

Updated Cologne ABC Risk Score for implant treatment – Guideline 2022

Risk assessment at a glance

Among the many continuing professional development (CPD) events in the dental field, the Expert Symposium by BDIZ EDI – European Association of Dental Implantologists is an event that sets standards. After ten years, the paper on the Cologne ABC Risk Score has now been revised and updated. The 17th European Consensus Conference of BDIZ EDI (EuCC) conducted this year's proceedings using remote communication technology. Prof. Dr Jörg Neugebauer presented the results at the 17th Expert Symposium in Cologne.

Held in conjunction with the Expert Symposium, the European Consensus Conference (EuCC) discussed the topic "Cologne ABC Risk Score for Implant Treatment". As every year, the results of the Consensus Conference were condensed into a BDIZ EDI Guideline designed to assist dental implantologists in assessing, ahead of time, in advance the individual complexity of a given implantological procedure, thereby contributing to minimizing risks associated with implant therapy.

On 26 April 2022, the EuCC, hosted by Professor Hans-Joachim Nickenig, discussed a working paper submitted by members of the University of Cologne. Using a simple ABC system, possibly and attractively visualized in four colours, clinicians are given the opportunity to assess the risk of their planned implant treatment.

There are four partial scores:

1. Medical history
2. Local findings
3. Surgical
4. Restorative

Each partial score is given a summary rating, with the results – like the criteria – expressed in terms of the colours green, yellow and orange, corresponding to A, B and C (Always – Between – Complex). If two or more criteria for a partial score are assessed as yellow (for B, medium risk), the entire partial score is deemed to be B (yellow, medium risk). Similarly, four yellow or two orange criteria result in an overall partial score of C (orange, increased risk). The ABC classification is defined as follows:

- **A = Always**
lowest assessed risk, green
- **B = Between**
medium risk, yellow
- **C = Complex**
increased risk, orange

Red is reserved for cases where the risk assessment shows that treatment at issue may not be recommended (which is not the same as being contraindicated). "We do not want to issue any contraindications, but if a partial score is red, the therapy in question may not be recommended," Neugebauer said.

The overall patient assessment for the Cologne ABC Risk Score works as follows:

- If all four partial scores are green, the patient case as a whole is assessed as low-risk (A for Always).
- If at least two of the four partial scores are yellow, the patient case is assessed as medium-risk (B for Between)
- If all four partial scores are yellow, the patient case is assessed as high-risk (C for Complex). The same is true if at least two of the four partial scores are orange or yellow.

Compared to the previous version of the ABC Risk Score, Neugebauer pointed out, certain changes have been made, particularly in the area of medication. One innovation was the classification of antiresorptive drugs (ARD). At high doses, the respective partial score is assessed as red: no bone augmentation and no immediate implant placement recommended. Further drugs were included to reflect new developments in recent years. Local findings now incorporate the prevailing occlusal situation.

AWU

Info

The Cologne ABC Risk Score can be determined as a total score for findings and treatment planning or separately for the different partial scores. The Cologne ABC Risk Score developed by the 17th European Consensus



Conference of BDIZ EDI is available to members as a download, including literature references, at www.bdizedi.org/en/european-consensus-conference/ or using the QR code in this box.



Bundesverband der
implantologisch
tätigen Zahnärzte
in Europa

European
Association of
Dental
Implantologists

Guideline 2022

Cologne ABC Risk Score for Implant Treatment (Update)

17th European Consensus Conference (EuCC) 2022

April 26, 2022

Authors: Prof Hans-Joachim Nickenig
Prof Jörg Neugebauer
Prof Joachim E. Zöller
Interdisciplinary Polyclinic for Oral Surgery and Implantology and Department of Oral and Maxillofacial Plastic Surgery, University of Cologne, Director: Professor Joachim E. Zöller

Host: Prof Hans-Joachim Nickenig (Germany)
Secretary: Prof Jörg Neugebauer (Germany)

Participants: Christian Berger (Germany)
Dr Eimear O'Connell (Great Britain)
Prof António Felino (Portugal)
Dr Fisnik Kasapi (North Macedonia)
Prof Pavel Kobler (Croatia)
Prof Vitomir Konstantinović (Serbia)
Dr Stefan Liepe (Germany)
Prof Katalin Nagy (Hungary)
Prof Jörg Neugebauer (Germany)
Dr Wolfgang Neumann (Germany)
Prof Hans-Joachim Nickenig
Prof Hakan Özyuvacı (Turkey)
Witold Tomkiewicz (Poland)
Dr Jan Willem Vaartjes (Netherlands)
Prof Andrzej Wojtówic (Poland)
Prof Joachim E. Zöller (Germany)

Content

1. Methods	Page	2
2. Practical application of the Cologne ABC Risk Score	Page	3
3. Partial scores (Medical history – Local findings – Surgical – Restorative)	Page	5
4. References	Page	7

BDIZ EDI
Mühlenstr. 18
51143 Köln
Germany

Phone: +49 2203 8009339
Fax +49 2203 9168822
office@bdizedi.org
www.bdizedi.org



Guideline: Cologne ABC Risk Score for Implant Treatment (Update)
17th European Consensus Conference (EuCC), April 2022
Page 2 of 4

1. Methods

1.1. Purpose

This updated Guideline was designed to help dental implantologists to assess, in advance, the individual complexity of a given implantological procedure, contributing to minimizing risks associated with implant therapy. It is an update of the 2007 Guideline.

1.2. Introduction

This consensus paper addresses the general aspects (i.e., those aspects not specific to a given implant design) of implant treatment to eliminate diagnostic and therapeutic uncertainties and to avoid complications. All consensus recommendations in this paper should be considered as guidelines only. The patient's specific situation is always an important consideration and may justify a deviation from the recommendations of this consensus paper.

1.3. Background

Since the first elaboration of the Cologne ABC Risk Score, overall medical treatment concepts with a bearing on implant treatment have evolved. For this reason, Partial Score (Medical history) had to be revised extensively- The more strictly implantological partial scores 2 to 4 were revised according to reflect the current state of our knowledge.

1.4. Literature search

The Cochrane Library, EMBASE, DIMDI and Medline literature databases were used to conduct the search. The searching strategy included selected search terms specific to the corresponding fields and issues. The studies returned by the search were screened by reading the abstracts. Studies found to be irrelevant to the subject were identified and excluded on this basis. All articles that were found to be (potentially) relevant were obtained in full-text form. Few if any randomized controlled trials (RCT) or other systematic clinical studies were available on the various topics.

1.5. Procedure for developing the Guideline/consensus paper

A first draft of the Cologne ABC Risk Score (authored by Professors *Hans-Joachim Nickenig*, *Joachim E. Zöller* and *Jörg Neugebauer*, Interdisciplinary Polyclinic for Oral Surgery and Implantology and Department of Oral and Maxillofacial Plastic Surgery, University of Cologne, Director: Professor Joachim E. Zöller) was made available online to the members of the working group on the day of the consensus conference.

The agenda of the Consensus Conference consisted of four steps: Reviewing the preliminary draft; collecting alternative proposals; discussing non-consensual issues; final voting.

BDIZ EDI
Mühlenstr. 18
51143 Köln
Germany

Phone: +49 2203 8009339
Fax +49 2203 9168822
office@bdizedi.org
www.bdizedi.org



Guideline: Cologne ABC Risk Score for Implant Treatment (Update)
17th European Consensus Conference (EuCC), April 2022
Page 3 of 4

2. Practical application of the Cologne ABC Risk Score

2.1. Introduction

Descriptions in the literature are limited mainly to classifications or scores applicable only to partial aspects of implant therapy (e.g., classifications for indications). There are only few classifications intended to assess the overall risk involved with a potential implantological patient case (e.g., the SAC Classification). The Cologne ABC Risk Score is intended to allow a professional assessment of an individual case with regard to medical history, local findings, surgical aspects and restorative aspects to be made simply and quickly and in a well-structured manner. Only a few scattered RCT on the subject matter of the partial scores were available at the time of the consensus conference. The studies that were available for review were mainly retrospective studies (evidence levels IIb/III), so the level of recommendation of these guidelines falls into class B (indicating "should"-type recommendations).

2.2. Principles of the Cologne ABC Risk Score (see enclosed form)

- Any evaluation or risk assessment using the Cologne ABC Risk Score is made specifically for an individual patient.
- The Cologne ABC Risk Score can be assessed only by the treating physician (or team of physicians).
- The Cologne ABC Risk Score is unsuitable for assessing risks based on patient records or diagnostic casts.
- The Cologne ABC Risk Score can be determined as a total score for overall findings (medical history and local findings) and treatment planning (surgical and restorative).
- Partial scores of the Cologne ABC Risk Score can be used if appropriate (e.g., for restorative aspects only, in the case of patient referrals).

2.3. Evaluation of the Cologne ABC Risk Score

Each of the partial scores of the Cologne ABC Risk Score should be assessed as completely as possible.

2.3.1 Criteria

- Each criterion or issue within a partial score receives its own appropriate rating, where green stands for A (Always, lowest assessed risk), yellow stands for B (Between, medium risk) and orange stands for C (Complex, high risk)
- Red is strictly reserved for situations where the risk profile indicates that treatment may not be recommended (which is not the same as a contraindication).

2.3.2. Partial scores (Medical history – Local findings – Surgical – Restorative)

- Each partial score is given a summary rating, with the results – like the criteria – expressed in terms of the colours green, yellow and orange, corresponding to A, B and C (Always – Between – Complex).
- If two or more criteria for a partial score are assessed as yellow (for B, medium risk), the entire partial score is deemed to be B (yellow, medium risk). Four yellow or two orange criteria result in an overall partial score of C (orange, high risk).

BDIZ EDI
Mühlenstr. 18
51143 Köln
Germany

Phone: +49 2203 8009339
Fax +49 2203 9168822
office@bdizedi.org
www.bdizedi.org



Guideline: Cologne ABC Risk Score for Implant Treatment (Update)
17th European Consensus Conference (EuCC), April 2022
Page 4 of 4

2.3.3 Overall assessment of a given patient case

- If all four partial scores are green, the patient case as a whole is assessed as low-risk (A for Always).
- If at least two of the four partial scores are yellow, the patient case is assessed as medium-risk (B for Between).
- If all four partial scores are yellow, the patient case is assessed as high-risk (C for Complex).

The same is true if at least two of the four partial scores are orange or yellow.



Cologne, 7 May 2022

Prof Joachim E. Zöller
Vice President

Prof Jörg Neugebauer
Secretary General

BDIZ EDI
Mühlenstr. 18
51143 Köln
Germany

Phone: +49 2203 8009339
Fax +49 2203 9168822
office@bdizedi.org
www.bdizedi.org

PARTIAL SCORE 1: MEDICAL HISTORY

Health status	ASA classification [11]	ASA = 1, 2	Small risk
		ASA = 3	Medium risk
		ASA ≥ 4	High risk
Pre-existing conditions	diabetes mellitus [5, 15, 17, 18, 44, 45, 54, 55, 61, 78]	HbA1c < 6.5	Small risk
		HbA1c 6.5–7.5	Medium risk
		HbA1c > 7.5	High risk
	irradiated jaw [18, 25, 62, 79, 88]	< 55 Gy	Medium risk
		< 55 Gy: maxilla or augmented areas	Therapy not recommended (no AI)
		> 55 Gy	Therapy not recommended (no AI)
		in past 12 months	Therapy not recommended (no AI)
	periodontal disease [6, 21, 28, 53, 72, 76, 87]	no evidence of periodontal disease	Small risk
		treated or history of periodontal disease	Medium risk
		inadequate supportive periodontal therapy	High risk
untreated periodontal disease		Therapy not recommended (no AI)	
Medications	no medication		Small risk
	anti-resorptive drugs (ARD) [7, 16, 40, 63, 67, 77, 81, 85]	lower dose, for osteoporosis (oral and systemic)	Small risk
		• low dose with bone augmentation, immediate implant placement	Medium risk
		higher dose, for the prevention of osseous tumour-related complications	Medium risk
		• higher dose with augmentation, immediate implant placement	Therapy not recommended (no AI)
		high dose, > 4 × yearly for the treatment of osseous metastases	High risk
		• high dose with bone augmentation, immediate implant placement	Therapy not recommended (no AI)
		ARD and other infection risks (e.g., periodontal disease)	Therapy not recommended (no AI)
		ARD and drug-related cofactors (e.g., immunosuppression)	Therapy not recommended (no AI)
	immunosuppression [32, 33, 68]	low dose steroid therapy	Medium risk
		cytotoxic medication	High risk
	anticoagulation	prophylactic	Small risk
therapeutic		Medium risk	
proton pump inhibitors [1, 4, 27]		Medium risk	
Smoking [18, 24, 59]	non-smoker	Small risk	
	mild smoking habit	Medium risk	
	severe smoking habit	High risk	
Bruxism [10, 22, 26, 49–51, 89]	no	Small risk	
	yes	High risk	
Patient expectations [86]	appropriate	Small risk	
	over-demanding	Medium risk	

KEY TO COLOURS

	Small risk		Medium risk		High risk		Therapy not recommended (no AI)
-------------------------------------------------------------------------------------	------------	-------------------------------------------------------------------------------------	-------------	-------------------------------------------------------------------------------------	-----------	---------------------------------------------------------------------------------------	---------------------------------

PARTIAL SCORE 2: LOCAL FINDINGS

Aesthetic risk factors	outside the aesthetic zone		Green
	smile line [83]	low	Green
		medium	Yellow
		high	Orange
Soft tissue	attached gingiva [14, 56]	adequate	Green
		inadequate	Yellow
	periodontal biotype [3, 35, 43, 46, 75]	thick biotype	Green
		thin biotype	Orange
previous surgeries/scar tissue		Orange	
Cologne Classification of Alveolar Ridge Defects (CCARD)	no or small defect		Green
	horizontal, > 4 mm		Yellow
	vertical or combined, > 4 mm		Orange
	outside the alveolar ridge		Orange
Jaw position	regular		Green
	unfavourable		Orange
Periapical lesions, pathologies of adjacent teeth [31, 66, 69]	no		Green
	present		Orange
Oral hygiene [29]	adequate		Green
	inadequate		Orange

PARTIAL SCORE 3: SURGICAL

Anatomical risks [38, 80]	none		Green
	close proximity to adjacent structures (nerves, roots, papillae, etc.)		Yellow
Healing period after tooth loss [9, 19, 23, 37]	late implant placement		Green
	early or delayed implant placement		Green
	immediate implant placement		Yellow
Loading after insertion [13, 20, 37, 73]	conventional healing (at least 8 weeks)		Green
	early loading (within 4 to 8 weeks)		Green
	early restoration/loading (within 72 hours)		Yellow
Augmentation techniques [2, 57]	Cologne Classification of Alveolar Ridge Defects (CCARD)	no augmentation required	Green
		horizontal, > 4 mm	Yellow
		vertical or combined, > 4 mm	Orange
		outside the alveolar ridge	Orange
	sinus floor elevation [34, 48, 60]	with septae	Yellow
		Internal sinus lift with < 2 mm residual bone height	Orange

PARTIAL SCORE 4: RESTORATIVE

Biomechanics [39]	no biomechanical problems expected		
	implant/tooth connection [12, 42, 47, 82, 84]	rigid	
		mobile	
	extension required [36, 70, 71, 74]		
	unfavourable load distribution [65] (crown-to-implant ratio/single-tooth restoration)		
	non-matching implant diameter [52]		
	need for repair, superstructure revision		
multiple implant systems in same restoration			
Aesthetics [41, 52, 58]	adjacent tooth situation	tooth	
		pontic	
		Implant	
Type of restoration [39, 52, 64]	number and distribution of implants	adequate	
		not adequate	
	fixed restoration	cross-arch fixed restoration	
	removable	bridge design	
Complexity exceeding patient capabilities [64, 86]	handling or cleansability	favourable	
		difficult or impossible	

LIST OF REFERENCES FOR THE 2022 COLOGNE ABC RISK SCORE

- Aghaloo T, Pi-Anfruns J, Moshaverinia A, Sim D, Grogan T, Hadaya D. The Effects of Systemic Diseases and Medications on Implant Osseointegration: A Systematic Review. *Int J Oral Maxillofac Implants* 2019; 34: s35–s49.
- Aghaloo TL, Moy PK. Which hard tissue augmentation techniques are the most successful in furnishing bony support for implant placement? *Int J Oral Maxillofac Implants* 2007; 22 Suppl: 49–70.
- Al-Sabbagh M, Xenoudi P, Al-Shaikhi F, Eldomiati W, Hanafy A. Does Peri-Implant Mucosa Have a Prognostic Value? *Dent Clin North Am* 2019; 63: 567–580.
- Altay MA, Sindel A, Ozalp O, Yildirimyan N, Kocabalkan B. Proton pump inhibitor intake negatively affects the osseointegration of dental implants: a retrospective study. *J Korean Assoc Oral Maxillofac Surg* 2019; 45: 135–140.
- American Diabetes A. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2019. *Diabetes Care* 2019; 42: S13–S28.
- Amerio E, Mainas G, Petrova D, Giner Tarrida L, Nart J, Monje A. Compliance with supportive periodontal/peri-implant therapy: A systematic review. *J Clin Periodontol* 2020; 47: 81–100.
- Anastasilakis AD, Pepe J, Napoli N, Palermo A, Magopoulos C, Khan AA, Zillikens MC, Body JJ. Osteonecrosis of the Jaw and Antiresorptive Agents in Benign and Malignant Diseases: A Critical Review Organized by the ECTS. *J Clin Endocrinol Metab* 2022; 107: 1441–1460.
- Bajkin BV, Wahl MJ, Miller CS. Dental implant surgery and risk of bleeding in patients on anti-thrombotic medications: A review of the literature. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2020; 130: 522–532.
- Bassir SH, El Kholy K, Chen CY, Lee KH, Intini G. Outcome of early dental implant placement versus other dental implant placement protocols: A systematic review and meta-analysis. *J Periodontol* 2019; 90: 493–506.
- Bertolini MM, Del Bel Cury AA, Pizzoloto L, Acapa IRH, Shibli JA, Bordin D. Does traumatic occlusal forces lead to peri-implant bone loss? A systematic review. *Braz Oral Res* 2019; 33: e069.
- Böhmer A, Defosse J, Geldner G, Rossaint R, Zacharowski K, Zwißler B, Wappler F. Die aktualisierte Version der ASA-Klassifikation. *Anästh Intensivmed* 2021; 62: 223–228.
- Borg P, Puryer J, McNally L, O'Sullivan D. The Overall Survival, Complication-Free Survival, and Related Complications of Combined Tooth-Implant Fixed Partial Dentures: A Literature Review. *Dent J (Basel)* 2016; 4.
- Borges GA, Costa RC, Nagay BE, Magno MB, Maia LC, Barao VAR, Mesquita MF. Long-term outcomes of different loading protocols for implant-supported mandibular overdentures: A systematic review and meta-analysis. *J Prosthet Dent* 2021; 125: 732–745.
- Brito C, Tenenbaum HC, Wong BK, Schmitt C, Nogueira-Filho G. Is keratinized mucosa indispensable to maintain peri-implant health? A systematic review of the literature. *J Biomed Mater Res B Appl Biomater* 2014; 102: 643–650.
- Bundesärztekammer (BÄK), Kassenärztliche Bundesvereinigung (KBV), Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF). Nationale VersorgungsLeitlinie Typ-2-Diabetes—Teilpublikation der Langfassung, 2. Auflage. Version 1. 2021; 10.6101/AZQ/000475.
- Chadha GK, Ahmadieh A, Kumar S, Sedghizadeh PP. Osseointegration of dental implants and osteonecrosis of the jaw in patients treated with bisphosphonate therapy: a systematic review. *J Oral Implantol* 2013; 39: 510–520.
- Chambrone L, Palma LF. Current status of dental implants survival and peri-implant bone loss in patients with uncontrolled type-2 diabetes mellitus. *Curr Opin Endocrinol Diabetes Obes* 2019; 26: 219–222.
- Chen H, Liu N, Xu X, Qu X, Lu E. Smoking, radiotherapy, diabetes and osteoporosis as risk factors for dental implant failure: a meta-analysis. *PLoS One* 2013; 8: e71955.
- Chen H, Zhang G, Weigl P, Gu X. Immediate placement of dental implants into infected versus noninfected sites in the esthetic zone: A systematic review and meta-analysis. *J Prosthet Dent* 2018; 120: 658–667.
- Cheng Q, Su YY, Wang X, Chen S. Clinical Outcomes Following Immediate Loading of Single-Tooth Implants in the Esthetic Zone: A Systematic Review and Meta-Analysis. *Int J Oral Maxillofac Implants* 2020; 35: 167–177.
- Chrcanovic BR, Albrektsson T, Wennerberg A. Periodontally compromised vs. periodontally healthy patients and dental implants: a systematic review and meta-analysis. *J Dent* 2014; 42: 1509–1527.
- Chrcanovic BR, Albrektsson T, Wennerberg A. Bruxism and Dental Implants: A Meta-Analysis. *Implant Dent* 2015; 24: 505–516.
- Chrcanovic BR, Albrektsson T, Wennerberg A. Dental implants inserted in fresh extraction sockets versus healed sites: a systematic review and meta-analysis. *J Dent* 2015; 43: 16–41.
- Chrcanovic BR, Albrektsson T, Wennerberg A. Smoking and dental implants: A systematic review and meta-analysis. *J Dent* 2015; 43: 487–498.
- Chrcanovic BR, Albrektsson T, Wennerberg A. Dental implants in irradiated versus nonirradiated patients: A meta-analysis. *Head Neck* 2016; 38: 448–481.
- Chrcanovic BR, Kisch J, Albrektsson T, Wennerberg A. Bruxism and dental implant failures: a multilevel mixed effects parametric survival analysis approach. *J Oral Rehabil* 2016; 43: 813–823.
- Chrcanovic BR, Kisch J, Albrektsson T, Wennerberg A. Intake of Proton Pump Inhibitors Is Associated with an Increased Risk of Dental Implant Failure. *Int J Oral Maxillofac Implants* 2017; 32: 1097–1102.
- Coli P, Christiaens V, Sennerby L, Bruyn H. Reliability of periodontal diagnostic tools for monitoring peri-implant health and disease. *Periodontol* 2000 2017; 73: 203–217.
- Cortellini S, Favril C, De Nutte M, Teughels W, Quirynen M. Patient compliance as a risk factor for the outcome of implant treatment. *Periodontol* 2000 2019; 81: 209–225.
- Dawoud BES, Kent S, Tabbenor O, George P, Dhanda J. Dental implants and risk of bleeding in patients on oral anticoagulants: a systematic review and meta-analysis. *Int J Implant Dent* 2021; 7: 82.
- Di Murro B, Canullo L, Pompa G, Di Murro C, Papi P. Prevalence

- and treatment of retrograde peri-implantitis: a retrospective cohort study covering a 20-year period. *Clin Oral Investig* 2021; 25: 4553–4561.
32. Diz P, Scully C, Sanz M. Dental implants in the medically compromised patient. *J Dent* 2013; 41: 195–206.
 33. Duttenhoefer F, Fuessinger MA, Beckmann Y, Schmelzeisen R, Groetz KA, Boeker M. Dental implants in immunocompromised patients: a systematic review and meta-analysis. *Int J Implant Dent* 2019; 5: 43.
 34. Esposito M, Felice P, Worthington HV. Interventions for replacing missing teeth: augmentation procedures of the maxillary sinus. *Cochrane Database Syst Rev* 2014; 5: CD008397.
 35. Forna N, Agop-Forna D. Esthetic aspects in implant-prosthetic rehabilitation. *Med Pharm Rep* 2019; 92: 6–13.
 36. Freitas da Silva EV, Dos Santos DM, Sonego MV, de Luna Gomes JM, Pellizzer EP, Goiato MC. Does the Presence of a Cantilever Influence the Survival and Success of Partial Implant-Supported Dental Prostheses? Systematic Review and Meta-Analysis. *Int J Oral Maxillofac Implants* 2018; 33: 815–823.
 37. Garcia-Sanchez R, Dopic J, Kalemaj Z, Buti J, Pardo Zamora G, Mardas N. Comparison of clinical outcomes of immediate versus delayed placement of dental implants: A systematic review and meta-analysis. *Clin Oral Implants Res* 2022; 33: 231–277.
 38. Giovannoli JL, Rocuzzo M, Albouy JP, Duffau F, Lin GH, Serino G. Local risk indicators - Consensus report of working group 2. *Int Dent J* 2019; 69 Suppl 2: 7–11.
 39. Goodacre CJ, Bernal G, Rungcharasaeung K, Kan JY. Clinical complications with implants and implant prostheses. *J Prosthet Dent* 2003; 90: 121–132.
 40. Guazzo R, Sbricoli L, Ricci S, Bressan E, Piattelli A, Iaculli F. Medication-Related Osteonecrosis of the Jaw and Dental Implants Failures: A Systematic Review. *J Oral Implantol* 2017; 43: 51–57.
 41. Happe A, Schmidt A, Neugebauer J. Peri-implant soft-tissue esthetic outcome after immediate implant placement in conjunction with xenogeneic acellular dermal matrix or connective tissue graft: A randomized controlled clinical study. *J Esthet Restor Dent* 2022; 34: 215–225.
 42. Hoffmann O, Zafiropoulos GG. Tooth-implant connection: a review. *J Oral Implantol* 2012; 38: 194–200.
 43. Isler SC, Uraz A, Kaymaz O, Cetiner D. An Evaluation of the Relationship Between Peri-implant Soft Tissue Biotype and the Severity of Peri-implantitis: A Cross-Sectional Study. *Int J Oral Maxillofac Implants* 2019; 34: 187–196.
 44. Javed F, Romanos GE. Impact of diabetes mellitus and glycemic control on the osseointegration of dental implants: a systematic literature review. *J Periodontol* 2009; 80: 1719–1730.
 45. Jiang X, Zhu Y, Liu Z, Tian Z, Zhu S. Association between diabetes and dental implant complications: a systematic review and meta-analysis. *Acta Odontol Scand* 2021; 79: 9–18.
 46. Khzam N, Arora H, Kim P, Fisher A, Mattheos N, Ivanovski S. Systematic Review of Soft Tissue Alterations and Esthetic Outcomes Following Immediate Implant Placement and Restoration of Single Implants in the Anterior Maxilla. *J Periodontol* 2015; 86: 1321–1330.
 47. La Monaca G, Pranno N, Annibaldi S, Massimo C, Polimeni A, Patini R, Paola Cristalli M. Survival and complication rates of tooth-implant versus freestanding implant supporting fixed partial prosthesis: a systematic review and meta-analysis. *J Prosthodont Res* 2021; 65: 1–10.
 48. Lozano-Carrascal N, Anglada-Bosqued A, Salomo-Coll O, Hernandez-Alfaro F, Wang HL, Gargallo-Albiol J. Short implants (<8mm) versus longer implants (>=8mm) with lateral sinus floor augmentation in posterior atrophic maxilla: A meta-analysis of RCTs in humans. *Med Oral Pathol Oral Cir Bucal* 2020; 25: e168–e179.
 49. Manfredini D, Ahlberg J, Lobbezoo F. Bruxism definition: Past, present, and future - What should a prosthodontist know? *J Prosthet Dent* 2021; 10.1016/j.prosdent.2021.01.026.
 50. Manfredini D, Poggio CE, Lobbezoo F. Is bruxism a risk factor for dental implants? A systematic review of the literature. *Clin Implant Dent Relat Res* 2014; 16: 460–469.
 51. Melo G, Duarte J, Pualetto P, Porporatti AL, Stuginski-Barbosa J, Winocur E, Flores-Mir C, De Luca Canto G. Bruxism: An umbrella review of systematic reviews. *J Oral Rehabil* 2019; 46: 666–690.
 52. Momberger N, Mukaddam K, Zitzmann NU, Bornstein MA, Filippi A, Kuhl S. Esthetic and functional outcomes of narrow-diameter implants compared in a cohort study to standard diameter implants in the anterior zone of the maxilla. *Quintessence Int* 2022; 53: 502–509.
 53. Monje A, Aranda L, Diaz KT, Alarcon MA, Bagramian RA, Wang HL, Catena A. Impact of Maintenance Therapy for the Prevention of Peri-implant Diseases: A Systematic Review and Meta-analysis. *J Dent Res* 2016; 95: 372–379.
 54. Monje A, Catena A, Borgnakke WS. Association between diabetes mellitus/hyperglycaemia and peri-implant diseases: Systematic review and meta-analysis. *J Clin Periodontol* 2017; 44: 636–648.
 55. Moraschini V, Barboza ES, Peixoto GA. The impact of diabetes on dental implant failure: a systematic review and meta-analysis. *Int J Oral Maxillofac Surg* 2016; 45: 1237–1245.
 56. Moraschini V, Luz D, Velloso G, Barboza EDP. Quality assessment of systematic reviews of the significance of keratinized mucosa on implant health. *Int J Oral Maxillofac Surg* 2017; 46: 774–781.
 57. Moy PK, Aghaloo T. Risk factors in bone augmentation procedures. *Periodontol* 2000 2019; 81: 76–90.
 58. Naishlos S, Reiser V, Zelikman H, Nissan J, Masri D, Nassra H, Chaushu G, Blumer S, Chaushu L. Esthetic Assessment following Ridge Augmentation, Late Implant Placement and Immediate Esthetic Reconstruction of the Atrophic Anterior Maxilla. *Int J Environ Res Public Health* 2022; 19.
 59. Naseri R, Yaghini J, Feizi A. Levels of smoking and dental implants failure: A systematic review and meta-analysis. *J Clin Periodontol* 2020; 47: 518–528.
 60. Nasr S, Slot DE, Bahaa S, Dorfer CE, Fawzy El-Sayed KM. Dental implants combined with sinus augmentation: What is the merit of bone grafting? A systematic review. *J Craniomaxillofac Surg* 2016; 44: 1607–1617.
 61. Naujokat H, Kuzendorf B, Wiltfang J. Dental implants and diabetes mellitus-a systematic review. *Int J Implant Dent* 2016; 2: 5.
 62. Nooh N. Dental implant survival in irradiated oral cancer patients: a systematic review of the literature. *Int J Oral Maxillofac Implants* 2013; 28: 1233–1242.
 63. Papadakis I, Spanou A, Kalyvas D. Success Rate and Safety of Dental Implantology in Patients Treated With Antiresorptive Medication: A Systematic Review. *J Oral Implantol* 2021; 47: 169–180.
 64. Paspapiridakos P, Bordin TB, Kim YJ, El-Rafie K, Pagni SE, Natto ZS, Teixeira ER, Chochlidakis K, Weber HP. Technical Complications and Prosthesis Survival Rates with Implant-Supported Fixed Complete Dental Prostheses: A Retrospective Study with 1- to 12-Year Follow-Up. *J Prosthodont* 2020; 29: 3–11.
 65. Pellizzer EP, Marcela de Luna Gomes J, Araujo Lemos CA, Minatel L, Justino de Oliveira Limiro JP, Dantas de Moraes SL. The influence of crown-to-implant ratio in single crowns on clinical outcomes: A systematic review and meta-analysis. *J Prosthet Dent* 2021; 126: 497–502.
 66. Penarrocha-Oltra D, Blaya-Tarraga JA, Menendez-Nieto I, Penarrocha-Diago M, Penarrocha-Diago M. Factors associated with early apical peri-implantitis: A retrospective study covering a 20-year period. *Int J Oral Implantol (Berl)* 2020; 13: 65–73.
 67. Qi WX, Tang LN, He AN, Yao Y, Shen Z. Risk of osteonecrosis of the jaw in cancer patients receiving denosumab: a meta-analysis of seven randomized controlled trials. *Int J Clin Oncol* 2014; 19: 403–410.
 68. Radzewski R, Osmla K. The Use of Dental Implants in Organ Transplant Patients Undergoing Immunosuppressive Therapy: An Overview of Publications. *Implant Dent* 2016; 25: 541–546.
 69. Ramanauskaitė A, Juodzbalys G, Tozum TF. Apical/Retrograde Periimplantitis/Implant Periapical Lesion: Etiology, Risk Factors, and Treatment Options: A Systematic Review. *Implant Dent* 2016; 25: 684–697.
 70. Rodriguez AM, Aquilino SA, Lund PS. Cantilever and implant biomechanics: a review of the literature, Part 2. *J Prosthodont* 1994; 3: 114–118.
 71. Rodriguez AM, Aquilino SA, Lund PS. Cantilever and implant biomechanics: a review of the literature. Part 1. *J Prosthodont* 1994; 3: 41–46.
 72. Salvi GE, Cosgarea R, Sculean A. Prevalence and Mechanisms of Peri-implant Diseases. *J Dent Res* 2017; 96: 31–37.
 73. Sanda M, Fueki K, Bari PR, Baba K. Comparison of immediate and conventional loading protocols with respect to marginal bone loss around implants supporting mandibular overdentures: A systematic review and meta-analysis. *Jpn Dent Sci Rev* 2019; 55: 20–25.
 74. Schmid E, Morandini M, Rocuzzo A, Ramseier CA, Sculean A, Salvi GE. Clinical and radiographic outcomes of implant-supported fixed dental prostheses with cantilever extension. A retrospective cohort study with a follow-up of at least 10 years. In *Clinical oral implants research*, Edition 2020.
 75. Seyssens L, De Lat L, Cosyn J. Immediate implant placement with or without connective tissue graft: A systematic review and meta-analysis. *J Clin Periodontol* 2021; 48: 284–301.
 76. Sgolastra F, Petrucci A, Severino M, Gatto R, Monaco A. Peri-odontitis, implant loss and peri-implantitis. A meta-analysis. *Clin Oral Implants Res* 2015; 26: e8–e16.
 77. Sher J, Kirkham-Ali K, Luo JD, Miller C, Sharma D. Dental Implant Placement in Patients With a History of Medications Related to Osteonecrosis of the Jaws: A Systematic Review. *J Oral Implantol* 2021; 47: 249–268.
 78. Singh K, Rao J, Afsheen T, Tiwari B. Survival rate of dental implant placement by conventional or flapless surgery in controlled type 2 diabetes mellitus patients: A systematic review. *Indian J Dent Res* 2019; 30: 600–611.
 79. Smith Nobrega A, Santiago Jr, Jr, de Faria Almeida DA, Dos Santos DM, Pellizzer EP, Goiato MC. Irradiated patients and survival rate of dental implants: A systematic review and meta-analysis. *J Prosthet Dent* 2016; 116: 858–866.
 80. Smith RB, Rawdin SB, Kagan V. Influence of Implant-Tooth Proximity on Incidence of Caries in Teeth Adjacent to Implants in Molar Sites: A Retrospective Radiographic Analysis of 300 Consecutive Implants. *Compend Contin Educ Dent* 2021; 42: 38–42.
 81. Stavropoulos A, Bertl K, Pietschmann P, Pandis N, Schiodt M, Klinge B. The effect of antiresorptive drugs on implant therapy: Systematic review and meta-analysis. *Clin Oral Implants Res* 2018; 29 Suppl 18: 54–92.
 82. Tsasoulglou P, Michalakis K, Kang K, Weber HP, Sculean A. The effect of rigid and non-rigid connections between implants and teeth on biological and technical complications: a systematic review and a meta-analysis. *Clin Oral Implants Res* 2017; 28: 849–863.
 83. Tunkiwala A, Kher U, Bijlani P. Numerical guidelines for selection of implant supported prostheses for completely edentulous patients. *Quintessence India* 2017; 1: 47–54.
 84. von Stein-Launsnitz M, Nickenig HJ, Wolfart S, Neumann K, von Stein-Launsnitz A, Spies BC, Beuer F. Survival rates and complication behaviour of tooth implant-supported, fixed dental prostheses: A systematic review and meta-analysis. *J Dent* 2019; 88: 103167.
 85. Walter C, Al-Nawas B, Wolff T, Schiegnitz E, Grotz KA. Dental implants in patients treated with antiresorptive medication – a systematic literature review. *Int J Implant Dent* 2016; 2: 9.
 86. Wright SP, Hayden J, Lynd JA, Walker-Finch K, Willett J, Ucer C, Speechley SD. Factors affecting the complexity of dental implant restoration – what is the current evidence and guidance? *Br Dent J* 2016; 221: 615–622.
 87. Zangrando MS, Damante CA, Sant'Ana AC, Rubo de Rezende ML, Gregni SL, Chambrone L. Long-term evaluation of periodontal parameters and implant outcomes in periodontally compromised patients: a systematic review. *J Periodontol* 2015; 86: 201–221.
 88. Zen Filho EV, Tolentino Ede S, Santos PS. Viability of dental implants in head and neck irradiated patients: A systematic review. *Head Neck* 2016; 38 Suppl 1: E2229–E2240.
 89. Zhou Y, Gao J, Luo L, Wang Y. Does Bruxism Contribute to Dental Implant Failure? A Systematic Review and Meta-Analysis. *Clin Implant Dent Relat Res* 2016; 18: 410–420.