.

Dental implant proximity to adjacent teeth: A retrospective study.

Authors: Han, H.S., et al.

DOI: 10.1111/cid.13132

Purpose: To evaluate the frequency and outcomes of dental implants positioned close to or contacting adjacent teeth, with discussion of treatment approaches and preventive strategies.

Key Findings:

- *Tooth symptoms decreased by approximately 95% for each 1.0 mm increase in distance between the implant and adjacent tooth.*

Conclusions: Proximity or direct contact between implants and adjacent teeth are iatrogenic factors that can lead to complications, including tooth symptoms and peri-implantitis. Prevention through proper surgical technique and intraoperative periapical radiographs is essential.

Immediate bleeding complications in dental implants: a systematic review.

Authors: Balaguer-Martí, J. C., Peñarrocha-Oltra, D., Balaguer-Martínez, J., & Peñarrocha-Diago, M.

DOI: 10.4317/medoral.20203

Purpose: Reviews the literature on immediate or immediate postoperative bleeding complications in dental implants. To identify the areas of greatest bleeding risk, the causes of bleeding (including the implicated arteries), the length of the implants associated with bleeding, and the treatments provided.

Key Findings:

- *Immediate bleeding complications: Mandibular canine incisor premolar. Common cause: Perforation of the lingual plate. Damaging sublingual artery. Length of the implant was usually 15mm or longer.*

Conclusions: Bleeding complications after dental implant placement are infrequent but can be serious, particularly in the anterior mandibular region. The most common cause of heavy bleeding in the mandibular zone is lingual cortical bone perforation, with damage to the sublingual artery - in all cases on placing long implants.

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

Authors: Herranz-Aparicio J., Marques J., Almendros-Marqués N., Gay-Escoda C.

DOI: 10.4317/medoral.21256

Purpose: To evaluate the bone morphology and the prevalence of the lingual concavity in the mandibular first molar area.

Key Findings:

- *Morphology types: Undercut was present in 64.2% of samples. Concavity angle was 66 degrees in males and 71 degrees in females. Concavity depth was 4.5 mm in males and 3.1 mm in females.*

Conclusions: The lingual concavity with an undercut was the dominant morphology present in this study population. This morphology presents a potential increased risk of lingual cortical perforation during implant placement surgery.

Variation in arterial supply to the floor of the mouth and assessment of relative hemorrhage risk in implant surgery.

Authors: Katsumi Y, Tanaka R, Hayashi T, Koga T, Takagi R, Ohshima H.

DOI: 10.1111/j.1600-0501.2011.02348.x.

Purpose: Clarify 3D course of submental and sublingual arteries and their topographic relation to the mylohyoid muscle, sublingual gland, and mandible in human cadavers

Key Findings:

- *4 groups of course patterns of submental and sublingual arteries identified and subdivided into A and B with relation with the sublingual gland . Type A: artery ran medial to gland. Type B: artery ran lateral to gland.*

Conclusions: Submental artery in type II, III, and IV is susceptible to injury during implant sx. Need to assess variation in arterial supply via CBCT

Mandibular nerve neurosensory impairment after dental implant surgery: management and protocol.

Authors: Misch, et al.

DOI: 10.1097/ID.0b013e3181effa92.

Purpose: To create guidelines for diagnosing and managing mandibular nerve neurosensory deficits after dental implant surgery

Key Findings:

- *Read article. Be able to define types of neurosensory deficits and treatment thereof.*

Conclusions: Clinicians must know how to prevent and treat nerve injuries as well as the causes. Most important thing to know is when to refer.

Postoperative infections after dental implant placement: Variables associated with increased risk of failure

Authors: Camps-Font, O. et al.

DOI: 10.1002/JPER.18-0024

Purpose: To identify factors that increase failure rates for implants with postoperative infections during osseointegration.

Key Findings:

- *1,322 patients received 2,673 dental implants; 37 postoperative infections were recorded. Prevalence: 2.80% of patients. 1.38% of implants. Infections occurred 19–208 days after implant placement (median: 55 days). Implants with postoperative infections, particularly mandibular or with rough-surfaced collars, have a poor prognosis with 33.5% survival rate. Risk factors for early failure include infections occurring within the first two months, while rough-surfaced collars increase failure 2.35x compared to smooth collar surfaces.*

Conclusions: Postoperative implant infections have a poor prognosis, with a survival rate of 33.5%. 89% of cases require surgical intervention because antibiotics are usually ineffective on their own. Implants with rough-surfaced collars are particularly vulnerable to early failure when these infections occur.

Peri-implant health, peri-implant mucositis, and peri-implantitis: Case definitions and diagnostic considerations.

Authors: Renvert, S., Persson, G. R., Piri, F. Q., & Camargo, P. M. (2018).

DOI: 10.1002/JPER.17-0588

Purpose: To identify case definitions and clinical criteria of periimplant healthy tissues, peri-implant mucositis, and peri-implantitis.

Key Findings:

- *Peri-Implant Health- Requires the absence of clinical signs of inflammation. No- Erythema, Swelling, BOP*
- *Peri-Implant Mucositis- Local swelling, redness, shininess of the soft tissue, increase in PD compared to baseline.*
 - 1. *Bleeding- Clear evidence of bleeding such as a line of bleeding or drop bleeding should be used as an indication. Suppuration. Baseline radiograph- Remodeling should not exceed 2mm.*
- *Peri-Implantitis (BOP + bone loss)- Redness, swelling, pain, and bleeding on probing, Increase in PD compared to baseline. Radiographs- Progressive bone loss in relation to the radiographic bone level assessment @1 year following the delivery of the implant-supported prosthetics reconstruction.*
- *In the absence of initial radiographs and probing depths, radiographic evidence of bone level*
- *≥ 3 mm and/or probing depths 6 mm in conjunction with profuse bleeding represents peri-implantitis. Remodeling not to exceed 2mm*

Conclusions: N/A

Diagnosis of peri-implant status after peri-implantitis surgical treatment: Proposal of a new classification

Authors: Ravidà A., Galli M., Siqueira R., Saleh MHA., Galindo-Moreno P., Wang HL.

DOI: 10.1002/JPER.20-0124

Purpose: To build upon the recent peri-implantitis classification and to propose a framework for the peri-implant status after treatment.

Key Findings:

- *Concept of reduced periodontium - framework for "implants with reduced support"*
- *Treatment options for treating peri-implantitis- Resective therapy: APF + ostectomy/osteoplasty, optional implantoplasty. Regenerative therapy: Goal: regenerate bone levels around the dental implant in presence of intrabony defects.*
- *BOP as diagnostic tool- PD penetrate deeper around implants . No attachment of CT and less organized CT. These sites are more prone to BOP*

- *RBL - Following radiographic marginal changes over time is important in diagnosing peri-implantitis. Without sequential radiographs, RBL $\geq$ 3 mm from the implant platform and PD $\geq$ 6 mm with BOP marks a peri-implantitis case*

Classification of peri-implant status after surgical therapy-

- *After resective therapy, peri-implant status is classified into:*
- *Peri-implant health with reduced support*
- *Peri-implant mucositis w/reduced support*
- *Recurrent or refractory peri-implantitis (found with a progressive increase in PD and MBL)*
- *After regenerative therapy, peri-implant status classified into:*
- *Peri-implant health after complete regeneration*
- *Peri-implant health with reduce support*
- *Peri-implant mucositis after complete generation*
- *Peri-implant mucositis with reduced support*
- *Recurrent or refractory peri-implantitis*

Conclusions: N/A

Diagnosis of peri-implantitis in the absence of baseline data: A diagnostic accuracy study.

Authors: Romandini M, Berglundh J, Derks J, Sanz M, Berglundh T.

DOI: 10.1111/clr.13700.

Purpose: Evaluate the diagnostic accuracy of clinical and radiographic evaluations made at a single time point during follow-up (indirect evidence) in identifying: History of bone loss and presence of peri-implantitis (assessed by direct evidence)

Key Findings:

- *Bone levels were highly accurate in detecting bone loss 2mm (AUC: 0.96) and close to perfect in identifying bone loss 3mm and upwards. Sensitivity: 93%. Specificity: 89.2%.*
- *Most accurate combination of parameters was BOP/SOP $\neq$ 1 sites together with bone levels $\neq$ 1mm*
- *Secondary case definition in absence of baseline documentation suggested by 2017 WWP: BOP/SOP, PD $\neq$ 6mm, bone levels $\neq$ 3mm. Sensitivity: 15.4%, Specificity: 99.5%*
- *VIII EWP case definition- in identifying peri-implantitis: BOP/SOP and bone level $\neq$ 2mm. Sensitivity: 45.2%. Specificity: 97.4%*

Conclusions: Secondary case definition of peri-implantitis suggested at the 2017 WWP demonstrated high level of specificity but low sensitivity Mod/sever peri-implantitis most accurately identified by combination of BOP/SOP and bone level $\neq$ 2mm (EWP definition)

Probing at implants with peri-implantitis and its relation to clinical peri-implant bone loss.

Authors: Serino, et al.

DOI: 10.1111/j.1600-0501.2012.02470.x

Purpose: To evaluate implants with signs of peri-implantitis in regard to PD and peri-implant bone level before and after removal of the prosthesis during open flap surgery

Conclusions: Measurements around implants with the prosthetic present do have variation from PD's w/o prosthetic on. PD w/o prosthetic on have a high correlation with the amount of bone loss

present. Implants should be probed circumferentially, and results with prosthetic still on need to be evaluated carefully.

The diagnosis of peri- implantitis: A systematic review on the predictive value of bleeding on probing

Authors: Hashim, D. et al.

DOI: 10.1111/clr.13127

Purpose: to evaluate the predictive value of BOP for the diagnosis of peri- implantitis. For persons with osseointegrated dental implants, is assessing BOP and/or suppuration after probing (SUP) as accurate (i.e., with equal or better sensitivity and specificity) as diagnosis of peri- implantitis based on bone loss after initial remodelling (i.e., identified by comparing new radiographs with radiographs taken upon completion of the prosthetic reconstruction)?

Key Findings:

- *BOP is a poor independent predictor of PI, as it often occurs in the absence of the disease, with 24.1% chance for implants and 33.8% chance for patients being diagnosed with PI.*

Conclusions: BOP is a poor independent predictor of PI, as it often occurs in the absence of the disease, with 24.1% chance for implants and 33.8% chance for patients being diagnosed with PI. High BOP rates are attributed to the mechanical fragility of healthy peri-implant mucosa or tissue trauma from excessive probing force. BOP (+) implants carry a 24.1% risk of peri-implantitis, while BOP (+) patients have a 33.8% risk of the disease. While a key indicator, the diagnostic consistency of BOP is affected by varying bone loss thresholds and longer follow-up periods.

Suppuration as diagnostic criterium of peri-implantitis

Authors: Monje

DOI: 10.1002/JPER.20-0159

Purpose: to assess what pt, implant, and site characteristics are found in pts w/ suppuration (SUP).

Key Findings:

- *88.3% non-smokers. SUP prevalence (none in healthy implants or w/ peri-implant mucositis). 27.92% in the total sample. Peri-implantitis group- Pt level: 54.38% - 35.5% grade 1, 38.7% grade 2, 25.8% grade 3. Implant level: 28.74% - 23% grade 1, 28.1% grade 2, 18.8% grade 3.*

Conclusions: In peri-implantitis, SUP and the grade are associated w/ bone loss, PD, and the defect morphology. PD when comparing SUP vs. no SUP (OR 1.63)- every 1mm increase associated w/ a 63% increased risk of SUP. Radiographic MBLoss when comparing SUP vs. no SUP (OR 1.35) e/ 1mm increase was associated w/ 35% increased risk of SUP

The Association Between Suppuration on Palpation and Diagnosis of Peri-implantitis: A Cross-sectional Study

Authors: Holtzman LP, Donno S, Lafori A, D'Emidio F, Blaya Tarraga JA, Cordaro L

DOI: 10.11607/jomi.8987

Purpose: To evaluate the association btw suppuration on palpation in the context of the EFP/AAP Consensus on peri-implantitis Background: Peri-implantitis cases exhibit signs of inflammation and progressive bone loss, incl. BoP, suppuration on probing, increasing PPD.

Conclusions: An implant w/o suppuration on palpation will have a high chance of not having peri-implantitis; if there is suppuration around an implant, once cannot conclude it has peri-implantitis. No one clinical sign alone permits a diagnosis of peri-implantitis.

Reliability of periodontal diagnostic tools for monitoring peri-implant health and disease.

Authors: Coli P, et al.

DOI: 10.1111/prd.12162

Purpose: To review how reliable periodontal diagnostic tools are for monitoring peri-implant health and disease, with emphasis on PD, BOP, and radiographic bone evaluation.

Key Findings:

- *Teeth are supported by the PDL, whereas implants are surrounded by a collagen-rich, less vascular, scar-like CT with fibers running parallel to the implant surface vs perpendicular on teeth.*
- *Peri-implant tissues are more prone to inflammation. Two-piece implants have a microgap at IAI that leads to chronic infiltrate; one-piece implants are inflammation free.*
- *Peri-implantitis lesions are described as larger and less well-contained than periodontitis lesions with more plasma cells and macrophages. Peri-implant mucositis is limited to soft tissue (ST) inflammation with BOP on probing force of <0.25N (plaque or residual cement induced). Peri-implantitis includes inflammatory changes with progressive crestal BL. 2mm BL is expected following remodeling.*
- *Peri-implantitis includes inflammatory changes with progressive crestal BL . 2mm BL is expected following remodeling.*
- *Using BOP and PD alone may promote overdiagnosis and unnecessary tx.*

Conclusions: PD 4 mm and increased PD over time are not reliable indicators of peri-implant BL. BOP is also not a dependable stand-alone marker because it may reflect the nature of peri-implant ST rather than active dz. Using BOP and PD alone may promote overdiagnosis and unnecessary tx. Serial radiographic evaluation of crestal bone levels is the most reliable method for identifying clinically meaningful peri-implant breakdown and deciding when tx is needed. One BL episode does not justify tx unless it is accompanied by clear clinical signs such as profuse bleeding, suppuration, pain, or tenderness. Tx decisions should be based on verified progression and meaningful clinical evidence, not routine probing thresholds alone.

Characteristics and frequency distribution of bone defect configurations in peri-implantitis lesions-A series of 193 cases

Authors: Wehner, C., Bertl, K., Durstberger, G., Arnhart, C., Rausch-Fan, X., Stavropoulos, A.

DOI: 10.1111/cid.12961

Purpose: To characterize bone defects associated with peri-implantitis and identify potential predictive factors.

Key Findings:

- 193 implants over the 100 patients in the study
- Peri-implant bone defects:
- Class Ic – 25.4%
- Class Id – 23.8%
- Class II defects – 17.1%
- Did not fit the classification – 18.7%

Conclusions: Implants affected by peri-implantitis commonly showed a mix of intrabony defects and buccal/oral dehiscences rather than purely circumferential defects. Implants positioned near the lateral aspect of the alveolar ridge were more prone to bone dehiscences and those in the lower anterior region carried the highest risk of severe peri-implant bone loss.

Morphology and severity of peri-implantitis bone defects.

Authors: Monje A, Pons R, Insua A, Nart J, Wang HL, Schwarz F.

DOI: 10.1111/cid.12791.

Purpose: To assess the morphologic features and severity of peri-implantitis defects. Also, to gain insight on the influence of patient- and implant-related characteristics on defect morphology.

Background: Definition of Peri-implantitis (WW 2017): Presence of bleeding and/or suppuration on gentle probing. Probing depth ≥ 6 mm. Bone level ≥ 3 mm apical to the most coronal portion of the implant or at the rough-smooth interface in tissue-level implants.

Key Findings:

- **Residents need to study diagram in article.**
- Peri-implantitis defect morphology and severity- At patient-level, the most frequent peri-implantitis defect morphology was class Ib-(2-3 wall) (87%) then IIIb-(2-3 walls defect + horizontal bone loss) (22%) and with the least frequently on II (horizontal) (3%). At implant-level, the most prevalent defect morphology type was class Ib-(2-3 wall) (55%) then Ia-(buccal dehiscence) (16.5%) and IIIb-(2-3 walls defect + horizontal bone loss) (13.9%). On the contrary, the least frequent defect was II (1.9%).

Conclusions: Certain patient-, implant-, and site-specific variables are related with defect morphology and severity. However, morphological patterns for peri-implantitis bone defects could not be proven.

A Revised Peri-implantitis Classification Scheme: Adding Three-Dimensional Considerations to Facilitate Prognosis and Treatment Planning

Authors: Rosen PS., Froum SJ., Sarmiento H., Wadhawani CPK.

DOI: 10.11607/prd.5876

Purpose: To propose a modified classification for peri-implantitis to better facilitate discussion and recommendations for management.

Key Findings:

- **Residents should refer to tables in abstract for details.**
- *Classification based on PD and bone loss. Subclassification is based on implant position. Including the subclassification is the most critical contribution of this modification. Reflects the buccolingual position of the implant, which is critical for prognosis and treatment. Subcategory B and C have poor regenerative potential and a downgraded prognosis.*
- *P is added to the subcategory when proximity limitation are found*

Conclusions: The updated classification provides a clinically useful diagnosis, which aids in prognosis, treatment, and communication efforts.

The importance of histopathological diagnosis in the management of lesions presenting as peri-implantitis.

Authors: Kaplan I, Hirshberg A, Shlomi B, Platner O, Kozlovsky A, Ofec R, Schwartz-Arad D

DOI: 10.1111/cid.12137

Purpose: Evaluate histopathological findings of cases clinically diagnosed as peri-implantitis (PI) or peri-implant mucositis. Investigate frequency of lesions clinically mimicking PI.

Key Findings:

- *117 biopsies included. 18.8% were pyogenic granuloma, 10.3% were giant cell granuloma, 8.5% were foreign body reaction.*

Conclusions: One third of cases clinically diagnosed as Pi were either pyogenic granuloma or peripheral giant cell granuloma. PG/PGCG are reactive lesions with highest frequency of destructive behavior. PG: 17% recurrence rate. PGCG: 10-15% recurrence rate .

“Prevalence and Mechanisms of Peri-implant Diseases.”

Authors: Salvi, G E et al.

DOI: 10.1177/0022034516667484

Purpose: To summarize recent evidence on the prevalence of peri-implant diseases and their similarities and differences with periodontal diseases with a focus on their pathogenetic mechanisms.

Key Findings:

- *Peri-implantitis has more aggressive character and may progress more rapidly when compared to periodontitis. Peri-implantitis contains a greater proportion of B cells and neutrophils. Area of inflammatory connective tissue at implant sites is twice as large when compared with a tooth site.*
- *Varying threshold/definition*
- *Stronger host response to bacteria in implant sites*
- *(Irreversibility)*
- *Inflammatory lesion twice as large as periodontitis*
- *Peri-implantitis has more aggressive character and may progress more rapidly*

Conclusions: N/A

Current Emerging Concepts on the Pathogenesis of Periimplant Diseases: A Narrative Review

Authors: Guarnieri, R, et al.

DOI: 10.11607/jomi.10723

Purpose: To describe emerging evidence on etiologic factors and pathophysiologic mechanisms involved in peri-implant inflammatory diseases.

Key Findings:

- *Peri-implant mucositis and peri-implantitis is characterized as inflammatory reactions in the tissues surrounding an implant. The etiology for peri-implant mucositis (PIM) – accumulation of a biofilm around the implant. Etiology for peri-implantitis (PI) – inflammatory process encompassing both soft tissue inflammatory and progressive loss of supporting bone exceeding physiologic remodeling. PIM is currently believed to precede PI, but its conversion in practice remains an enigma. In this regard, it is unclear why one implant in a patient's mouth experiences peri-implantitis while another does not despite sharing the same host and similar microbiota. Bacteria is necessary but not sufficient for development of PI.*
- *Practically speaking, it is most likely that peri-implant diseases are influenced by the presence of alloplastic materials where the interaction between the bacterial plaque and Ti may lead to alterations in the Ti surface, where bacterial attachment and growth is promoted on the corroded surface.*

Conclusions: PIM and PI have classically been defined as inflammatory conditions associated with a microbial challenge. However, emerging evidence has demonstrated several etiologic factors, often iatrogenic, which are important to recognize and include in the treatment of PI disease if found. A growing body of evidence is also suggesting peri-implant inflammatory conditions may be connected to aseptic reactions associated with an immunologic response. More research is needed to better understand the inflammatory mechanisms occurring around dental implants.

Peri-implantitis.

Authors: Schwarz F, Derks J, Monje A, Wang HL

DOI: 10.1002/JPER.16-0350.

Purpose: Review addresses: Definition of peri-implantitis, Conversion from peri-implant mucositis to peri-implantitis, Onset and pattern of disease progression, Characteristics of peri-implantitis, Risk factors/indicators for peri-implantitis, Progressive crestal bone loss in the absence of soft tissue inflammation

Key Findings:

- **Good review. Recommend reading.**
- *progressive crestal bone loss around implants in absence of clinical signs of soft tissue inflammation is a rare event*

Conclusions: Peri-implantitis: pathological condition with inflammation in peri-implant CT and progressive bone loss. Conversion of peri-implant mucositis to peri-implantitis not completely understood. Onset of peri-implantitis may occur early and disease progression is non-linear and accelerating. Peri-implantitis shows inflammation with increased PD compared to baseline. Peri-implantitis sites have larger inflammatory lesions, Commonly present as circumferential pattern of bone loss, Strong evidence for history of perio, poor plaque control, no regular maintenance as

increase RF for developing peri-implantitis. Inconclusive evidence in smoking/diabetes for RF/RI of peri-implantitis. Limited evidence linking peri-implantitis to: cement, lack of KT, malpositioning (difficult OH). Progressive bone loss with absence of clinical soft tissue inflammation is rare

Microbial Community-Driven Etiopathogenesis of Peri-Implantitis.

Authors: Belibasakis GN, Manoil D.

DOI: 10.1177/0022034520949851

Purpose: To assess and discuss the physiology + virulence of microbial communities that are the drivers of disease in the peri-implant environment in order to understand the etiopathogenic mechanisms of peri-implant infections

Key Findings:

Clinical definition and epidemiology of peri-implant infections.

- *Berglundh 2018- Peri-implant mucositis = BOP/suppuration w/o radiographic bone loss.*
- *Peri-implantitis = BOP/suppuration w/ radiographic bone loss and increased PD from baseline.*
- *Heitz-Mayfield 2015- Dysbiotic shifts can occur in microenvironment increasing inflammation and decreasing peri-implant health/function.*
- *Targeted identification of peri-implantitis-associated pathogens- Staph epidermidis, aureus, Peptostreptococcus spp, Prevotella, Treponema spp., Prevotella spp. and Porphyromonas spp*

Conclusions: Peri-implant sites have a lower diversity than periodontal niches with different abundance of microbiota which varies in health vs. disease. Compositional shifts are seen in health vs. disease sites.

Microbial profiles of peri-implant mucositis and peri-implantitis: Submucosal microbial dysbiosis correlates with disease severity

Authors: Shi Y et al.

DOI: 10.1111/clr.13880

Purpose: to compare microbiological profiles of PI and PM and identify correlations between submucosal dysbiosis, the severity of clinical symptoms (PD, BOP, MBL), and other patient characteristics.

Key Findings:

- *64 implant sites (64 patients), 37 PI and 27 PM*
- *Dominant Phyla*
- *Bacteroidetes (~45% PM, ~43% PI)*
- *Firmicutes (~21% PM, ~19% PI)*
- *Proteobacteria (~11% PM, ~10% PI)*
- *Fusobacteria (~11% PM, ~15% PI)*
- *Spirochetes (~8% PM, ~10% PI)*
- *Dominant Genera*
- *Porphyromonas (~17% PM, ~17% PI)*
- *Fusobacterium (~10% PM, ~12% PI)*
- *Treponema (~8% PM, ~10% PI)*

- *Prevotella* (~7% PM, ~7% PI)

Conclusions: Microbial richness, diversity, and distribution were similar between PM and PI, with a shared core microbiome; increased MBL was significantly associated with MDI, while PDmean, PDmax, and BOP% were not.

Microbiome and Microbial Biofilm Profiles of Peri-Implantitis: A Systematic Review.

Authors: Lafaurie GI, Sabogal MA, Castillo DM, Rincón MV, Gómez LA, Lesmes YA, Chambrone L.

DOI: 10.1902/jop.2017.170123.

Purpose: to review and compare the microbiome in periodontitis, peri-implantitis (PI), and healthy implants.

Key Findings:

- 26 studies w/ 2134 implants were included
- Microbiome of PI vs. healthy implants:
- Major pathogens: red complex, orange complex, A.a, E. corrodens, P. micra, C. rectus, opportunistic organisms (G- enteric rods and Staph. Aureus)
- P. gingivalis: health: 0-79% vs. PI: 0-65%
- T. forsythia: health 0-80% vs. PI 0-80.3%
- P. intermedia: health 6.6-23% vs. PI 25-66%
- Staph. Aureus: health 0-19.1% vs. PI 0-43.4%
- 33.3% of the studies found no difference in the frequency of organisms between PI and healthy implants
- PI: 38% of studies found higher frequency of red complex vs. 42.8% higher frequency of orange complex . 8 studies: P. gingivalis (33.3%) T. forsythia (23.8%). 9 studies: P. intermedia (42.8%) F. nucleatum (19%)

Conclusions: Healthy implants and those w/ PI are all colonized by pathogens: P. gingivalis, and mainly P. intermedia and P. nigrescens (orange complex), as well as AAGPRs and OGNRs are more frequent in PI. PI is a more complex heterogeneous infection of mainly non-cultivable G-species vs. periodontitis. Different results are obtained via conventional subG biofilm techniques and entire microbiome sequencing. The latter allows for non-cultivable bacteria that colonize implants (PI) to be included

Protein biomarkers and microbial profiles in peri-implantitis

Authors: Wang H-L, Garaicoa-Pazmino C, Collins A, Ong H-S, Chudri R, Giannobile WV

DOI: 10.1111/clr.12708

Purpose: To determine the profile of peri-implant crevicular fluid (PICF) biomarkers associated with peri-implantitis-affected vs. healthy implants

Key Findings:

- 68 patients (34 in each group) were included.
- Concentrations of biomarkers were increased in peri-implantitis implants vs. healthy controls. Their OR's are...
- IL-1B: 7.71 (P=.0002)

- TIMP-2: 4.37 ($P=.004$)
- VEGF: 2.60 ($P=.054$)
- OPG: (SSD in volume in PICF, but not in individual diagnostic ability)
- Concentrations of MMP-8 failed to have a meaningful difference.

Conclusions: Increased PICF-derived biomarkers have potential to be predictors of peri-implant diseases.

Microbiological Profile and Human Immune Response Associated with Peri-Implantitis: A Systematic Review

Authors: Kensara, A et al.

DOI: 10.1111/jopr.13270

Purpose: To review the microbial and host immune characteristics associated with peri-implantitis compared with healthy implants.

Key Findings:

- *PI sites generally showed a more complex and diverse microbial profile than healthy implants. Frequently reported organisms included obligate anaerobic Gram- rods (OGNRs), asaccharolytic anaerobic Gram+ rods (AAGPRs). Commonly reported bacteria linked to PI included species such as P. gingivalis, T. forsythia, T. denticola, F. nucleatum, and P. intermedia, although findings varied across detection methods. Some studies also reported fungi and viruses, though these findings were less consistent. Immune-response studies showed higher levels of several pro-inflammatory mediators in PI, most commonly IL-1 β , IL-6, IL-17, and TNF- α .*

Conclusions: PI is linked to a more diverse microbial environment than peri-implant health, including obligate anaerobic gram- bacteria and asaccharolytic anaerobic gram+ rods. Increased inflammatory cytokines, bone-resorptive mediators, and tissue-degrading enzymes promote local inflammation and peri-implant BL.

Peri-implantitis is not periodontitis: Scientific discoveries shed light on microbiome-biomaterial interactions that may determine disease phenotype

Authors: Kotsakis, G.A., Olmedo, D.G

DOI: 10.1111/prd.12372

Purpose: An overview of the microbiome and biomaterial interactions in peri-implantitis (PI).

Key Findings:

- *Peri-implantitis is not periodontitis: clinical observations:*
- *Both conditions are associated with biofilm accumulation, erythema, edema, and histologic evidence of leukocyte infiltration and pro-inflammatory activity.*
- *Peri-implantitis is dissimilar to periodontitis and a new model of infection is required:*
- *Inflammation around implants is associated with rapid bone loss, often occurring within 6 months of placement. This observation remains unexplained when compared to the slower progression seen in periodontitis.*
- *Findings of titanium particles in the tissues surrounding titanium dental implants:*

- *Titanium particles can be released into surrounding tissues due to corrosion and mechanical wear, a combined process known as tribocorrosion.*
- *There is a clear association between tribocorrosion, titanium particle release, and biological complications.*

Conclusions: No metal is completely inert; in vivo degradation is unavoidable. Tribocorrosion influences biofilm behavior and contributes to peri-implant inflammation through both direct and indirect mechanisms, immune modulation and microbiome disruption. Metal particles can disseminate systemically via blood and serum, potentially accumulating in distant organs. Aluminum and zirconium particles have been detected in peri-implant tissues surrounding zirconia implants, though further investigation is needed. The effects of tribocorrosion do not solely determine implant outcomes, as host responses vary among individuals. Further research on peri-implant biofilms, particularly in relation to implant-specific environmental factors, is essential to guide therapies aimed at reducing the burden of peri-implant disease

“The role of foreign body response in peri-implantitis: What is the evidence?.”

Authors: Ivanovski, Sašo et al.

DOI: 10.1111/prd.12456

Purpose: Explore the evidence for a role of “foreign body reaction” in peri-implantitis by examining the influence that implant-related factors may have in initiating or exacerbating the progressive crestal bone loss that is characteristic of peri-implantitis.

Key Findings:

- *Foreign body response- “reaction composed of macrophages and foreign body giant cells (that) is the end-stage response of the inflammatory and wound healing responses following implantation of a medical device, prosthesis, or biomaterial.”*
- *Foreign body reaction and peri-implantitis- A central premise to the foreign body equilibrium theory for periimplant bone loss. Presence of “multinucleated” cells around osseointegrated dental implants (“foreign body giant cells”) constitutes a mild chronic inflammatory state.*

Conclusions: Although titanium, like all implanted biomaterials, elicits an inflammatory response upon implantation and cannot be considered absolutely “inert,” the available evidence supports the notion that the osseointegration of titanium dental implants represents a return to tissue homeostasis rather than a chronic inflammatory state that is characteristic of a “foreign body response.” There is no evidence for a prominent role of a “foreign body response” (also characterized as “foreign body equilibrium” or a “mild chronic inflammatory state”) to an osseointegrated implant in the pathogenesis of peri-implantitis. The available evidence supports our understanding that the dental plaque biofilm is the key modifiable etiological factor in peri-implantitis and, hence, is the logical frontline target of both preventative and therapeutic interventions. There is a lack of evidence for a unidirectional causative role of corrosion by-products and titanium particles as possible nonplaque-related factors in the etiology of peri-implant disease, although this area remains underexplored and requires further investigation.

Osteoimmune regulation underlies oral implant osseointegration and its perturbation

Authors: Albrektsson T., Tengvall P., Amengual L., Coli P., Kotsakis GA., Cochran D.

DOI: 10.3389/fimmu.2022.1056914

Purpose: To review osteoimmunology and oral microbiology in the context of osseointegration

Key Findings:

- *Three types of bone cells exist: osteoblasts, osteoclasts, osteocytes.*
- *Stages of osseointegration failure:*
 1. *Early failure- Integration never achieved – implant surrounded by connective tissue*
 2. *Late implant failure - May be caused by overload, secondary corrosion, or both.*
Excessive MBL, implant mobility, and stratified connective tissue
- *Macrophages play a fundamental role in modulating osteogenesis and facilitates osteogenic cytokine release and formation of new bone tissue around implants by recruiting osteoprogenitor cells.- M1 and M2 macrophages drive Th1 and Th2 responses, which influence local inflammatory levels and subsequent bone repair or degradation.*
- *Implant-abutment site placement and removal can prevent stable soft tissue attachment, causing corrosion, and increases bacterial access to interface . Absence of an interface (like a tissue level implant) results in minimal cell infiltrate and no peak of inflammation at marginal bone level and minimal bone loss.*

Conclusions: Teeth are natural part of human bodies and are inherently not similar to implants, which are foreign bodies with measurable immune reactions. Surgery to address MBL around implants have questionable clinical results. Many factors may caused marginal bone loss around implants and increase susceptibility to bacteria. Osseointegration is needed for oral implant function Osseointegration is an osteoimmune reaction, not just simple bone repair Bone anchorage is an immunoinflammatory process, not only an inflammatory one Osteoimmunological mechanisms of MBL is a condition, not disease The immune system is capable of causing MBL by controlling osteoblast/osteoclasts Bacteria may affect oral implants once immune rejection reaction has been initiated Local bacterial reaction may occur adjacent to leakage from abutment connection, but not affect implant stability Patient related factors such as smoking, drugs, genetic disorders, surgical and prosthodontic techniques, local microbes, foreign bodies (cement), primary corrosion, implant fractures can cause MBL via immune pathways Corrosion may negatively impact implant survival

Epidemiology and risk factors of peri-implantitis: A systematic review.

Authors: Dreyer H, Grischke J, Tiede C, et al.

DOI: 10.1111/jre.12562

Purpose: To analyze the current clinical data on prevalence and incidence of periimplantitis. To identify risk factors and its level of evidence.

Key Findings:

Risk factors and risk indicators

- *Patients' age-Not a risk factor for peri-implantitis for patients, nor as being protective for peri-implantitis*
- *Male gender- Controversial results. Ferreira: yay significantly more prone to develop peri-implantitis. Swierkot: nay. Aguirre and Koldslund: nay*
- *Presence of periodontitis- Although heterogeneity was high strong tendency favoring patients with periodontitis as more susceptible to peri-implantitis*
- *Hx of periodontitis- Although heterogeneity was high strong tendency favoring patients with periodontitis as more susceptible to peri-implantitis*
- *Lack of prophylaxis- Although heterogeneity was tendency favoring patients with periodontitis as more susceptible to peri-implantitis*
- *Smoking- SS association between smoking and peri-implantitis (OR 1.7)*

- *Diabetes mellitus- Positive association between diabetes mellitus and peri-implantitis. The patients with diabetes mellitus were 2 times (2x) more likely to have peri-implantitis compared to those without diabetes mellitus (OR 2.5)*
- *Presence of keratinized mucosa at the implant site- Controversial*
- *Edentulism- NSS*
- *Implant surface characteristics- Controversial. Dvorak (nay for rough/moderate surface) vs. Marrone (yay for rough surface developing peri-implantitis)*
- *Maxillary implants- Controversial*
- *Osteoporosis- NSS association b/t osteoporosis and peri-implantitis*

Conclusions: Dental implants are successful tx options. Risk factors (w/ medium and medium-high level of evidence). Smoking, Diabetes mellitus, Lack of prophylaxis, History or presence of periodontitis. Not related to peri-implantitis (medium-high evidence)- Pt's age, gender and maxillary implants Low evidence currently- Absence of keratinized mucosa at the implant site, edentulism, implant surface characteristics and osteoporosis.

Risk factors for periodontitis & peri-implantitis

Authors: Darby I.

DOI: 10.1111/prd.12447

Purpose: To introduce many different risk factors for periodontitis and peri-implantitis, known and emerging, in narrative format.

Conclusions: Risk factors of periodontitis and peri-implant disease continue to change as our understanding improves. Reducing and managing modifiable risk is necessary for successful long-term treatment. Non-modifiable risks present a challenge.

Is the degree of physiological bone remodeling a predictive factor for peri-implantitis?

Authors: Rodriguez MV, Ravidà A, Saleh MHA, Basma HS, Dukka H, Khurshid H, Wang HL, Moreno PG.

DOI: 10.1002/JPER.21-0723.

Purpose: Investigate association between amount of initial physiological bone remodeling (IPBR) during the first year of implant placement and incidence of peri-implantitis, as well as the pattern of progressive bone loss

Key Findings:

- *Analysis of pathological MBL.*
- *Splinted implants showed 0.6mm/year higher MBL rate than non-splinted. Implants undergoing 2-3 maintenance visits per year showed higher rate of MBL/year by 0.2mm compared to those with fewer than two visits .*

Conclusions: No SIG association between IPBR and incidence of Pim. Each additional year of follow-up after first year showed 20% increased risk of developing Pim. Splinted implants had 0.6mm/year greater MBL than non-splinted.

Prevalence of Peri-implantitis in Medically Compromised Patients and Smokers: A Systematic Review.

Authors: Turri A, et al.

DOI: 10.11607/jomi.4149

Purpose: To assess possible risk factors for peri-implantitis, specifically smoking and other systemic conditions

Key Findings:

Conclusions: "The aim of this systematic review was to verify whether medical conditions and smoking could act as biologic factors for the occurrence of periimplantitis. Based on the available evidence, this hypothesis cannot be confirmed." However, Smoking and T II DM appear to be associated factors for peri-implantitis. Evidence is weak and more studies needed

Systemic Risk Factors for the Development of Periimplant Diseases.

Authors: Kumar P.

DOI: 10.1097/ID.0000000000000873.

Purpose: To review extrinsic factors influencing peri-implantitis risk at the subject and site levels.

Key Findings:

- *History of periodontitis- History of periodontitis increases peri-implant disease risk 4.7 to 9-fold via bacterial translocation from periodontal pockets. Unique implant features promote microbial adaptation, creating distinct, high-risk microenvironments.*
- *Bisphosphonates- Short-term (1–3 yrs): no ↑ peri-implantitis risk. Long-term (4 yrs): ↑ risk of implant loss & peri-implantitis.*
- *Oral Hygiene and compliance-Implants need rigorous plaque control due to restoration contours. Poor OH= strongest predictor of peri-implant disease. Combined with smoking or HIV, ↑ bone loss and inflammation. 1 in 5 w/o maintenance develop peri-implantitis in 5 yrs. Regular maintenance therapy reduces implant-level risk.*
- *Smoking (nicotine): ↓ bone formation, ↓ calcium absorption, ↓ bone density.*
- *Poor OH= strongest predictor of peri-implant disease*
- *Regular maintenance therapy reduces implant-level risk*

Conclusions: External risk factors impact the host-microbial interface early in healing, though disease may take years to appear. Subject and site-level evaluation is essential during treatment planning.

A. Smoking and the risk of peri-implantitis. A systematic review and meta-analysis

Authors: Sgolastra, et al.

DOI: 10.1111/clr.12333

Purpose: review the evidence on smoking as a risk factor for peri-implantitis.

Key Findings:

- *Implant-based analysis: higher and sig risk in smokers vs. non-smokers for peri-implantitis (RR 2.1)*

Conclusions: There is insufficient evidence indicating that smoking is a risk factor for peri-implantitis. Additional studies are required in order to make clinical recommendations.

Association between diabetes mellitus/hyperglycaemia and peri-implant diseases: Systematic review and meta-analysis.

Authors: Monje A, Catena A, Borgnakke WS

DOI: 10.1111/jcpe.12724

Purpose: To assess the association btw hyperglycemia and peri-implant diseases. Are hyperglycemia & peri-implant diseases associated? Is incidence of peri-implant diseases more in hyperglycemic patients vs. normoglycemic patients? Is the degree of hyperglycemia related to the prevalence of peri-implant diseases?

Key Findings:

- *Limited evidence in this study suggests those w/ HbA1c 8% have greater prevalence of peri-implant mucositis and peri-implantitis.*

Conclusions: The risk of peri-implantitis is greater in those w/ hyperglycemia compared to those w/ normal blood glucose levels. Hyperglycemia in non-smokers is associated w/ at least a 3x increase in risk of peri-implantitis. Hyperglycemia is not significantly differently associated w/ peri-implantitis vs. smoking. NSD between hyperglycemia and peri-implant mucositis.

What is the influence of implant surface characteristics and/or implant material on the incidence and progression of peri-implantitis? A systematic literature review.

Authors: Stavropoulos A, et al.

DOI: 10.1111/clr.13859

Purpose: Assess whether implant surface characteristics or implant material influence the occurrence or progression of peri-implantitis (PI).

Key Findings:

- *Clinical studies- 12/31 studies reported at least 10 years of f/u. Meta-analysis not performed. Implant surface type generally showed NSD in PI incidence and BL.*
- *Long-term implant survival was high overall (93% to 100%), even with f/u up to 30 yrs.*

Conclusions: Preclinical evidence suggests modified implant surfaces may be associated with faster or greater PI progression. Clinical evidence does not show a clear difference in PI incidence among implant surface types. Evidence on implant material was too limited to support firm conclusions.

Impact of design elements of the implant supracrestal complex (ISC) on the risk of peri-implant mucositis and peri-implantitis: A critical review

Authors: Mattheos, N., Janda, M., Acharya, A., Pekarski, S., Larsson, C.

DOI: 10.1111/clr.13823

Purpose: To evaluate the evidence linking emergence profile and angle, peri-implant tissue height, implant neck design, abutment or prosthesis materials, and types of retention and connection with the risk of developing peri-implant mucositis and peri-implantitis.

Key Findings:

- *Emergence Profile and Emergence Angle. The highest peri-implantitis rates were observed with convex emergence profiles combined with emergence angles greater than 30° in bone-level implants; this pattern was not confirmed for tissue-level implants.*

Conclusions: Current limited evidence suggests that emergence angle, emergence profile, sulcus depth, and restricted access for oral hygiene may influence the development and management of peri-implant mucositis and peri-implantitis.

Combined Effect of Abutment Height and Restoration Emergence Angle on Peri-Implant Bone Loss Progression: A Retrospective Analysis.

Authors: Misch J, Abu-Reyal S, Lohana D, et al.

DOI: 10.1111/clr.14408

Purpose: To investigate the combined effect of trans-mucosal abutment height (TmAH) and restorative emergence angle (REA) on marginal bone loss (MBL) around bone-level implants.

Conclusions: REA ≥ 30 appears to only have significant influence on MBL when TmAH is large. Small TmAH had the greatest influence on experiencing MBL, where short/narrow implants experienced an odds ratio of 4.19 for peri-implantitis compared to long/wide, and for every 1 mm increase in TmAH the prevalence of MBL 0 mm decreased by 37%.

Convex Versus Concave Emergence Profile of Implant-Supported Crowns in the Aesthetic Zone: 3-Year Results of a Randomized Controlled Trial

Authors: Endres J., Strauss FJ., Siegenthaler M., Naenni N., Jung RE., Thoma DS.

DOI: 10.1111/jcpe.70018

Purpose: To evaluate 3-year outcomes of implants restored with convex vs concave emergence profiles.

Conclusions: Convex emergence design is significantly at risk for mid-facial mucosal recession, particularly within 1-year from prosthetic delivery. Little changes in mucosal level were found from 1 to 3 years. Concave emergence design is preferable.

Excess cement and the risk of peri-implant disease - a systematic review.

Authors: Staubli N, Walter C, Schmidt JC, Weiger R, Zitzmann NU.

DOI: 10.1111/clr.12954.

Purpose: Assess role of excess cement as a risk indicator for peri-implant disease and to investigate role of possible cofactors such as duration of the healing period, abutment design, type of retention, or cementum medium used

Key Findings:

- 26 articles included.
- Prevalence of peri-implant diseases and association with excess cement.
- 1.9 to 75% of implant sites with cemented restorations were diagnosed with peri-implant disease (mucositis or implantitis).
- 33 to 100% of sites exhibited excess cement.
- Prevalence of peri-implant diseases higher in cement retained (13-75%) vs screw-retained (0-64.5%).

Conclusions: Presence of excess cement associated with a tendency of higher disease prevalence. Higher disease prevalence with cemented vs screw retained implant restoration, esp with FPD or splinted crowns (esp with submucosal margins). Excess cement higher with short soft tissue healing periods. Early follow-ups allow for disease diagnosis and cement detection in early phase of inflammatory process.

Association between periodontitis treatment outcomes and peri-implantitis: A long-term retrospective cohort study.

Authors: Vagia P., et al.

DOI: 10.1111/clr.13741.

Purpose: To investigate if there is an association between periodontal treatment outcomes and long-term prevalence of peri-implantitis

Conclusions: Peri-implantitis incidence is associated with periodontal conditions before implant placement and is thus deemed a risk indicator. At follow up periodontal status severity was a reliable indicator of peri-implantitis susceptibility.

Impact of Maintenance Therapy for the Prevention of Peri-implant Diseases: A Systematic Review and Meta-analysis

Authors: Monje A, et al.

DOI: 10.1177/0022034515622432

Purpose: Assess the impact of peri-implant maintenance therapy (PIMT) on the incidence of peri-implant diseases. Focused question "What is the impact of PIMT upon the incidence of biologic complications (i.e., mucositis and peri-implantitis)?"

Conclusions: Implant therapy requires PIMT to reduce biologic complications and improve long-term success. Tailor to patient risk, with minimum 5–6 mo recall, though complications can still occur.

Association of prosthetic features and peri-implantitis: A cross-sectional study.

Authors: Yi Y, Koo KT, Schwarz F, Ben Amara H, Heo SJ.

DOI: 10.1111/jcpe.13251.

Purpose: to assess how prosthetic features impact peri-implantitis (PI).

Key Findings:

- 169 pts w/ 349 implants were included. MBLoss and PI were higher in EA $\neq$ 30 and convex groups. Mean MBLoss was 1.20mm
- and 24.8% of the implants had peri-implantitis. EP: convex (46.7%) straight (32.2%) concave (21.1%).

Conclusions: EA $\neq$ 30, convex EP, and splinting to M and D adjacent implants are associated w/ higher risks of peri-implantitis.

Restoration contour is a risk indicator for peri-implantitis: A cross-sectional radiographic analysis

Authors: Katafuchi M, Weinstein BF, Leroux BG, Chen Y-W, Daubert DM

DOI: 10.1111/jcpe.12829

Purpose: To analyze cross-sectional radiographs to determine whether wide emergence angles and/or convex profiles would increase risk for peri-implantitis.

Key Findings:

- 83 patients with $n=168$ implants were included (101 bone-level, 59 tissue-level).

Conclusions: For bone-level implants, emergence angle of 30 degrees is a risk indicator for peri-implantitis, with convex profile creating additional risk. Discussion- Shallower emergence angle with a straight or concave profile interproximally should be considered to minimize peri-implantitis risk for bone-level implants. The above conclusion cannot be made for tissue level implants. Marginal bone loss was not analyzed in this study. Oral hygiene access and plaque accumulation around the implant are the potential mechanisms to explain these results.

Iatrogenic Peri-Implantitis-Factors Interplaying the Implant Suprastructure Design

Authors: Dab, SS.

DOI: 10.1002/cap.10199

Purpose: To show how poor implant suprastructure design can contribute to peri-implantitis (PI) and how this risk may be reduced.

Key Findings:

- Overcontoured restorations may compress soft tissue, promote apical soft tissue migration, and contribute to BL around implants. Smooth, polished, slightly convex suprastructure contours are favored.

Conclusions: A favorable EA and EP can be achieved by creating adequate running room and a smooth, polished suprastructure through proper implant diameter selection based on ridge dimensions and depth of placement, which may improve long-term implant prognosis.

Implant prosthodontic design as a predisposing or precipitating factor for peri-implant disease: A review

Authors: Hamilton, A., et al.

DOI: 10.1111/cid.13183

Purpose: To summarize key prosthodontic design parameters associated with peri-implantitis and bone loss surrounding implants.

Key Findings:

- ***Lots of info in this article. Advise reading.***

Conclusions: The design of implant restorations directly impacts future peri-implant health. Imperative to consider restorative outcomes when planning implants, ensuring that restorative contours and cleansability are prioritized. If implants pose a risk to the long-term success of the restoration, additional bone and soft tissue augmentation may be needed, or an alternative prosthesis may be required

The Prosthetic-Biologic Connection and Its Influence on Peri-implant Health: An Overview of the Current Evidence.

Authors: Saleh MH, Galli M, Siqueira R, Vera M, Wang HL, Ravida A.

DOI: 10.11607/jomi.9523

Purpose: to discuss key prosthetic factors associated with peri-implant diseases.

Key Findings:

- ***Important article.***
- *Relationship between implant positioning and access for monitoring and hygiene:*
- *“Too buccal” placement - increased peri-implant bone remodeling as well as a higher susceptibility to development of hard and soft tissue deficiencies and esthetic concerns.*
- *Need: 2 mm of buccal bone relative to the implant platform.*
- *Too lingual” placement may result in an overcontoured restoration facilitating food debris accumulation and hindering access for hygiene and peri-implant probing*
- *Too shallow” implant placement does not allow establishment of adequate peri-implant supracrestal tissue height - overcontoured restorations, implant thread exposure, and esthetic concerns.*
- *Too deep” implant placement - higher propensity for deeper PD and may potentially create a niche for pathogenic bacterial accumulation. Saleh 2018 (Sys Rev): subcrestal implant positioning does not create significant differences in marginal bone loss (MBL) as long as the implants are not placed too deep (3 mm subcrestally).*
- *To splint or not to splint?*

Conclusions: Current evidence shows that the prosthetic factors are significantly intertwined with the biologic response of the periimplant supporting tissues. Each step of the restorative process is important in determining long-term prosthetic and biologic outcomes.