

# Prescription of antibiotics for the prevention of failures and postoperative infections in oral implantology: a literature review

**Précis:** The evidence does not support routine antibiotic administration for the prevention of dental implant infections and failures in healthy patients. Clinicians should consider the local, systemic and procedural risk factors for each patient before deciding to prescribe prophylactic antibiotics.



*Journal of the Irish Dental Association August/September 2021; 67 (4): 207-212*

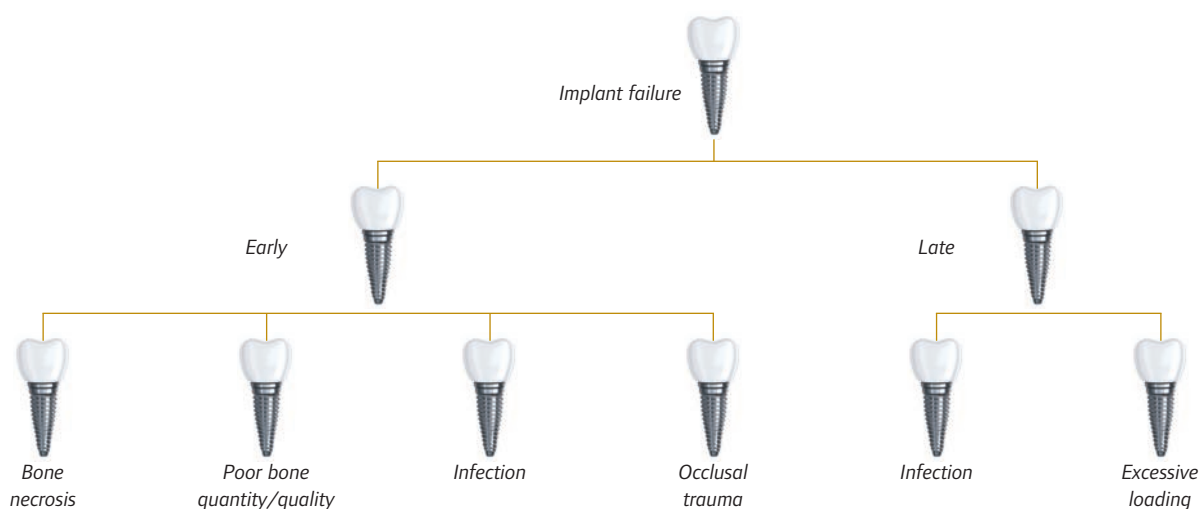


FIGURE 1: Classification of implant failure.

## Introduction

The increased success and survival of dental implants reported in the literature has led them to become increasingly popular. Albrektsson estimated that more than 12 million implants are placed annually around the globe.<sup>1</sup> A recent systematic review reported a mean survival value of 94.6% and success rates ranging from 34.9-100% over a mean follow-up period of 13 years.<sup>2</sup>

Antibiotics are a type of antimicrobial agent that kill or slow the growth of bacteria, and they are prescribed by health professionals to treat and prevent

infections. Surgical antibiotic prophylaxis can be defined as “the use of antibiotics to prevent infections at the surgical site”.<sup>3</sup> There are currently no clear guidelines on antibiotic prophylaxis for implant surgery and antibiotic prophylaxis remains a controversial topic.

## Dental implant failure

Dental Implant failures are subdivided into early and late failures (Figure 1). Early failure of implants occurs due to lack of osseointegration, while late



Dr Mohamed El Azrak BA BDentSc

Dr Ioannis Polyzois

Associate Professor/Consultant in Periodontology  
Dublin Dental University Hospital

Corresponding author: Dr Mohamed El Azrak E: elazrakm@tcd.ie

failures occur because osseointegration could not be maintained. Late failures usually occur within the first two years of implant service. Confounding factors that can precipitate infection or implant failure include: the experience of the operator; the degree of asepsis and surgical time; tobacco smoking; certain types of medication; the patient's overall health; and, the patient's oral hygiene practices.<sup>4-6</sup>

### Problems with antibiotic prescription

Reports suggest that around 30% of antibiotics prescribed in primary care settings are unnecessary.<sup>7</sup> The prescription of antibiotics is associated with risks to both the individual and the economy. In addition to the risk of side effects or allergic reactions to the patient, over prescription of antibiotics is associated with the emergence of resistant strains of bacteria.<sup>8</sup> Resistant infections can become fatal and the process of developing new antibiotics active against the resistant strains is expensive.

### Methods

A literature search was performed in MEDLINE through the PubMed database of the US National Library of Medicine and the Web of Science for articles published until May 2019 using Medical Subject Heading search terms [MESH] + free text terms alone and in different combinations. Key articles that were unavailable electronically were searched manually.

### Results

#### Antibiotic prophylaxis and dental implants

Antibiotic prophylaxis is recommended for surgical procedures in which infection is likely and for surgery where infection results in severe consequences even though it is unlikely.<sup>9</sup> The prevalence of postoperative infection following dental implant surgery ranges from 1.6% to 11.5%.<sup>10</sup> Dental implant infections are difficult to treat, and a lot of infected implants end up being removed.<sup>10</sup> In an attempt to avoid this complication, it has been reported that about 50% of dentists prescribe preoperative and/or postoperative antibiotics to all patients during implant placement.<sup>11-18</sup>

The first two published studies looking at the effect of antibiotic prescription on the outcome of dental implant placement provided conflicting results. Dent *et al.* (1997), in a prospective clinical trial, observed that when preoperative antibiotics were not used, the risk of implant failure increased two to three times (1.5% with preoperative antibiotics vs 4% without preoperative antibiotics).<sup>19</sup> On the other hand, Gynther *et al.* (1998) reported in a retrospective study that antibiotic prophylaxis does not offer any obvious advantage in the routine placement of implants in healthy patients.<sup>20</sup>

#### RCT comparing one preoperative antibiotic regimen vs no antibiotic (Table 1)

The randomised controlled trial (RCT) published by Kashani *et al.* (2019) is the only one to show a statistically significant difference in implant failure rates between the antibiotic and no antibiotic groups.<sup>21</sup> However, this trial was not placebo controlled and both the randomisation process and blinding are unclear. Additionally, a sub-analysis by the author showed that confounding factors associated with the surgical procedure affected the outcome.

#### RCTs comparing one preoperative antibiotic regimen vs placebo (Table 1)

Results from four double-blinded RCTs show that a single preoperative dose of antibiotics has no statistically significant effect on the incidence of postoperative infection or implant failure in healthy patients.<sup>22-25</sup> Thankfully, results also show that the risk of adverse events with antibiotic use is extremely low.<sup>22</sup>

The RCT published by Nolan *et al.* (2014) utilised 3g amoxicillin preoperatively as the intervention.<sup>23</sup> Although the differences were not statistically significant, failures and infections occurred only in the placebo group. Results demonstrated that longer surgical time and placement of multiple implants resulted in more implants failing to integrate. This could be explained by the fact that the implants were placed by postgraduate students and operator experience has previously been reported to have an effect on the survival of dental implants.<sup>26</sup>

Similar findings were reported by Anitua *et al.* (2009)<sup>24</sup> and Esposito *et al.* (2008, 2010).<sup>22,25</sup> It is important to note that in the study by Anitua and co-workers, the sample size was low and only patients requiring single implants were included.<sup>24</sup> Additionally, the implants were covered in plasma-rich growth factors (PRGFs) before placement. It has been demonstrated that PRGFs play a role in healing and bone regeneration, and thus this action might have skewed the results. In the two studies by Esposito and co-workers, different surgical approaches and loading times were followed.<sup>22,25</sup> Interestingly, it was found that immediate implants were more likely to fail regardless of antibiotic use.<sup>25</sup>

#### RCT comparing preoperative plus postoperative antibiotics vs no antibiotics (Table 1)

Abu Ta'a *et al.* (2008) used 1g of amoxicillin one hour preoperatively plus 500mg amoxicillin four times a day for two days postoperatively as their intervention.<sup>27</sup> Implant failure was only noted in those participants who did not receive antibiotics (five implants in three participants). One patient smoked more than 40 cigarettes a day and for the other patient a one-stage protocol was used and the patient had parafunctional habits. Postoperative infection was only detected in one participant in the antibiotic group and in four in the control group.

#### RCTs comparing multiple regimens of antibiotic prophylaxis (Table 1)

Two multicentre RCTs comparing different antibiotic regimens to each other and to no antibiotics showed no significant difference in the incidence of postoperative infection or implant failures.

In the study by Caiazzo *et al.* (2011), no postoperative infections were noted over follow-up of eight weeks.<sup>28</sup> However, the only two implant failures in the study occurred in the no antibiotic group. In the study by Tan *et al.* (2014), there was no suppuration noted in the no antibiotic group. However, that group had the one and only implant failure in the study.<sup>29</sup>

Table 1: Characteristics of RCTs.

| Primary author         | Number of subjects / implants               | Intervention                                                                                                                                                                                                                                          | Control                                           | Additional measures                                                                                                                                                                                                                                         | Smokers                                                                                                                                                                                                 | Drawbacks                                                                                                                                                          |
|------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Anitua <sup>24</sup>   | 105 (52 antibiotic, 53 placebo)/105         | 2g amoxicillin one hour preoperatively                                                                                                                                                                                                                | Placebo one hour preoperatively                   | Oral hygiene instructions<br>One-minute chlorhexidine rinse preoperatively<br>4mg intravenous or intramuscular dexamethasone<br>Implants were humidified in liquid plasma rich in growth factors (PRGF)                                                     | 19% smokers in antibiotic group<br>15% smokers in placebo group                                                                                                                                         | Trial supported by implant manufacturer<br>Relatively low sample size                                                                                              |
| Abu Ta'a <sup>27</sup> | 80 (40 antibiotic, 40 no antibiotic)/247    | 1g amoxicillin one hour preoperatively plus 500mg amoxicillin four times a day for two days                                                                                                                                                           | No antibiotics                                    | 0.12% chlorhexidine rinse for one minute preoperatively, and twice a day for one minute for 7-10 days postoperatively<br>Perioral skin for all patients disinfected for 30 seconds using cetrimonium bromide 0.5% in water and chlorhexidine 0.05% in water | Smokers included, percentage not reported                                                                                                                                                               | Not placebo controlled<br>Blinding is unclear<br>Heavy smokers included<br>Surgeons with different levels of experience performed surgeries                        |
| Esposito <sup>22</sup> | 316 (158 antibiotic, 158 placebo)/696       | 2g amoxicillin one hour preoperatively                                                                                                                                                                                                                | Placebo one hour preoperatively                   | OHI and debridement one week preoperatively<br>One-minute rinse 0.2% chlorhexidine preoperatively and twice a day for seven days postoperatively                                                                                                            | 37.3% smokers in antibiotic group; 31.6% smokers in placebo group                                                                                                                                       | Immediate, early and conventional loading done<br>136 immediate implants inserted<br>Variation in surgical approach<br>Multiple implant types used                 |
| Esposito <sup>25</sup> | 506 (252 antibiotic, 254 placebo)/972       | 2g amoxicillin one hour preoperatively                                                                                                                                                                                                                | Placebo one hour preoperatively                   | OHI and debridement one week preoperatively<br>One-minute rinse 0.2% chlorhexidine preoperatively and twice a day for seven days postoperatively                                                                                                            | 32.1% smokers in antibiotic group<br>34.6% smokers in placebo group                                                                                                                                     | Immediate, early and conventional loading done<br>136 immediate implants inserted<br>Variation in surgical approach<br>Multiple implant types used                 |
| Kashani <sup>21</sup>  | 447 (223 antibiotic, 224 no antibiotic)/963 | Amoxicillin 2g one hour preoperatively or 600mg clindamycin one hour preoperatively                                                                                                                                                                   | No antibiotics                                    | N/A                                                                                                                                                                                                                                                         | Not reported                                                                                                                                                                                            | Not placebo controlled<br>Randomisation and blinding unclear<br>Variation in surgical approach<br>Simultaneous grafting included<br>Hygiene protocols not reported |
| Nolan <sup>23</sup>    | 55 (27 antibiotic, 28 placebo)/82           | Amoxicillin 3g one hour preoperatively                                                                                                                                                                                                                | Placebo one hour preoperatively                   | One-minute rinse 0.2% chlorhexidine preoperatively and 4-5 times a day for seven days postoperatively                                                                                                                                                       | 25.9% smokers in antibiotic group<br>21.4% smokers in placebo group                                                                                                                                     | 28 of 83 initial participants excluded from the analysis<br>Variation in surgical approach<br>Multiple implant types used<br>Low sample size                       |
| Caiazzo <sup>28</sup>  | 100/148                                     | 2g amoxicillin one hour preoperatively (25 participants)<br>2g amoxicillin one hour preoperatively and 1g twice a day for seven days postoperatively (25 participants)<br>1g amoxicillin twice a day for seven days postoperatively (25 participants) | No antibiotics (25 participants)                  | Scaling and root planing<br>One-minute rinse 0.2% chlorhexidine preoperatively and twice a day for 15 days postoperatively                                                                                                                                  | Not reported                                                                                                                                                                                            | Low sample size<br>Not placebo controlled<br>Subjects and assessor not blinded<br>No allocation concealment implemented<br>Multiple implant systems used           |
| Tan <sup>29</sup>      | 329/329                                     | 2g amoxicillin one hour preoperatively (81 participants)<br>2g amoxicillin immediately postoperatively (82 participants)<br>2g amoxicillin one hour preoperatively and 500mg three times daily postoperatively (86 participants)                      | Placebo one hour preoperatively (80 participants) | Periodontal and endodontic health was established prior to surgical interventions<br>One-minute rinse 0.2% chlorhexidine preoperatively                                                                                                                     | 8.6% smokers in preoperative antibiotic group<br>11% smokers in postoperative-only antibiotic group<br>12.8% smokers in preoperative and postoperative antibiotic group<br>10% smokers in placebo group | Single blinded (patients not blinded)                                                                                                                              |

Table 2: Findings of systematic reviews and meta-analyses.

| Primary author           | Year | Number of studies included | Findings                                                                                                                                                                                          |
|--------------------------|------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ahmad <sup>45</sup>      | 2012 | 6                          | Antibiotic prophylaxis is not beneficial in low- and moderate-risk patients                                                                                                                       |
| Esposito <sup>37</sup>   | 2013 | 6                          | Prophylactic antibiotics significantly reduce early implant failures but are of no significance in reducing postoperative infections                                                              |
| Ata-Ali <sup>35</sup>    | 2014 | 4                          | Prophylactic antibiotics significantly reduce implant failures but are of no significance in reducing postoperative infection                                                                     |
| Chrcanovic <sup>36</sup> | 2014 | 14                         | Prophylactic antibiotics significantly reduce failures of dental implants but have no significant effect on the reduction of postoperative infection                                              |
| Lund <sup>34</sup>       | 2015 | 5                          | Antibiotic prophylaxis for dental implants gives a reduction of 2% for the risk of failure. Sub-analysis showed no benefit of antibiotic prophylaxis in uncomplicated surgery in healthy patients |
| Lobos <sup>31</sup>      | 2015 | 11                         | No statistically significant difference observed regarding failure due to infection between the different antibiotic groups and the control group                                                 |
| Park <sup>32</sup>       | 2017 | 15                         | Antibiotic prophylaxis in healthy patients undergoing implant placement does not improve clinical outcomes                                                                                        |
| Chen <sup>33</sup>       | 2017 | 9                          | Prophylactic antibiotics significantly reduced the incidence of failure but did not significantly reduce postoperative infection                                                                  |
| Sanchez <sup>39</sup>    | 2018 | 9                          | Single dose of preoperative prophylaxis is effective at preventing implant failure but was not significant for infections                                                                         |
| Braun <sup>38</sup>      | 2019 | 8                          | Antibiotic prophylaxis may significantly reduce implant failures in healthy patients                                                                                                              |
| Khouly <sup>30</sup>     | 2019 | 10                         | No statistically significant difference in incidence of postoperative infection between antibiotic and control group                                                                              |

### Systematic reviews and meta-analyses (Table 2)

The latest systematic review and meta-analysis by Khouly *et al.* (2019) used the incidence of postoperative infection as the primary outcome rather than implant failure.<sup>30</sup> Results showed no statistically significant difference in the

Table 3: The number needed to treat (NNT) to prevent implant failure in one patient.

| Author (year)                                 | NNT to prevent implant failure in one patient | 95% confidence interval |
|-----------------------------------------------|-----------------------------------------------|-------------------------|
| Braun <i>et al.</i> (2019) <sup>38</sup>      | 24                                            | 15.6-47.9               |
| Sanchez <i>et al.</i> (2018) <sup>39</sup>    | 67                                            | 26-125                  |
| Lund <i>et al.</i> (2015) <sup>34</sup>       | 50                                            | Not Stated              |
| Chrcanovic <i>et al.</i> (2014) <sup>36</sup> | 50                                            | 33-100                  |
| Ata-Ali <i>et al.</i> (2014) <sup>35</sup>    | 49                                            | 31-109                  |
| Esposito <i>et al.</i> (2013) <sup>37</sup>   | 25                                            | 14-100                  |

incidence of postoperative infection between the control group and the antibiotic group. Furthermore, no statistically significant difference was reported when the authors compared the different antibiotic regimens, which included preoperative only, preoperative and postoperative, and postoperative only, to the control group. Lobos *et al.* (2015) reported similar findings.<sup>31</sup>

Another systematic review did not support the routine administration of antibiotic prophylaxis to healthy patients undergoing implant surgery, as the majority of included studies showed no statistical difference in terms of prosthetic failure, implant failure or postoperative infection. The two studies that supported the use of antibiotics were assessed as having a high risk of bias.<sup>32</sup>

Other systematic reviews and meta-analyses showed that prophylactic antibiotics significantly reduce implant failure<sup>33-39</sup> but have no significant effect on the incidence of postoperative infection.<sup>33,35-37,39</sup> The numbers needed to treat (NNT) to prevent implant failure in one patient ranged from 25 to 67 across these studies (Table 3). Even though a statistically significant difference was found between the antibiotic and control groups in their meta-analysis, Braun *et al.* (2019) concluded that routine use of antibiotics is still not warranted and further evidence is needed.<sup>38</sup> Sanchez *et al.* (2018) concluded that a single dose of preoperative antibiotics (SDOAP) is effective at preventing implant failures (risk difference of 1.3%) but was of no significance in preventing postoperative infection.<sup>39</sup> They reported that the NNT to prevent one patient from developing postoperative infection using SDOAP was 100.<sup>39</sup> They also failed to find a significant benefit from administering postoperative antibiotics (both with preoperative or solely postoperative), which is similar to what was reported later by Romandini *et al.* (2019).<sup>40</sup> The advantage of the complex systematic review and meta-analysis by Lund *et al.* (2015) was that a sub-analysis of two studies that had reduced clinical heterogeneity was done, which led to the conclusion that antibiotic prophylaxis provided no benefit in uncomplicated surgery.<sup>34</sup>

### Discussion

Associating antibiotics directly with implant failure can be misleading, as implant failure is a complex and multifactorial process, in which postoperative infection is one of several causes. Furthermore, a new definition of osseointegration states that "osseointegration is a foreign body reaction where interfacial bone is formed as a defence reaction to shield off the implant from

the tissues".<sup>41</sup> A mild response, along with mild inflammation, can be considered normal. However, overactivation of the immune system can increase osteoclastic activity, which will result in bone loss and loosening of the implant. This is usually independent of bacteria and it is reported that bacterial causes of implant loosening account for as little as 1% of operated cases.<sup>42</sup> More important factors identified include: smoking; genetic deficiencies; poor clinical handling; corrosion of the implant; residual cement; and, use of certain pharmaceutical products such as selective serotonin reuptake inhibitors (SSRIs) and proton pump inhibitors (PPIs).<sup>42,43</sup>

Chlorhexidine mouth rinse was a confounding variable in a number of the studies.<sup>22-25,27-29</sup> This antimicrobial agent has been shown to be efficacious against a variety of microorganisms including gram-positive and gram-negative bacteria, yeasts, and viruses.<sup>44</sup> In addition, it has high substantivity, which enables a prolonged effect. Thus, it is difficult to rule out the influence of chlorhexidine rinse on the results. It is important that future studies consider this and study the effects of antibiotics and chlorhexidine independently of one another.

Overall, it is very difficult to conduct a well-controlled RCT as a large sample size is needed. Most studies that had a pre-calculated sample size failed to reach their target. Furthermore, there are many confounding variables such as smoking status, number of implants placed per patient, location of implants placed, implant placement and loading protocols, which all need to be controlled for. Additionally, there is no consensus regarding which is the most appropriate antibiotic as well as the dose to be used.

It is also important to note that postoperative infections in the published literature were detected clinically as suppuration with or without pain, swelling and fever. It has been suggested that low-grade infections that are not detected clinically can account for some implant failures and so the actual occurrence of infection may be underestimated.<sup>36</sup>

## Conclusion

Based on the best available evidence, routine antibiotic prophylaxis to prevent dental implant infections in healthy patients may not be indicated. Further large, multicentre, double-blinded RCTs are needed. The authors' advice to clinicians is to consider the local, systemic and procedural risk factors for each patient before deciding to prescribe prophylactic antibiotics.

## References

- Albrektsson, T., Dahlin, C., Jemt, T., Sennerby, L., Turri, A., Wennerberg, A. Is marginal bone loss around oral implants the result of a provoked foreign body reaction? *Clin Implant Dent Relat Res* 2014; 16 (2): 155-165.
- Moraschini, V., Poubel, L.A.daC., Ferreira, V.F., Barboza, E.dos.S.P. Evaluation of survival and success rates of dental implants reported in longitudinal studies with a follow-up period of at least 10 years: a systematic review. *Int J Oral Maxillofac Surg* 2015; 44 (3): 377-388.
- Munckhof, W. Antibiotics for surgical prophylaxis. *Aust Prescr* 2005; 28: 38-40.
- Chrcanovic, B.R., Kisch, J., Albrektsson, T., Wennerberg, A. Factors influencing early dental implant failures. *J Dent Res* 2016; 95 (9): 995-1002.
- Al-Sabbagh, M., Bhavsar, I. Key local and surgical factors related to implant failure. *Dent Clin North Am* 2015; 59 (1): 1-23.
- Dawson, D.R., Jasper, S. Key systemic and environmental risk factors for implant failure. *Dent Clin North Am* 2015; 59 (1): 25-39.
- Suda, K.J., Henschel, H., Patel, U., Fitzpatrick, M.A., Evans, C.T. Use of antibiotic prophylaxis for tooth extractions, dental implants, and periodontal surgical procedures. *Open Forum Infect Dis* 2018; 5 (1): ofx250.
- Ziment, I. Complications of antibiotic therapy. *Calif Med* 1972; 117 (5): 24-48.
- Bratzler, D.W., Dellinger, E.P., Olsen, K.M., et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Surg Infect (Larchmt)* 2013; 14 (1): 73-156.
- Camps-Font, O., Martín-Fatás, P., Clé-Ovejero, A., Figueiredo, R., Gay-Escoda, C., Valmaseda-Castellón, E. Postoperative infections after dental implant placement: variables associated with increased risk of failure. *J Periodontol* 2018; 89 (10): 1165-1173.
- Ireland, R.S., Palmer, N.O., Lindenmeyer, A., Mills, N. An investigation of antibiotic prophylaxis in implant practice in the UK. *Br Dent J* 2012; 213 (8): E14.
- Khalil, D., Hultin, M., Andersson Fred, L., Parkbring Olsson, N., Lund, B. Antibiotic prescription patterns among Swedish dentists working with dental implant surgery: adherence to recommendations. *Clin Oral Implants Res* 2015; 26 (9): 1064-1069.
- Pyysalo, M., Helminen, M., Antalainen, A.K., Sándor, G.K., Wolff, J. Antibiotic prophylaxis patterns of Finnish dentists performing dental implant surgery. *Acta Odontol Scand* 2014; 72 (8): 806-810.
- Datta, R., Grewal, Y., Batth, J.S., Singh, A. Current trend of antimicrobial prescription for oral implant surgery among dentists in India. *J Maxillofac Oral Surg* 2014; 13 (4): 503-507.
- Deeb, G.R., Soung, G.Y., Best, A.M., Laskin, D.M. Antibiotic prescribing habits of oral and maxillofacial surgeons in conjunction with routine dental implant placement. *J Oral Maxillofac Surg* 2015; 73 (10): 1926-1931.
- Froum, S.J., Weinberg, M.A. An evaluation of antibiotic use in periodontal and implant practices. *Int J Periodontics Restorative Dent* 2015; 35 (4): 481-487.
- El-Kholey, K.E., Wali, O., Elkomy, A., Almozayen, A. Pattern of antibiotic prescription for oral implant treatment among dentists in Saudi Arabia. *Implant Dent* 2018; 27 (3): 317-323.
- Camps-Font, O., Viaplana-Gutiérrez, M., Mir-Mari, J., Figueiredo, R., Gay-Escoda, C., Valmaseda-Castellón, E. Antibiotic prescription for the prevention and treatment of postoperative complications after routine dental implant placement. A cross-sectional study performed in Spain. *J Clin Exp Dent* 2018; 10 (3): e264-e270.
- Dent, C.D., Olson, J.W., Farish, S.E., et al. The influence of preoperative antibiotics on success of endosseous implants up to and including stage II surgery: a study of 2,641 implants. *J Oral Maxillofac Surg* 1997; 55 (12 Suppl. 5): 19-24.
- Gynther, G.W., Köndell, P.A., Moberg, L.E., Heimdahl, A. Dental implant installation without antibiotic prophylaxis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1998; 85 (5): 509-511.
- Kashani, H., Hilon, J., Rasoul, M.H., Friberg, B. Influence of a single preoperative dose of antibiotics on the early implant failure rate. A randomized clinical trial. *Clin Implant Dent Relat Res* 2019; 21 (2): 278-283.
- Esposito, M., Cannizzaro, G., Bozzoli, P., et al. Efficacy of prophylactic antibiotics for dental implants: a multicentre placebo-controlled randomised clinical trial. *Eur J Oral Implantol* 2008; 1 (1): 23-31.
- Nolan, R., Kemmoona, M., Polyzois, I., Claffey, N. The influence of prophylactic antibiotic administration on post-operative morbidity in dental implant surgery. A prospective double blind randomized controlled clinical trial. *Clin Oral Implants Res* 2014; 25 (2): 252-259.
- Anitua, E., Aguirre, J.J., Gorosabel, A., et al. A multicentre placebo-controlled randomised clinical trial of antibiotic prophylaxis for placement of single dental implants. *Eur J Oral Implantol* 2009; 2 (4): 283-292.

25. Esposito, M., Cannizzaro, G., Bozzoli, P., et al. Effectiveness of prophylactic antibiotics at placement of dental implants: a pragmatic multicentre placebo-controlled randomised clinical trial. *Eur J Oral Implantol* 2010; 3 (2): 135-143.
26. Laskin, D.M., Dent, C.D., Morris, H.F., Ochi, S., Olson, J.W. The influence of preoperative antibiotics on success of endosseous implants at 36 months. *Ann Periodontol* 2000; 5 (1): 166-174.
27. Abu-Ta'a, M., Quirynen, M., Teughels, W., van Steenberghe, D. Asepsis during periodontal surgery involving oral implants and the usefulness of peri-operative antibiotics: a prospective, randomized, controlled clinical trial. *J Clin Periodontol* 2008; 35 (1): 58-63.
28. Caiazzo, A., Casavecchia, P., Barone, A., Brugnami, F. A pilot study to determine the effectiveness of different amoxicillin regimens in implant surgery. *J Oral Implantol* 2011; 37 (6): 691-696.
29. Tan, W.C., Ong, M., Han, J., et al. Effect of systemic antibiotics on clinical and patient-reported outcomes of implant therapy – a multicenter randomized controlled clinical trial. *Clin Oral Implants Res* 2014; 25 (2): 185-193.
30. Khouly, I., Braun, R.S., Chambrone, L. Antibiotic prophylaxis may not be indicated for prevention of dental implant infections in healthy patients. A systematic review and meta-analysis. *Clin Oral Investig* 2019; 23 (4): 1525-1553.
31. Asenjo-Lobos, C. Use of antibiotics in dental implant surgery: a decision based on evidence from systematic review. In: Jofre, J., Cortes, M., Carlos, M., (eds.). *Int J Odontostomat* Vol 9: 137-147.
32. Park, J., Tennant, M., Walsh, L.J., Kruger, E. Is there a consensus on antibiotic usage for dental implant placement in healthy patients? *Aust Dent J* 2018; 63 (1): 25-33.
33. Chen, Z., Chen, D., Zhang, S., Tang, L., Li, Q. Antibiotic prophylaxis for preventing dental implant failure and postoperative infection: a systematic review of randomized controlled trials. *Am J Dent* 2017; 30 (2): 89-95.
34. Lund, B., Hultin, M., Tranaeus, S., Naimi-Akbar, A., Klinge, B. Complex systematic review – perioperative antibiotics in conjunction with dental implant placement. *Clin Oral Implants Res* 2015; 26 (Suppl. 11): 1-14.
35. Ata-Ali, J., Ata-Ali, F. Do antibiotics decrease implant failure and postoperative infections? A systematic review and meta-analysis. *Int J Oral Maxillofac Surg* 2014; 43 (1): 68-74.
36. Chrcanovic, B.R., Albrektsson, T., Wennerberg, A. Prophylactic antibiotic regimen and dental implant failure: a meta-analysis. *J Oral Rehabil* 2014; 41 (12): 941-956.
37. Esposito, M., Grusovin, M.G., Worthington, H.V. Interventions for replacing missing teeth: antibiotics at dental implant placement to prevent complications. *Cochrane Database Syst Rev* 2013 (7): CD004152.
38. Braun, R.S., Chambrone, L., Khouly, I. Prophylactic antibiotic regimens in dental implant failure: a systematic review and meta-analysis. *J Am Dent Assoc* 2019; 150 (6): e61-e91.
39. Rodríguez Sánchez, F., Rodríguez Andrés, C., Arteagoitia, I. Which antibiotic regimen prevents implant failure or infection after dental implant surgery? A systematic review and meta-analysis. *J Craniomaxillofac Surg* 2018; 46 (4): 722-736.
40. Romandini, M., Tullio, I., Congedi, F., et al. Antibiotic prophylaxis at dental implant placement: which is the best protocol? A systematic review and network meta-analysis. *J Clin Periodontol* 2019; 46 (3): 382-395.
41. Albrektsson, T., Chrcanovic, B., Jacobsson, M., Wennerberg, A. Osseointegration of implants – a biological and clinical overview. *JSM Dent Surg* 2017; 2: 1022-1028.
42. Albrektsson, T., Becker, W., Coli, P., Jemt, T., Mölne, J., Sennerby, L. Bone loss around oral and orthopedic implants: an immunologically based condition. *Clin Implant Dent Relat Res* 2019; 21 (4): 786-795.
43. 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.
44. Wade, W.G., Addy, M. In vitro activity of a chlorhexidine-containing mouthwash against subgingival bacteria. *J Periodontol* 1989; 60 (9): 521-525.
45. Ahmad, N., Saad, N. Effects of antibiotics on dental implants: a review. *J Clin Med Res* 2012; 4 (1): 1-6.

## CPD questions

To claim CPD points, go to the MEMBERS' SECTION of [www.dentist.ie](http://www.dentist.ie) and answer the following questions:

1. Early implant failure occurs when:

- ☐ A: Osseointegration could not be maintained
- ☐ B: There is a lack of osseointegration
- ☐ C: All of the above
- ☐ D: None of the above

2. Which of the following have been shown to increase the risk of dental implant failure:

- ☐ A: Smoking
- ☐ B: Selective serotonin reuptake inhibitors
- ☐ C: Proton pump inhibitors
- ☐ D: All of the above

3. True or false: there is sufficient evidence to support the routine use of antibiotics prior to dental implant placement in healthy patients

- ☐ A: True
- ☐ B: False



CPD