

# Antibiotic prophylaxis for dental procedures

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## SUMMARY

Patients at risk of developing infective endocarditis or infection of a prosthetic joint may require antibiotic prophylaxis during dental treatment.

Current guidelines recommend prophylaxis less often than in the past. This is because of concerns about antimicrobial resistance and an increased understanding about the daily incidence of bacteraemia.

There is international variation in the recommendations for preventing infective endocarditis so Australian health professionals should consult Australian guidelines. Conditions for which prophylaxis is still recommended include prosthetic heart valves and rheumatic heart disease in patients at high risk of endocarditis.

Most experts no longer recommend antibiotic prophylaxis for dental procedures in patients with prosthetic joints.

## Introduction

Antibiotic prophylaxis has been used in dentistry for patients at risk of infective endocarditis or prosthetic joint infection. The scientific rationale for prophylaxis was to eliminate or reduce transient bacteraemia caused by invasive dental procedures. Despite a long history of use and multiple guidelines for prophylaxis, there remains uncertainty about its effectiveness. In the last 10 years, there have been significant changes to the guidelines for antibiotic prophylaxis. These changes have been driven partly by global concerns about antimicrobial resistance<sup>1</sup> and subsequent recommendations that any prescription of antibiotics should be appropriate and judicious.<sup>2</sup>

Another factor that has driven the changes has been the recognition that the incidence of transient bacteraemia caused by oral hygiene procedures is often the same as the incidence caused by many dental treatments for which prophylaxis has traditionally been given. Regular toothbrushing and flossing pose a greater risk in relation to both infective endocarditis<sup>3</sup> and prosthetic joint infection<sup>4</sup> than episodic dental treatment.

Toothbrushing,<sup>5</sup> flossing,<sup>6</sup> pulsating water irrigators<sup>7</sup> and interdental woodsticks<sup>8</sup> can all produce bacteraemia. Gingival inflammation has been significantly associated with an increased incidence of bacteraemia caused by toothbrushing.<sup>9</sup> However, the incidence of bacteraemia with flossing does not differ significantly between people with or without periodontal disease.<sup>10</sup> The incidence and magnitude of bacteraemia caused by flossing are the same as that caused by deep scaling/root planing within the same

patients,<sup>11</sup> yet deep scaling/root planing is considered an 'invasive dental procedure' that has traditionally required antibiotic prophylaxis.

## Infective endocarditis

The annual incidence of infective endocarditis is approximately 3–10 per 100 000 people<sup>12</sup> but its mortality rate is around 20%.<sup>13,14</sup> About half of all cases occur in patients with no known cardiac risk factors.<sup>14</sup> Staphylococci cause the majority of cases in developed countries<sup>12,13</sup> with the highest incidence found in patients over 65 years old undergoing diagnostic or interventional procedures in hospitals.<sup>14</sup> Viridans streptococci are found as commensal organisms in the mouth and in plaque. They account for approximately 20% of native valve and 25% of cases of late prosthetic valve infective endocarditis.<sup>15</sup> Studies show that viridans streptococcal bacteraemia occurs commonly with invasive dental treatments, especially tooth extraction.<sup>16</sup> Anaerobic oral bacteria seldom cause infective endocarditis.<sup>17</sup>

## Evolution of prophylaxis guidelines

Since the 1950s there has been a progressive reduction in the use of antibiotics in the prevention of endocarditis following dental therapy (see Table). Different countries have made different recommendations. The changes in the USA in 2007 limited prophylaxis to patients with conditions including prosthetic cardiac valves or valves repaired with prosthetic material, previous infective endocarditis, unrepaired and repaired congenital cardiac defects and cardiac transplants with subsequent valvulopathy. Patients with mitral valve

Table Evolution of guidelines for endocarditis prophylaxis

Year	Organisation	Recommendation for patients without penicillin hypersensitivity
1955	American Heart Association	Intramuscular benzylpenicillin for all patients at risk
1982	British Society for Antimicrobial Chemotherapy	Oral amoxicillin, 3 g one hour before treatment, 1.5 g six hours after treatment
1997	American Heart Association	Oral amoxicillin, 2 g one hour before treatment
2007	American Heart Association	Prophylaxis limited to high-risk patients
2008	National Institute for Health and Clinical Excellence (UK)	No antibiotic prophylaxis

prolapse, even with severe regurgitation, no longer required prophylaxis.<sup>18</sup>

In 2008 the abolition of antibiotic prophylaxis for all patients in the UK was a radical change in practice.<sup>19</sup> It resulted in considerable controversy including claims from UK cardiologists that patient safety would be compromised.<sup>20</sup> There were allegations of making a cost-effectiveness judgment on the basis of insufficient evidence and for instituting a de facto population-wide clinical trial.<sup>21</sup>

Following these changes in the USA and UK, revised infective endocarditis prophylaxis guidelines were soon introduced in Australia,<sup>22</sup> New Zealand<sup>23</sup> and Europe.<sup>24</sup> These countries followed the USA and reduced the types of cardiac conditions requiring prophylaxis.

The reason for differing opinions on prophylaxis is the lack of evidence on which to base conclusions. A Cochrane review found no randomised controlled trials that had studied the efficacy of antibiotic prophylaxis for preventing infective endocarditis due to dental treatment.<sup>25</sup> This review identified only one case-control study<sup>26</sup> which found no significant effect of penicillin prophylaxis. The review therefore concluded that there was no evidence that antibiotic prophylaxis was effective or ineffective in preventing infective endocarditis in at-risk individuals undergoing invasive dental procedures.<sup>25</sup>

### Outcome studies

As there is a lack of evidence about the efficacy of antibiotic prophylaxis, expert groups have assessed studies investigating associations between guideline changes and the incidence of infective endocarditis. While an increased incidence following a reduced use of antibiotics would suggest that there is a need for prophylaxis, methodological limitations in some studies mean that it is difficult to say that the cases of endocarditis were related to dental procedures.

Two retrospective studies in the USA<sup>27,28</sup> showed no changes in the rate of infective endocarditis due to viridans streptococci three years after the revision of the guidelines in 2007. A third study found a significant increase in streptococcal infective endocarditis, but it

did not report the incidence of viridans streptococcal infective endocarditis, nor provide any data on dental treatment or antibiotic prophylaxis.<sup>29</sup> No firm conclusions can therefore be drawn about the impact of the change in the guidelines.

In France, a prospective study<sup>30</sup> found no increase in infective endocarditis following revision of the guidelines. However, the number of patients who had dental treatment in the preceding three months was low both before and after the revision. The study concluded that changes in the guidelines had not resulted in any increase in streptococcal infective endocarditis, but no specific conclusions were made regarding the efficacy of antibiotic prophylaxis for dental treatment.<sup>30</sup>

Two studies in England<sup>31,32</sup> have investigated the impact of the recommendation to cease prophylaxis. From 2000 to 2008, before the guidelines were changed, there had been a steady increase in cases of infective endocarditis as well as cases 'possibly' attributable to oral streptococci. The rate of increase in infective endocarditis did not alter significantly in the 25 months after introduction of the new guidelines.<sup>31</sup> However, despite a 78.6% reduction in prescriptions for antibiotic prophylaxis, there were still approximately 2000 prescriptions per month during that time. More than 90% were from dentists, suggesting that they were still prescribing prophylaxis to patients at high risk of infective endocarditis.

This possibility was supported by a subsequent survey<sup>33</sup> four years after the guidelines changed. It found that 36% of dentists had provided antibiotic prophylaxis and one-third had treated patients who had taken prophylaxis prescribed by a medical practitioner. The survey also found that the majority of infectious diseases physicians and cardiologists and 25% of the dentists thought that patients with prosthetic heart valves should receive antibiotic prophylaxis for dental treatment despite the guidelines to the contrary.<sup>33</sup>

In contrast with the short-term English study,<sup>31</sup> the more recent study<sup>32</sup> found that five years after the guidelines

changed, there had been a significant increase in the incidence of infective endocarditis. The investigators were unable to identify the number of cases caused by viridans streptococci and the results were confounded by residual prescribing of antibiotic prophylaxis, with an average of more than 1300 prescriptions per month in the last six months of the study.<sup>32</sup>

The earlier English study<sup>31</sup> had been interpreted as evidence that antibiotic prophylaxis was unnecessary for patients at risk of infective endocarditis undergoing invasive dental procedures. However, the more recent study<sup>32</sup> has been interpreted as evidence that antibiotic prophylaxis is necessary for at-risk patients.<sup>34</sup> Both studies have methodological deficiencies that make it impossible to arrive at a cause-and-effect conclusion in relation to antibiotic prophylaxis and infective endocarditis caused by dental procedures.

### Current guidelines

Expert committees around the world have recently issued updated guidelines. In the UK, NICE concluded that there was insufficient evidence to change its existing guidelines and it continues to recommend no routine antibiotic prophylaxis for dental treatment for patients at risk of infective endocarditis.<sup>35</sup> In contrast, expert committees in Europe,<sup>36</sup> the USA<sup>37</sup> and Australia,<sup>38</sup> despite assessing the same evidence as NICE, continue to recommend antibiotic prophylaxis in selected patients (see Box).

The NICE guidelines have continued to attract opposition in the UK.<sup>34,39</sup> Concerns have been expressed that by following the NICE guidelines, rather than the European guidelines, an extra 419 cases of infective endocarditis could occur per year in the UK including a possible 66 extra deaths.<sup>34</sup>

There have also been claims that NICE has incorrectly calculated the risk of deaths from anaphylaxis if antibiotic prophylaxis is given. No cases of fatal anaphylaxis with amoxicillin prophylaxis were reported in the UK during 1972–2007.<sup>40</sup> There were also no reported cases of fatal anaphylaxis in the USA.<sup>18</sup> In contrast, an investigation of the use of oral clindamycin for prophylaxis in England found a significant risk. There were 15 fatalities during 1969–2014, mostly due to *Clostridium difficile* infection.<sup>41</sup> No clinical trials have yet been published to validate whether antibiotic prophylaxis for invasive dental procedures, for example extractions, can provide significant protection against infective endocarditis in at-risk patients. Australian dentists and medical practitioners are therefore advised to follow the current guidelines published in Therapeutic Guidelines: Antibiotic<sup>38</sup> (see Box) which follow closely the guidelines recommended in the USA<sup>37</sup> and Europe.<sup>36</sup> These are to give amoxicillin, or ampicillin, before the procedure. Cefalexin is recommended for patients hypersensitive to penicillin, unless they have a history of immediate hypersensitivity in which case clindamycin is used.<sup>38</sup>

### Prosthetic joint infection

Bacteraemia caused by dental procedures has been considered a surrogate measure of the risk of prosthetic joint infection.<sup>42</sup> As a consequence, there has been a long history of antibiotic prophylaxis for dental procedures despite a lack of evidence for oral *Streptococcus* species being significantly involved in prosthetic joint infection.<sup>43</sup> The overall infection rate for prosthetic joints is approximately 1.5% with the main infecting organism being the skin commensal staphylococci.<sup>42</sup>

### Evolution of prophylaxis guidelines

Differing protocols have been published over the years regarding antibiotic prophylaxis for dental treatment of patients with prosthetic joints. The recommended intervals during which prophylaxis should be given have ranged from the first three months to the first two years after joint replacement.<sup>43</sup>

In Australia, guidelines published in 2005 by the Arthroplasty Group of the Australian Orthopaedic Association in conjunction with the Australian Dental Association recommended that prophylaxis was not required for dental treatment, including extraction, after three months in a patient with a normally functioning prosthetic joint.<sup>44</sup> For immunocompromised patients, consultation with the patient's treating physician was advised. However in 2010 Therapeutic Guidelines: Antibiotic stated that for patients with prosthetic joints: 'prophylaxis is not recommended as risks of adverse effects outweigh

#### Box Cardiac conditions for which antibiotic prophylaxis is recommended for dental treatment in Australia

Prosthetic cardiac valve or prosthetic material used for cardiac valve repair

Previous infective endocarditis

Congenital heart disease *but only* if it involves:

- unrepaired cyanotic defects, including palliative shunts and conduits
- completely repaired defects with prosthetic material or devices, whether placed by surgery or catheter intervention, during the first six months after the procedure (after which the prosthetic material is likely to have been endothelialised)
- repaired defects with residual defects at or adjacent to the site of a prosthetic patch or device (which inhibits endothelialisation)

Rheumatic heart disease in patients at high risk of endocarditis (indigenous Australians and those at significant socioeconomic disadvantage)

Heart transplant patients (consult the patient's cardiologist for specific recommendations)

Source: Reference 38

the benefits of prophylaxis'.<sup>45</sup> Despite these guidelines, some orthopaedic surgeons continued to require that patients with no significant medical history and a healthy, functioning prosthetic joint must receive lifetime antibiotic prophylaxis for all dental visits.

### Current guidelines

In 2012, an expert committee of the American Academy of Orthopaedic Surgeons and the American Dental Association reviewed the available evidence on dental treatment and prosthetic joint infection.<sup>42</sup> Only one study satisfied the search criteria.<sup>4</sup> This case-control study found that dental procedures are not risk factors for subsequent prosthetic joint infection and that antibiotic prophylaxis does not reduce the risk of infection. A clinical practice guideline was published recommending that: 'The practitioner might consider discontinuing the practice of routinely prescribing prophylactic antibiotics for patients with hip and knee prosthetic joint implants undergoing dental procedures'.<sup>42</sup>

The wording of this recommendation created some confusion among dentists so an expert panel was therefore convened. It concluded that the evidence in relation to hip and knee prosthetic joints could be extrapolated to all joints on the basis of the morphological and physiological characteristics of the tissues involved.<sup>46</sup> The guideline was amended to read: 'In general, for patients with prosthetic joint implants, prophylactic antibiotics are not recommended prior to dental procedures to prevent prosthetic joint infection'.<sup>46</sup> Currently, antibiotic prophylaxis for patients with prosthetic joints who are undergoing dental treatment is not routinely recommended in Australia,<sup>38</sup> the USA,<sup>42</sup> Canada,<sup>47</sup> the UK<sup>48</sup> or New Zealand.<sup>49</sup>

### Choosing when to prescribe prophylaxis

In situations where a patient has a significant immunodeficiency or an already infected prosthetic joint, the dentist should discuss the situation not only with the orthopaedic surgeon, but also

with the physician managing the patient to determine the need for appropriate prophylaxis.

What should a prescriber do if an orthopaedic surgeon insists that a healthy patient with a healthy prosthetic joint must receive antibiotic prophylaxis for dental treatment? The dentist should discuss the patient's medical status and planned dental treatment with the orthopaedic surgeon. If the orthopaedic surgeon recommends prophylaxis but the dentist considers that it is not recommended based on the guidelines, then the orthopaedic surgeon should be invited to prescribe antibiotic prophylaxis and thus be responsible for any adverse outcomes which might result from use of the antibiotic. The patient must be fully informed of the existing guidelines and a clear explanation given for the dentist's decision not to recommend antibiotic prophylaxis.

### Conclusion

In Australia, expert opinion recommends antibiotic prophylaxis for dental treatment to prevent infective endocarditis in patients with specific cardiac risk factors receiving specific dental treatments. However, antibiotic prophylaxis is not recommended routinely for patients with prosthetic joints.

All guidelines for prophylaxis stress the importance of optimising dental health before the placement of cardiac or orthopaedic prostheses to ensure that no dental sepsis is present. Patients should then be encouraged and trained to practise good oral hygiene and be advised to have regular dental check-ups to maintain their dental health. ◀

*Conflict of interest: none declared*

## Currently, antibiotic prophylaxis for patients with prosthetic joints who are undergoing dental treatment is not routinely recommended in Australia

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