

# White Paper on Optimal Care and Maintenance of Full Dentures for Oral and General Health

Global Task Force for Care of Full Dentures

*David Bartlett, Nigel Carter,  
Cees de Baat, Joke Duyck, Guy Goffin,  
Frauke Müller, Yasuhiko Kawai.*

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## Executive Summary

By 2050 there are expected to be two billion people aged 60 or older. This is more than double today's figure. The older you are, the more likely you are to have lost all, or nearly all, your natural teeth.

Research shows that people with dentures are using a variety of ways to clean their dentures, ranging from soap and water to toothpastes, bleaches and commercial products.

We carried out a comprehensive search of online and other available sources, and found no consistency in the recommendations for cleaning and maintaining dentures. Recommendations vary between countries and within a country, and usually rely on personal experience. Also, opinion leaders provide contradictory guidance for maintaining dentures.

A lack of denture cleanliness can lead to poorer oral health and possibly general health problems. However, no strong links are reported between the level of cleanliness and the severity or nature of any problems.

There are a wide range of recommendations being made to both dental professionals and denture wearers. We therefore have developed guidelines to give patients, oral healthcare professionals and caregivers guidance on optimal denture care. These guidelines are supported by best evidence and based on consensus from key international experts.

- 1. Daily cleaning of the dentures using mechanical action – brushing with a toothbrush or denture brush and an effective, non-abrasive denture cleanser (no dentifrice).**
- 2. Daily soaking in a denture-cleansing solution – this seems to deliver extra chemical breakdown of the remaining plaque and some level of disinfection of the denture. Denture-cleansing solutions should only be used outside the mouth, and denture wearers should strictly follow the manufacturers' guidelines.**
- 3. Denture wearers should not keep their dentures in the mouth overnight, unless there are specific reasons for keeping them in. This guideline is even more important for people at a higher risk of developing stomatitis and for frail or institutionalised older people. Soaking in a denture cleanser solution after mechanical cleaning seems to be beneficial for preventing denture stomatitis and the potential risk of pneumonia events in these groups of people.**
- 4. All patients who wear removable dentures should be enrolled into a regular recall and maintenance programme with their dental professional.**

The Oral Health Foundation will use their authority, independence and international reach to spread these guidelines globally and therefore improve the oral and general health of denture wearers worldwide.

We also recommend that the dental community invest in further research to refine the evidence for more specific guidelines on:

- the method and best products for cleaning dentures (both full and partial dentures)
- the frequency and time of cleaning
- the attitude towards wearing dentures at night
- storage of dentures out of the mouth

We also need more research to define the level of cleanliness needed to prevent any oral or general health problems for patients as a result of their wearing dentures, in both healthy and compromised patients.

The highest priority for research is on preventing denture stomatitis and pneumonia events among frail or institutionalised denture-wearing elderly people.

We thank the Global Task Force for Care of Full Dentures for their time and energy spent in building this White Paper and the guidelines for optimal care for full dentures.

# Global Task Force for Care of Full Dentures

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**Professor David Bartlett**

Prosthodontics

King's College London Dental Institute  
London (United Kingdom)

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**Dr. Nigel Carter OBE BDS LDS(RCS)**

CEO Oral Health Foundation – Chair Platform for Better Oral Health in Europe

Rugby – Warwickshire (United Kingdom)

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**Professor Emeritus Cees de Baat**

Gerodontology – Former Department of Oral Function and Prosthetic Dentistry

Radboud University Medical Center  
Nijmegen (the Netherlands)

---

**Dr. Joke Duyck**

Professor in Gerodontology & Prosthodontics

Department of Oral Health Sciences KU Leuven  
Leuven (Belgium)

---

**Dr. Guy Goffin**

**Visiting Senior Implementation Fellow**

Dental Innovation and Translation Centre – King's College London Dental Institute  
London (United Kingdom)

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**Dr Yasuhiko Kawai DDS MMedSci DDSc**

Professor, Department of Removable Prosthodontics

Nihon University School of Dentistry at Matsudo  
Sakaecho-Nishi Matsudo (Japan)

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**Dr Frauke Müller**

Professor and Chair – Division de Gérodontologie et Prothèse adjointe

Clinique Universitaire de Médecine Dentaire  
Geneva (Switzerland)

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# Introduction

## *Section 1: Dentures: description and classification*

**Dentures** are custom-made prosthetic devices used to replace missing teeth. There are two types of removable dentures: complete and partial. However, there are many denture designs which, to keep the dentures in place, rely on clasping to natural teeth, or attaching to crowns or implants.

**Complete or 'full' dentures** are worn by patients who have lost all their teeth in one or both jaws or 'arches'. These are called the maxillary (upper) and mandibular (lower) arches. The dentures are called 'complete' or 'full' dentures, and because of the global nature of this white paper we have used both terms interchangeably throughout the document.

In removable complete dentures, the replacement teeth are attached to a base, usually made of acrylic, and the dentures rest in place in the mouth. The dentures are supported and kept in place by the underlying soft and hard tissues in the mouth. Complete dentures are held in place by forming a seal between the dentures and the soft tissues of the mouth, and saliva helps keep this seal in place.

In the case of implant-supported dentures, there are two types of fixing:

- one where the implants are fixed to the prosthesis (for example, as in implant-retained crowns or bridges)
- one where attachments on the removable denture ('overdenture') clip onto the implants.

**Partial dentures** are used when a patient still has one or more of their natural teeth. The replacement teeth are attached to an acrylic or similar base, or to a metal framework (mainly cobalt-chrome). Metal-based dentures use teeth for support or to keep them in place. Acrylic dentures use the same method as full dentures, and may also use clips or clasps. Overdentures use teeth to help keep them in place.

Some dentures have internal attachments that attach to the adjacent crowns (on natural teeth or on implants) which help to keep them in place.

Dentures are made for people who have lost some or all of their teeth, to help:

- improve their appearance
- support their lips and cheeks
- improve their self-esteem and confidence
- improve their chewing ability and so help maintain healthy nutrition

In developed markets, fewer people need full dentures. This is because the impact of preventive measures means they are keeping their natural teeth. Scandinavia has one of the lowest percentages of denture-wearing people, and in this region most dentures are worn by the relatively large groups of immigrants.

In developing markets though, full dentures are still of major importance.

However, more people are wearing partial dentures worldwide because it has become less acceptable to be seen with missing teeth. Despite the popularity of dental implants, a lot of people rely on removable partial dentures as a simpler and less costly option for replacing lost teeth.

Caring for partial dentures involves more complicated decision-making than for full ones. Therefore the guidelines recommended as part of this white paper are only valid for full dentures. Both full and partial dentures need special care once they are taken out of the mouth.

## Section 2: Prevalence of edentulism\*

*\* Edentulism – the state of having no natural teeth*

Over the last 20 years, edentulism has declined globally. However, this is mainly due to the trend in high-income countries where more people are keeping their teeth. We see the opposite trend in low- and middle-income countries. Here the rate of edentulism is increasing<sup>1</sup>.

The World Health Organisation's Global Health Survey, carried out between 2002 and 2004, showed that edentulism is a highly prevalent condition globally. For people aged 65 and over, there was an overall average prevalence of 32.9% – in individual countries this ranged from as low as 7% in Egypt up to 72% in Iceland<sup>2</sup>.

There was a large variation between countries that had similar income levels. This suggests that average income per head may not be the main cause of the rate of edentulism in a given country. Other factors such as oral hygiene practices, nutritional habits, and socioeconomic inequalities have been suggested as being stronger driving factors<sup>3</sup>.

Edentulism remains a highly prevalent condition worldwide. It seems to be a more common problem in low- to middle-income countries, where the prevalence of caries and periodontal problems increases due to recent changes in dietary and lifestyle habits. The following factors were associated with edentulism in older age groups:

- socio-demographic factors (for example, lower education)
- lifestyle habits (for example, smoking)
- health conditions (for example, arthritis, asthma and diabetes)<sup>4</sup>

Because of ageing and increased life expectancy all over the globe, we expect edentulism to become more widespread and to be a growing public health problem. Although in developed countries extractions of natural teeth may be in decline, in developing countries they may still be the first remedy against toothache.

Because there is an increased focus on self-esteem and social interaction for quality of life, people nowadays are more likely to go quickly to get their missing teeth replaced, rather than remaining edentulous as was readily accepted 50 years ago.

In low- to middle-income countries, edentulous people will look to replace their missing teeth by getting removable full dentures. In high-income countries more people can afford more expensive implant-supported or -retained dentures.

## Section 3: Existing guidelines for optimal denture care

Because plaque and calculus can build up on dentures, just as they do on natural teeth, daily cleaning of dentures is recommended<sup>5</sup>. Regular cleaning of dentures is essential to the oral and general health of denture wearers.

However, there is only limited systematic data on the recommendations that dental professionals make to patients for denture cleaning, and we see some huge variations – both between and within countries. This is not surprising, since globally there are no standard guidelines on the best way to care for dentures. Recommendations are limited to some guidelines from dental organisations and denture-care companies, while key opinion leaders make other recommendations. This makes it difficult, if not impossible, for dental professionals to provide the right guidance to their denture-wearing patients.

There is also a lack of data on denture wearers' cleaning habits. Because the available guidelines vary tremendously, it is extremely difficult for denture wearers to find the best way to clean their dentures. Since nowadays denture wearers tend to look for guidance on the internet we cannot blame them for being confused, with there being so many different recommendations to choose from.

In principle all dental professionals agree that dentures need to be cleaned. Denture cleaning can use chemical methods or mechanical ones, such as brushing. Most professionals recommend daily brushing to remove most of the plaque and loosen what is left behind. However, the advice on how to brush effectively varies substantially. We found guidelines for using a toothbrush with soap and water, dishwashing liquid, conventional toothpaste or special denture pastes.

Many dental professionals recommend that users brush their dentures, then soak them in an immersion cleanser from time to time to control the plaque left behind after the brushing. Denture cleansers include bleaches, such as sodium hypochlorite, effervescent solutions and acid cleansers. Effervescent cleansers are the most popular immersion cleansers and include alkaline peroxides, perborates and persulphates. Other denture-cleaning methods include using enzymes, ultrasonic cleansers and microwave exposure<sup>6</sup>.

A Cochrane Review found that there is weak evidence to support any one method of cleaning. While the most effective method of eliminating plaque was not clear, the review showed that brushing with paste eliminates microbial plaque better than inactive methods, such as soaking. We therefore need further studies comparing the different methods of cleaning dentures<sup>7</sup>.

Most professionals recommend not wearing dentures at night. The reasons for this are unclear. Some suggest it gives tissues a chance to recover; others believe it reduces the risk of fungal infection.

There is also no consistency in recommendations on how to store the dentures while out of the mouth. Some recommend wet storage, others humid storage, and some recommend storing the dentures in dry conditions.

Although we all agree that dentures need to be cleaned regularly, it is clear that there are no evidence-based guidelines to guide professionals in their recommendations and help denture wearers to do the best they can for their oral health. This lack of strong guidance does not help denture wearers to effectively take care of their dentures.

Most surveys show that the majority of the denture-wearing population are failing to keep their dentures clean<sup>8</sup>.

A Turkish study<sup>9</sup> from 2001 revealed data on denture cleanliness and denture cleaning habits (method used and how often). The study used 70 full-denture wearers attending the Department of Prosthetic Dentistry at Marmara University (Istanbul).

In this limited study, 46.6% of patients were scored with poor cleanliness of their dentures while only 15.7% scored 'excellent'. From the total group:

- 25.7% said they cleaned their dentures less than once a day
- 45.7% said they cleaned their dentures more than once a day
- 11.5% said that they neither soaked nor brushed their dentures
- 17.1% soaked their dentures in water only
- only 8.6% claimed to do both brushing and soaking

There was no single cleaning regime used consistently across the group. Another study, also from Turkey, was published in 2006. It showed that among denture-wearing patients seeking treatment at the Yeditepe University (Istanbul) dental department, only 12% had clean dentures<sup>10</sup>.

With the global increase in the ageing population, we also see more older people living in care homes and for longer periods. In western countries, 3-8% of people aged 65 or older live in care homes (for example, 2.9 million in Europe), and demand for these services will substantially increase<sup>11</sup>. Quality of care in care homes has been a challenge, and multiple international reports describe poor quality of care in care homes. This is also the case for oral hygiene. Therefore, denture care is most probably also a major problem for caregivers, since no strict guidelines exist.

To assess the existing guidelines, we searched the internet for recommendations and guidelines by official or recognised bodies. Through this internet search, we have been able to collect data on official guidelines and recommendations for denture cleaning from only 19 organisations from 11 different countries, and from 4 companies.

We used search functions and entered the terms 'denture care', 'denture cleaning', 'guidelines for denture cleaning' and 'denture care recommendations'. Some sites did not provide an English translation of their website, and we then used Google Translate and our own knowledge of the language to create an adequate description of the details of the guidelines/recommendations. We were surprised to see that world-renowned organisations, such as the WHO (World Health Organisation) and FDI (World Dental Federation), do not have any guidelines for denture cleaning on their websites.

We were equally surprised to see that countries known for dental tourism, such as Hungary, Mexico and so on, have sites advertising their prosthodontic services but no denture-cleaning guidelines. Also for Russia and China, countries with many denture wearers, we couldn't find any official guidelines for denture cleaning.

GSK and Procter & Gamble, leaders in denture-care products worldwide, promote the use of denture cleansers and denture adhesives on their websites ([mydenturecare.com](http://mydenturecare.com) and [dentalcare.com](http://dentalcare.com)). But their recommendations differ. Dentaaid gives limited guidance, while Colgate refers to the American Dental Association (ADA) guidelines.

Some dental associations and private practices refer to existing guidelines from organisations such as the ADA or the Oral Health Foundation. Or they may publish without giving a reference, but give very similar advice. We found that in many countries the regulatory bodies or dental associations do not produce or publish official guidelines for denture cleaning.

We did not include the websites of individual practices as these were mainly a copy-and-paste from existing guidelines. However, these were very often adapted using personal comments, based on experience or knowledge picked up from opinion leaders or from their education in their respective dental schools.

We were disappointed by the limited number of sites that were visible enough to be included in our data collection. The lack of appropriate research and of evidence-based guidelines are most probably the cause of this low level of available support on denture care to professionals and the public at large.

Below is a list of the guidelines we were able to find.

Country	Organisation	Guidelines	Comments
<b>Australia</b>	Government of South Australia – SA Health	<p><b>Daily</b></p> <ul style="list-style-type: none"> <li>▪ Remove dentures before cleaning</li> <li>▪ Brush your dentures with a soft brush morning and night</li> <li>▪ Use soap and cold water or denture toothpaste then rinse well</li> <li>▪ Rest your gums at night by leaving your dentures out</li> <li>▪ Clean your dentures and leave them in cold water over night</li> </ul> <p><b>Weekly</b></p> <ul style="list-style-type: none"> <li>▪ Brushing your dentures with a soft brush and soap will keep them clean</li> <li>▪ Soaking can be useful to remove stains</li> <li>▪ Soak your dentures once a week in water and white vinegar (half and half) for three to four hours, or in water with a denture tablet</li> <li>▪ Brush and rinse your dentures before and after soaking</li> </ul>	<ul style="list-style-type: none"> <li>▪ Do not soak partial dentures in water and vinegar – it may corrode the metal</li> </ul>
<b>Belgium</b>	VVT	<ul style="list-style-type: none"> <li>▪ Clean dentures following the right method (no more guidance!)</li> </ul>	
<b>Canada</b>	CDA and Dental Hygiene Canada Association	<ul style="list-style-type: none"> <li>▪ Clean dentures every day</li> <li>▪ Take them out every night and soak them overnight. They can be soaked in a special cleaner for false teeth (denture cleanser), in warm water or in a mix of warm water and vinegar (half and half)</li> <li>▪ Then brush using a denture brush or soft toothbrush with a denture cleanser or mild soap</li> </ul>	<ul style="list-style-type: none"> <li>▪ If your denture has metal clasps, use warm water only for soaking</li> <li>▪ Household cleansers or regular toothpaste should not be used</li> </ul>
<b>France</b>	UFSBD	<ul style="list-style-type: none"> <li>▪ Rinse, brush with soap (savon de Marseille) and a denture brush, rinse thoroughly while brushing</li> <li>▪ Clean denture after every meal and before going to bed</li> <li>▪ Best to leave denture in mouth during sleep. If not comfortable with, store dry in a special denture box</li> </ul>	
<b>Germany</b>	BZAEK	Clean dentures with a special denture brush and liquid soap	

Country	Organisation	Guidelines	Comments
<b>Italy</b>	www.paolobroido.it	<ul style="list-style-type: none"> <li>▪ Brush with a brush and cold water after every meal and at least once a day</li> <li>▪ Use liquid soap or toothpaste (soft, not a very abrasive toothpaste) to eliminate the dental plaque, brush the teeth from top to bottom instead of from front to back</li> <li>▪ While not in the mouth, keep denture in a moist environment (a wet wipe is sufficient) to prevent the resin warping from dehydration</li> <li>▪ Avoid prolonged immersion in water</li> <li>▪ Disinfection with tablets or solution based on rising oxygen, used periodically, inhibits the growth of aerobic bacteria</li> <li>▪ Clean dentures with a brush</li> </ul>	
<b>Japan</b>	Japan Prosthetic Society (2009)	<ul style="list-style-type: none"> <li>▪ Immerse denture in a denture cleaning agent while the wearer is sleeping</li> <li>▪ Remove dentures at night and keep in water</li> <li>▪ Clean and massage alveolar ridge</li> </ul>	<ul style="list-style-type: none"> <li>▪ Clean above a bowl filled with water to prevent falling and breaking</li> </ul>
<b>New Zealand</b>	Ministry of Health & New Zealand Dental Association	<ul style="list-style-type: none"> <li>▪ Use a soft toothbrush or denture brush and mild soap to clean dentures. Gently brush all teeth surface and both sides of the dentures</li> <li>▪ After cleaning at night, place dentures overnight in a denture cup or glass of water with Steradent or Polident</li> </ul>	
<b>Spain</b>	Salud Actual	<ul style="list-style-type: none"> <li>▪ Rinse with water and clean thoroughly after every meal and before going to bed. Use a double-sided brush and neutral soap</li> <li>▪ Soak denture in a disinfecting solution once a week</li> <li>▪ Take out denture at night to allow mucosa to rest and oxygenate for 7-8 hours. Keep denture in humid medium, though do not immerse in water. You can use a box with a wet wipe</li> </ul>	

Country	Organisation	Guidelines	Comments
<b>Sweden</b>	Folktandvården (the organisation that owns all the public clinics in Sweden)  Textbook of Removable Prosthodontics – The Scandinavian Approach. Eds Molin Thorén M, Gunne J. Munksgaard Denmark 2012	<ul style="list-style-type: none"> <li>▪ Use a soft toothbrush to clean the denture under lukewarm water in the mornings and evenings. Unperfumed soap/detergent can be used if needed. The palate and gums need to be brushed as well</li> <li>▪ The denture should be taken out before going to bed and stored in water (if it is going to be stored for a long period it should be kept dry)</li> <li>▪ If calculus is present, the denture should be placed in a glass of water with vinegar essence overnight</li> </ul>	
<b>Switzerland</b>	HUG	<ul style="list-style-type: none"> <li>▪ Rinse dentures after each meal</li> <li>▪ Clean once a day with a toothbrush</li> <li>▪ Before sleep, clean denture and keep it dry overnight in a denture box</li> </ul>	<ul style="list-style-type: none"> <li>▪ Guidelines for personnel in University hospital</li> </ul>
<b>Switzerland</b>	Dental Hygienists Association	<ul style="list-style-type: none"> <li>▪ Rinse dentures after each meal</li> <li>▪ Clean dentures at least once a day with fluid soap or dishwashing liquid and a denture brush</li> <li>▪ For removal of calculus, soak denture in a 1:3 mix of water and vinegar for 2 hours. Clean with brush and rinse thoroughly with water</li> <li>▪ Severe staining can be removed using an ultrasonic bath</li> <li>▪ Regular review of the dentures by the dentist</li> <li>▪ Always clean dentures before going to sleep. Do not put dentures in a dishwasher</li> <li>▪ If kept out of the mouth overnight, store clean and dry in an open box</li> </ul>	
<b>UK</b>	British Society of Gerodontology	<ul style="list-style-type: none"> <li>▪ Brush dentures to remove any food and bacteria</li> <li>▪ Try to rinse dentures after every meal. Soak dentures daily in Sodium Hypochlorite</li> <li>▪ Soak for: <ul style="list-style-type: none"> <li>- <b>3 minutes</b> – plastic dentures</li> <li>- <b>1 minute</b> – dentures with metal parts or with Chlorohexidine Gluconate (e.g. Corsodyl)</li> </ul> </li> <li>▪ It is best to leave dentures out at night. Store them dry, in a container. Clean the denture container daily</li> </ul>	<ul style="list-style-type: none"> <li>▪ Soak for 1 minute – dentures with metal parts or with Chlorhexidine Gluconate</li> </ul>

Country	Organisation	Guidelines	Comments
UK	NHS	<ul style="list-style-type: none"> <li>▪ Clean dentures as often as normal teeth (2x/day)</li> <li>▪ Brush with toothpaste or soap and water</li> <li>▪ Then soak for removing food particles</li> <li>▪ Soak them in fizzy solution of denture cleansing tablets to remove stains and bacteria</li> <li>▪ Brush again (don't scrub too hard)</li> </ul>	
UK	Oral Health Foundation	<ul style="list-style-type: none"> <li>▪ Brush, soak and brush again</li> <li>▪ A denture cleanser will help remove stains and leave your denture feeling fresher</li> <li>▪ Dentists often recommend removing your dentures at night to give your mouth a chance to rest. If you remove your dentures, it is important to leave them in water to prevent any warping or cracking</li> </ul>	<ul style="list-style-type: none"> <li>▪ If you wear partial dentures, it is very important that you brush your natural teeth thoroughly every day</li> </ul>
USA	American College of Prosthodontics	<ul style="list-style-type: none"> <li>▪ Daily cleaning by soaking and brushing using a specialty brush or soft toothbrush with an effective, non-abrasive denture cleanser (e.g. a dish-washing liquid)</li> <li>▪ Dentures should be thoroughly rinsed after soaking and brushing</li> </ul>	
USA	ADA	<ul style="list-style-type: none"> <li>▪ Rinse your dentures before brushing to remove any loose food or debris. Use a soft bristle toothbrush and a non-abrasive cleanser to gently brush all the surfaces of the dentures so they don't get scratched</li> <li>▪ When you're not wearing your dentures, put them in a safe place covered in water to keep them from warping</li> </ul>	
USA	American Dental Hygienist Association	<ul style="list-style-type: none"> <li>▪ Dentures should be brushed daily with a soft toothbrush or denture brush, using a commercially prepared denture cleanser, hand soap or baking soda</li> </ul>	

Country	Organisation	Guidelines	Comments
USA	Mayo Clinic	<ul style="list-style-type: none"> <li>▪ Remove and rinse dentures after eating. Run water over your dentures to remove food debris and other loose particles</li> <li>▪ Brush your dentures at least daily. Remove and gently clean your dentures daily</li> <li>▪ Soak and brush them with a soft-bristled brush and non abrasive denture cleanser to remove food, plaque and other deposits. Don't use denture cleansers inside your mouth</li> <li>▪ Soak dentures overnight. Place the dentures in water or a mild denture-soaking solution overnight. Follow the manufacturer's instructions on cleaning and soaking solutions. Rinse dentures thoroughly before putting them back in your mouth, especially if using a denture-soaking solution</li> <li>▪ You typically should avoid: <ul style="list-style-type: none"> <li>- Abrasive cleaning materials. Avoid stiff-bristled brushes, strong cleansers and harsh toothpaste</li> <li>- Bleach-containing products. Don't use any bleaching products</li> <li>- Hot water</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Don't soak dentures with metal attachments in solutions that contain chlorine</li> </ul>
World	dentalcare.com (P&G)	<ul style="list-style-type: none"> <li>▪ <b>Prepare:</b> Drop one denture cleansing tablet into enough warm water to cover dentures</li> <li>▪ <b>Soak:</b> Place dentures in solution and soak them for the recommended period of time as per use instructions</li> <li>▪ <b>Rinse:</b> Remove dentures and rinse them thoroughly with running water</li> <li>▪ <b>Dispose:</b> Dispose of solution immediately and wash hands</li> </ul>	

Country	Organisation	Guidelines	Comments
World	mydenturecare.com (GSK)	<ul style="list-style-type: none"> <li>▪ <b>Step 1:</b> Soak the dentures in warm (not hot) water for the amount of time specified on the product packaging</li> <li>▪ <b>Step 2:</b> Gently brush using a soft-bristle toothbrush and the cleanser tablet solution. Specialist denture brushes are available which are suitable to use on dentures daily. Try to avoid using regular toothpaste. Brush all surfaces of your dentures with a specialist paste or with the remaining cleaning fluid</li> <li>▪ <b>Step 3:</b> Rinse your dentures thoroughly under running water</li> <li>▪ Have a daily cleaning routine</li> </ul>	
World	Colgate	See ADA	
World	dentaid.com	<ul style="list-style-type: none"> <li>▪ It is important to use cleaning tablets for removal of the biofilm, killing bacteria and eliminating stains</li> <li>▪ It is recommended to remove the dentures overnight</li> </ul>	

## Health challenges with wearing dentures

### Section 4: Oral health challenges associated with wearing dentures

Deposits such as microbial plaque, calculus and food debris can build up on dentures. In the literature, oral issues such as angular stomatitis, denture stomatitis, undesirable odours and tastes, as well as staining have been reported<sup>6</sup>.

Denture-related stomatitis has been described as a symptomless red lesion under a denture that is caused by the yeast *Candida*. It is sometimes made worse by mild secondary infections caused by other bacterial species<sup>8,9</sup>. The most frequently isolated organism is *Candida albicans*<sup>12</sup>. Candidosis appears as a mild inflammation and erythema of the mucosa under a denture, mostly the full upper-denture that may cover a large part of the palatal mucosa.

*Candida* may also cause soreness at the commissures of the mouth and is then called angular stomatitis or angular cheilitis.

Epidemiological studies report a high prevalence of denture-related stomatitis among institutionalised older denture-wearing patients. But its prevalence is much lower among denture-wearing patients who are not suffering from general health problems. The exact mode of action and the impact of the overall weakness of the patient are not described in the literature. However, poor oral and denture hygiene together with smoking and xerostomia seem to contribute to the development of denture-related stomatitis<sup>13</sup>

There are usually no symptoms with denture-related stomatitis. But if left unchecked it can become serious, and therefore guidelines for optimal denture care are important for the growing number of denture-wearing people around the world. Denture stomatitis is a chronic condition that does not have a single cause, and it tends to compromise the patient's quality of life. To cure, it needs both the oral tissues and the removable dentures to be treated.

The accumulation of plaque on dentures may also lead to overgrowth of volatile sulfur compounds. This produces bacteria, bad breath and eventually taste problems for the patient. It has been reported that the *Candida* overgrowth by itself may also lead to altered taste perception. Chromogens from the diet may contribute to staining of the denture. Build-up of calculus through calcification of the dental plaque is another result of poor denture hygiene.

Denture cleaning by brushing using only a denture brush, or a regular brush, and tap water may not be enough to eliminate *Candida*. Therefore, daily denture cleaning plus disinfection is claimed to be vital in preventing disease. It has been suggested that the ideal denture cleanser should be antibacterial and antifungal, non-toxic, compatible with the denture material and should not alter or damage the surface of the denture<sup>14</sup>.

## Section 5: General health challenges as a result of wearing dentures

Deposits on the dentures – such as microbial plaque, calculus and food debris – may increase the risk of the denture wearer developing a systemic disease, in particular aspiration pneumonia.

It has been reported in the literature that denture wearers and other people around them may develop a systemic disease from organisms such as Methicillin-resistant *Staphylococcus Aureus* (MRSA)<sup>17</sup>. Dentures may take on the role of foreign bodies and sustain persistent colonies of nasopharyngeal MRSA.

Studies have reported on the contamination of patients' dentures with both Methicillin-sensitive *Staphylococcus Aureus*, and MRSA. These studies concluded that staphylococci are frequent colonisers of the oral cavity and that dentures may serve as a potential reservoir allowing infection to travel to other parts of the body<sup>18</sup>. We need further comparative studies, with larger numbers of patients, to:

- evaluate the contribution of dentures to the long-term carriage of MRSA
- assess the value of denture cleaning in preventing MRSA colonisation

Overnight denture wear has also been linked to an increased risk of aspiration pneumonia. A study by Iinuma et al. in 2015 on people aged 85 or older, reported that perceived swallowing difficulties and denture wearing during sleep led to a 2.3-fold higher risk of serious pneumonia events. This is comparable with the risk among people with, for example, a history of stroke, respiratory disease and cognitive impairment. Also, those who wear their dentures during sleep tend to have poor denture hygiene practices, fewer dental office visits, denture and tongue plaque, and oral candidiasis. This suggests that the habit could be a sensitive marker for identifying individuals at high risk of both poor oral health and aspiration pneumonia<sup>21</sup>.

Some authors believe that chronic inflammation, because the dentures are acting as foreign bodies, may not only increase the patient's risk of infection in other parts of the body, but may also increase the risk of cardiovascular disease, diabetes and pulmonary disease<sup>15</sup>.

From the available literature, we may conclude that any intervention that can eliminate or reduce MRSA and other colonisation of dentures should be encouraged. This will help reduce the burden of chronic infection among patients. Therefore, denture cleaning is vital for the overall health of denture wearers as well as for the health of people they come into contact with.

Some *in-vitro* research examined bacterial cells that were suspended in denture-cleaning formulations, but not physically attached to a denture. This seemed to show effectiveness against MRSA for five commonly used denture-cleaning formulations, widely available for retail purchase<sup>19</sup>. However, more clinical research is needed to effectively claim any preventive action from using a denture-cleaning formulation as part of a denture-care routine.

# Evidence-based recommendations for optimal denture care

## *Section 6: Current problems with guidance for denture care*

Almost any dental practice with a website for their patients will refer to denture care, but recommendations are extremely varied. Some refer to other guidelines, such as the ADA's, or to manufacturers' guidelines. Others include personal experience and beliefs.

A recent study by GSK (2016) questioned dental healthcare professionals and groups of denture wearers in developed (Italy, Japan, USA) and developing (Brazil, India) countries. The dental professionals were asked about their recommendations to patients for denture cleaning, and the denture wearers about the methods they used to clean their dentures.

More than 10% of dental professionals made no primary recommendation on cleaning. The most common recommendations were for specialist denture-cleanser tablets, regular toothpaste, mouthwash, soap and water, denture paste, foam or liquid denture-cleanser, and dishwashing detergents<sup>16</sup>.

Denture wearers' cleaning habits are diverse. This is not a surprise, looking at the variety of recommendations and guidelines on the internet (see our research above). Denture wearers use products and methods similar to those recommended by dental professionals. Toothpaste, water and mouthwash were used more often than denture tablets<sup>16</sup>. Brushing is the most common method. But there is no obvious guidance on how often to clean dentures or whether to remove dentures at night.

Where there are recommendations about removing dentures while asleep, these go from 'no removal' to removal during the night, or for at least 6-8 hours. The reasoning behind this guidance may be that mucosa should rest for some time during the day, or that wearing a denture for 24 hours a day increases plaque accumulation and the risk of developing stomatitis. However, there is no evidence to support any of these guidelines.

Recommendations about storage while dentures are out of the mouth also vary tremendously. There seems to be some evidence that heat may affect the acrylic base of dentures. But there is no consensus on the humidity level for short or longer storage.

Again, this is not a surprise since there is no consensus on the most appropriate denture-cleaning methods. It seems that the reason for a lack of consensus is the shortage of clear, systematic evidence upon which to base recommendations<sup>16</sup>.

Several chemical formulations for denture cleansers are available on the market:

1. **Alkali hypochlorite disrupts the bacterial cell membrane and dissolves mucins in the plaque. Sodium hypochlorite is not recommended for long-term soaking of acrylic dentures. Soaking for more than 10 minutes may damage and lighten the colour of the acrylic denture material. It is not recommended for metal-based dentures.**
2. **Alkali peroxide disrupts the denture plaque through a process of effervescence<sup>10</sup>.**
3. **Acid-based cleansers disrupt the bacterial cell membrane and dissolve calculus.**
4. **Enzyme-based cleansers use specific enzymes that degrade fats, glycoproteins and other structures that then help destroy microorganisms in the plaque.**
5. **Oral rinses include any dental mouthwash products available on the market, and these have a good range of antibacterial properties. They can be used to soak dentures in. However, those containing chlorhexidine can stain dentures.**

No comparative research has shown evidence of superiority for any of the above.

## *Section 7: Available evidence for optimal denture care*

Several groups have searched for evidence on the different methods for cleaning dentures available in the marketplace and on the routines to be recommended.

A Cochrane systematic review on denture-cleaning methods was published in 2009<sup>7</sup> covering six RCTs (randomised controlled trials). These had a wide range of different interventions and outcome variables, so it was not possible to pool the data and perform a single analysis.

Isolated reports showed that chemicals and brushing appeared to be more effective than a placebo in reducing plaque coverage and microbial counts of anaerobes and aerobes on complete dentures. The authors concluded that there was a lack of evidence about the comparative effectiveness of the different denture-cleaning methods considered. Future research therefore should focus on comparisons between mechanical and chemical methods. The assessment of the association of methods, primary variables and costs should also receive future attention<sup>7</sup>.

The American College of Prosthodontics published in 2011 their Evidence-based guidelines for the care and maintenance of complete dentures<sup>14</sup>. Based on the 'best available evidence', they published the following guidelines for the effective cleaning of dentures:

1. **Careful daily removal of the bacterial biofilm present in the oral cavity and on complete dentures is of paramount importance to minimise denture stomatitis and to help contribute to good oral and general health.**
2. **To reduce levels of biofilm and potentially harmful bacteria and fungi, patients who wear dentures should do the following:**
  - a. **Dentures should be cleaned daily by soaking and brushing with an effective, nonabrasive denture cleanser.**
  - b. **Denture cleansers should ONLY be used to clean dentures outside of the mouth.**
  - c. **Dentures should always be thoroughly rinsed after soaking and brushing with denture-cleansing solutions prior to reinsertion into the oral cavity. Always follow the product usage instructions.**

- 3. Although the evidence is weak, dentures should be cleaned annually by a dentist or dental professional using ultrasonic cleansers to minimise biofilm accumulation over time.**
- 4. Dentures should never be placed in boiling water.**
- 5. Dentures should not be soaked in sodium hypochlorite bleach, or in products containing sodium hypochlorite, for periods that exceed 10 minutes. Placement of dentures in sodium hypochlorite solutions for periods longer than 10 minutes may damage dentures.**
- 6. Dentures should be stored immersed in water after cleaning, when not replaced in the oral cavity, to avoid warping.**
- 7. Patients who wear dentures should be checked annually by the dentist, prosthodontist, or dental professional for maintenance of optimum denture fit and function, for evaluation for oral lesions and bone loss, and for assessment of oral health status.**

A systematic review was published in May 2018<sup>20</sup>. It concluded that, though the number of RCTs was limited, combining different practices – namely mechanical methods and chemical agents – achieves optimal outcomes in terms of hygiene effectiveness. Combining brushing or ultrasound vibration with chemical agents may lead to more effective outcomes – that is, a reduction in denture biofilm percentage and/or the number of microorganisms' colony-forming units.

Persulfate has been included in denture cleansers, but it has recently been reported that it could cause allergic reactions that can be severe for some patients. In February 2008, the Food and Drug Administration (FDA) issued a report about persulfate risks. It said that the FDA had received information about 73 severe reactions involving this compound. They pointed out that the incidences involved both the proper and improper use of the cleansers.

Misuse of denture cleansers has also been cited as a cause of health problems, from oesophageal burning to low blood pressure or internal bleeding.

Since the various methods and frequency of denture cleaning have not been studied, the impact of a lack of denture cleanliness on oral and general health is not well known.

Based on the findings of the study of linuma et al.<sup>21</sup>, the continuous or night-time wearing of removable dentures has been associated with a 2.38-fold higher risk of serious pneumonia events in institutionalised very old or frail people.

The findings of an RCT on institutionalised people reported on the use of alkaline peroxide-based cleansing tablets during overnight storage of dentures. Compared with dry and water storage, it was found to decrease denture biofilm mass and bacterial and *Candida* levels in denture biofilms in cases of poor oral hygiene<sup>24</sup>. This provides evidence for a clinical guideline to minimise the microbial load of dentures, thereby reducing associated systemic health risks.

Duyck et al. conducted another clinical trial on institutionalised, denture-wearing elderly people<sup>25</sup>. They concluded that the use of cleansing tablets during overnight denture storage (in addition to mechanical denture cleaning) did not affect the *Candida albicans* count, but it reduced the total bacterial count on acrylic removable dentures compared to overnight storage in water. There were no differences in denture biofilm mass and composition after denture brushing compared with ultrasonic cleaning. This therefore shows that ultrasonic cleaning may be an appropriate alternative mechanical cleaning method<sup>25</sup>.

Given denture wearers' reported habits and attitudes towards the hygiene of their dentures, it is our opinion that evidence-based hygiene guidelines – together with appropriate warnings for misuse – should be communicated to patients.

An important unanswered question is what defines a 'clean' removable denture. A recent study in India<sup>26</sup> used a disclosing agent to reveal and measure plaque on dentures. This was used to research the effectiveness of the different methods that were tested. It concluded that brushing alone with a soft toothbrush and plain water could not clean the denture effectively, and that therefore use of denture cleansers was essential.

The two chemical cleansers used in the study (either Clinsodent powder or Fittydent tablets) helped remove significant amounts of accumulated denture plaque, but adequate soaking time or a recommended temperature is needed for proper action. The latter can be a serious problem for denture wearers, who are mainly older people and who may have lower levels of precise and adequate handling. This study also concluded that cleaning dentures with liquid handwashing soap after every meal or during the daytime is a convenient method of cleaning. It should be followed by soaking dentures overnight in chemical cleansers.

Further microbiological studies are definitely needed to support these results.

A Denture Cleanliness Index (DCI) was defined and tested in a UK clinical setting. This audit showed that the DCI system was effective in helping educate and motivate patients about denture hygiene. Patients needed to receive regular instruction on both oral and denture hygiene to help them maintain good oral health<sup>29</sup>.

It is also important that the physical properties of the denture materials should remain the same and not change during soaking or cleaning with denture cleansers. The colour stability of dentures being cleaned chemically is dependent on the critical concentration of chemical solutions as well as how long the dentures are exposed to them. It seems that microwave disinfection leads to insignificant alterations in the dimensional stability of prostheses<sup>22,23</sup>. We found one study that measured the colour change, surface roughness and flexural strength of heat-polymerised acrylic resin after its immersion in two effervescent denture cleansers (Corega tablets and Bony Plus) and a control in distilled water, simulating a 180-day use<sup>27</sup>. No significant colour changes were seen, but the Bony Plus group showed significantly increased surface roughness. Both tablets significantly reduced the flexural strength of the acrylic resin. The clinical relevance of these results is yet to be proven.

An article in a German dental journal<sup>28</sup> concluded that chemical denture cleansers are suitable for daily use at home, combined with mechanical cleaning. The authors of this study concluded that claims that chemical denture cleansers can damage the denture material are based on studies of products with highly alkaline pH values, which also contain strong bleaching agents such as hypochlorite. However, denture cleansing tablets available nowadays over the counter in Western-European countries belong to the group of neutral or weakly alkaline peroxides. This is why no side effects were reported on denture materials.

## Section 8: Recommendations for optimal denture care

### 1. The characteristics of an ideal denture cleanser

A denture cleanser should:

- demonstrate an effect on biofilm mass
- deliver substantial stain removal
- be antibacterial and antifungal, to reduce the level of biofilm harmful pathogens below clinically relevant levels (level to be defined)

It must be clear that it also should be safe to use (non-toxic and compatible with denture materials) and easy to use by patients or caregivers.

A recent publication in the Journal of Prosthetic Dentistry showed that denture cleansers on the market demonstrated good compatibility with commonly used denture materials: PMMA, stainless steel, cobalt chrome; but not with the layer formation on silver solder (as used in some Japanese partial dentures) and silicon-based reliners.

Other regularly used products such as alcohol-based mouthwashes and isopropyl-alcohol (IPA) damage the surface of PMMA, and brushing with toothpaste has been shown to cause scratching and surface material loss. Bleach causes limited damage to PMMA, but corrodes cobalt chrome alloy and solder. Vinegar and soap were compatible with all materials<sup>34</sup>.

In antimicrobial assays, bleach gave excellent results, but as indicated above, is incompatible with metal dental prosthesis components. IPA and alcohol-based mouthwash required concentrated dilutions to be effective. Toothpaste was effective against bacteria but not *Candida albicans*. Cleanser tablets were effective at 5 minutes' treatment time against all tested organisms. Vinegar, soaps, salt, and sodium bicarbonate were microbially ineffective<sup>34</sup>.

Denture cleansers containing sodium perborate seem to slightly increase the surface roughness of some denture materials, but there is no evidence on the clinical outcome. No changes in the hardness of the resins used in dentures were reported after immersion in the denture cleansers. Discoloration of the materials after immersion in solutions of different denture cleansers is similar and it is mainly slight<sup>35</sup>.

With regards to patient safety, denture-cleanser tablets are designed to be used outside the mouth, and denture wearers are expected to rinse the dentures before putting them back in the mouth. So safety issues are generally not expected with proper use.

The Cochrane Review from 2009 concluded that there was no evidence that any denture-cleaning method was more beneficial than others for the health of mucosa that supports the denture<sup>7</sup>. Earlier literature reviews on denture cleansers, published in 1985 and 1999, also concluded that new standards for evaluating denture cleansers were needed<sup>30,31</sup>. So far, we have not found any new reviews that could help us define exact guidelines on methods for optimal denture care, nor any evidence for one chemical cleanser being better than the others.

## **2. Brushing with denture creams and pastes**

No evidence has been reported showing the effectiveness of brushing with a denture cream or regular toothpaste in reducing *Candida* or other major pathogens in the denture plaque. The mechanical action reduces the biofilm mass, but other methods of denture cleaning seem to be better. The abrasiveness of regular toothpastes is also a concern for the integrity of the denture materials.

## **3. Soaking and brushing with commercially available denture cleansers**

Commercially available denture cleansers use various active agents to remove biofilm from dentures (see Section 6). Each of these immersion cleansers works differently and has a different rate of efficacy in removing denture biofilms. Gornitsky et al. evaluated different denture cleansers available on the Canadian market. They reported that the denture-cleaning methods tested were capable of reducing the levels of plaque, stain and food. They all showed substantially greater reductions in the numbers of tested microorganisms than dentures cleaned with water only<sup>32</sup>.

Microwave sterilisation as a way of reducing the bacterial load on dentures has been promoted to professionals. But we could not find any evidence of clinical relevance, though it may have a certain bactericidal effect and reduce biofilm mass. It would also not be appropriate for dentures containing metal.

The use of commercially available denture cleansers along with ultrasonic cleaning (mechanical 'cavitation' action) has been investigated by Duyck et al. in two separate studies<sup>24,25</sup>. These researchers concluded that the use of an effervescent tablet for denture overnight storage has an additional effect on denture plaque mass and composition if there has been prior mechanical denture cleaning. In fact, a decrease of total bacterial load and of specific bacteria was observed when the dentures were stored in water with an effervescent tablet.

However, no differences in denture biofilm mass and composition after denture brushing versus ultrasonic cleaning were noted. This was the case irrespective of additional overnight denture storage in water with an effervescent cleansing tablet. This shows that ultrasonic cleaning can be an appropriate alternative mechanical cleaning method. No effect, however, could be found on *Candida albicans* colonisation, which is considered the main etiological factor for denture stomatitis. This latter result contradicts another comparable study by Nishi et al. This compared microorganisms' survival on complete dentures following ultrasonic cleaning combined with immersion in an effervescent cleansing solution. These researchers also observed that the quantity of *Candida albicans* was significantly lower when ultrasonic cleaning was combined with immersion in water with a cleansing tablet<sup>33</sup>.

More clinical trials are definitely needed to deliver evidence showing the most effective method for preventing denture stomatitis, especially among frail, elderly or institutionalised denture wearers.

## **4. Guidelines for optimal denture care**

Plaque that forms on the surfaces of removable dentures may have a significant impact on oral health. It could lead to the denture-supporting mucosa being infected (stomatitis), or even lead to serious general health complications such as pneumonia.

Denture plaque can be removed from dentures by several different methods, which include mechanical and chemical action.

There seems to be some evidence that wearing dentures for longer time periods or overnight may lead to a higher risk of aspiration pneumonia. This is especially the case with elderly patients living in care homes, where the quality of denture maintenance and care may be insufficient or non-existent.

In defining our guidelines for optimal denture care we have considered:

- the existing evidence
- sporadic clinical trials reporting best-in-class practices for cleaning dentures
- the information above on the safety of existing denture cleansers
- tested protocols for denture care and maintenance

We may define the optimal guidelines as:

- 1. Daily cleaning of the dentures using mechanical action – brushing with a toothbrush or denture brush and an effective, non-abrasive denture cleanser (no dentifrice).**
- 2. Daily soaking in a denture-cleansing solution – this seems to deliver extra chemical breakdown of the remaining plaque and some level of disinfection of the denture. Denture-cleansing solutions should only be used outside the mouth, and denture wearers should strictly follow the manufacturers' guidelines.**
- 3. Denture wearers should not keep their dentures in the mouth overnight, unless there are specific reasons for keeping them in. This guideline is even more important for people at a higher risk of developing stomatitis and for frail or institutionalised older people. Soaking in a denture cleanser solution after mechanical cleaning seems to be beneficial for preventing denture stomatitis and the potential risk of pneumonia events in these groups of people.**
- 4. All patients who wear removable dentures should be enrolled into a regular recall and maintenance programme with their dental professional.**

We need to make it clear that, as part of the cleaning routine, any remaining teeth, the underlying oral mucosa, the tongue and the oral cavity also need appropriate care – but this is not covered by this paper.

## *Section 9: Call for action and next steps*

Although more people around the world are wearing dentures, we were not able to find any new evidence for re-confirming or adjusting the guidelines for the care and maintenance of complete dentures published by the American College of Prosthodontics in 2011. Unfortunately, we also found out that even these evidence-based guidelines were not broadly promoted to professionals or the public at large. This has left the door open for all kinds of non-evidence-based recommendations by organisations and dental professionals. In turn, this has created even more confusion among denture wearers about the routine and products to use for optimal care and maintenance of their dentures.

We therefore recommend that the Oral Health Foundation – the unique international and independent organisation dedicated to improving oral health and wellbeing around the world – uses this white paper consensus to provide independent and impartial advice on the optimal care and maintenance of dentures directly to:

- dental professionals, who are the first source of advice for patients
- caregivers for elderly people
- denture wearers themselves

We also acknowledge that there are serious gaps in the research on clinical scientific evidence about the optimal care and maintenance of complete dentures.

Future studies should aim to provide more reliable information about the level of cleanliness that needs to be achieved clinically to prevent oral and general disease (for example, aspiration pneumonia). This search for the acceptable microbial load should be addressed differently for healthy and for compromised patients.

We also recommend new research studies to investigate the cleanliness, biofilm-removal properties and antimicrobial efficacy of conventional methods (brushing, ultrasonic cleaning) and cleansers (soap, dishwashing liquids, specialised soaps), and comparing them with denture-cleaning solutions and methods for healthy and for compromised individuals. Because of the specifics of the denture-wearing population (it includes elderly, institutionalised people with limited manual dexterity), the safety profile of these products should be further investigated to limit health problems in case of misuse or overuse. The search for the optimal cleaning method and products should also include a proper definition of the best cleaning protocol in terms of the timing, sequence and frequency of denture-cleaning actions.

We need more evidence about the possible need to remove dentures to help prevent, for example, denture stomatitis and potential systemic complications. If wearers need to remove their dentures for a longer period or overnight, we need to define the optimal storage conditions for cleanliness, and for the colour and dimensional stability of the denture materials.

We recommend further exploration of alternative methods for mechanical denture plaque disruption which may help caregivers to provide optimal denture care more easily.

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