Dental Issues for the Ageing Population

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The major oral diseases

1. Dental Caries
2. Periodontal Diseases
3. Oral Cancer
Caries experience progresses with age and is a major problem in Australian adults.

Figure 8.8: Birth cohort trends in dental decay experience among dentate Australians, 1987–88 to 2001–06

Periodontal Diseases

- Nearly 1 in 4 Australian adults have moderate/severe periodontitis
  - 7.4% for 15-34 yrs old
  - 24.5% for 35-54 yrs old
  - 43.6% for 55-74 yrs old
  - 60.8% for 75+ yrs old

Emerging evidence suggests association between chronic oral and systemic diseases

Epidemiological research has identified six systemic conditions that are linked to oral disease.

- **Diabetes**  

- **Cardiovascular diseases**  

- **Preterm and low weight births**  

- **Respiratory diseases**  

- **Chronic inflammatory diseases (arthritis)**  

- **Cancers**  

“Oral health means much more than healthy teeth....Oral health is integral to general health”  
US Surgeon General 2000
Oral cancer prevalence is increasing

Ten-year trends and 20-year projections of the incidence of lip and tongue cancer in Western Australia

(Kruger & Tennant, 2008)
Oral disease has become the 2\textsuperscript{nd} most expensive disease group

(latest figure is $6.7 billion p.a.)

Six broad disease groups accounted for 50\% of the total health expenditure in Australia in 2004-05

<table>
<thead>
<tr>
<th>Disease Group</th>
<th>Health Expenditure by Disease Group ($ million, 2004-05)</th>
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<tbody>
<tr>
<td>Cardiovascular</td>
<td>11.2%</td>
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<tr>
<td>Oral disease</td>
<td>10.1%</td>
</tr>
<tr>
<td>Mental disorders</td>
<td>7.8%</td>
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<tr>
<td>Musculoskeletal</td>
<td>7.5%</td>
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<tr>
<td>Neoplasms</td>
<td>7.2%</td>
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<tr>
<td>Respiratory</td>
<td>6.3%</td>
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In 2001, oral disease was ranked the seventh most expensive disease group in Australia. The change in ranking demonstrates that oral disease is a large economic problem in Australia.

Conclusion

Oral diseases are a major public health problem for Australians:

- Caries experience increasing
- Periodontal diseases increasing and linked to cardiovascular diseases, diabetes and cancers
- Ageing population
- Growing economic and social burden
Good News

The major oral diseases are preventable by:

- Effective daily oral hygiene procedures
- Balanced nutritional diet
- Early diagnosis
- Modern minimally-invasive treatments
Dental caries (tooth decay)
Oral bacteria

Tooth surface after thorough cleaning

Mature biofilm
Plaque pH curves following the application of solutions of raw starch, cooked starch, lactose, glucose, maltose, fructose and sucrose (10μl, 0.9%).
White spot lesion

Goal: Early detection and non-invasive intervention
Fluoride and caries

- Fluoride-containing dentifrices and mouthrinses significantly decrease caries experience (Biesbrock et al. 2003; Marinho et al. 2003)
- Fluoride ions remineralize subsurface enamel lesions but net remineralization to form fluorapatite $[\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2]$ is calcium phosphate limited (ten Cate 1999; Reynolds 2006).
Saliva protective against oral disease

- Lubricates, hydrates
- Cleanses, neutralizes, buffers
- Supplies calcium and phosphate ions
- Antimicrobial properties
Loss of salivary function in the elderly:

- Xerostomia (dry mouth)
- Medications
- Lifestyle (dehydration)
- Increased risk of oral disease (e.g. caries, erosion)
Milk, milk concentrates, powders and cheeses have been shown to have anticariogenic activity in animals and *in situ* caries models (Reynolds and Johnson 1981; Rosen *et al.* 1984; Harper *et al.* 1986, 1987; Krobicka *et al.* 1987; Silva *et al.* 1987)
Recaldent™ (CPP-ACP) - CASRN 691364-49-5

CPP-ACP nanocomplexes (radius 1.6 – 2.0 nm)

Casein Phosphopeptides

1. $\alpha_{s1}(59-79)$ - Gln-Met-Glu-Ala-Glu-Ser(P)-Ile-Ser(P)-Ser(P)-Ser(P)-Glu-Glu-Ile-Val-Pro-Asn-Ser(P)-Val-Glu-Gln-Lys.

2. $\beta(1-25)$ - Arg-Glu-Leu-Glu-Glu-Leu-Asn-Val-Pro-Gly-Glu-Ile-Val-Glu-Ser(P)-Leu-Ser(P)-Ser(P)-Ser(P)-Glu-Glu-Ser-Ile-Thr-Arg.

3. $\alpha_{s2}(46-70)$ - Asn-Ala-Asn-Glu-Glu-Glu-Tyr-Ser-Ile-Gly-Ser(P)-Ser(P)-Ser(P)-Glu-Glu-Ser-Ala-Glu-Val-Ala-Thr-Glu-Glu-Val-Lys.

4. $\alpha_{s2}(1-21)$ - Lys-Asn-Thr-Met-Glu-His-Val-Ser(P)-Ser(P)-Ser(P)-Glu-Glu-Ser-Ile-Ile-Ser(P)-Gln-Glu-Thr-Tyr-Lys.

Amorphous Calcium Phosphate

$\text{Ca}_3(\text{PO}_4)_2 \times \text{H}_2\text{O}$.

CPP-ACP nanocomplex

Calcium and Phosphate ions
Over 100 publications demonstrating inhibition of enamel demineralisation and promotion of enamel subsurface lesion remineralisation by CPP-ACP

Promotion of enamel subsurface lesion remineralisation in situ by Recaldent (CPP-ACP) sugar-free gum

- Randomized, double-blind, crossover trials were conducted involving over 100 subjects to assess the ability of sugar-free chewing gum containing CPP-ACP to enhance enamel remineralisation.
- Chewing for 4 (20 min) or 7 (5 min) times per day.

Promotion of enamel subsurface lesion/ hypomineralised enamel mineralisation in vivo


Chronic periodontitis

- Nearly 1 in 4 Australian adults have moderate/severe periodontitis
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Prospective clinical study to determine bacterial species of subgingival plaque during disease progression

Methods
- Periodontal patients on a maintenance program
- Five periodontal sites monitored at 3 monthly intervals
- Clinical assessment
- Subgingival plaque sample and total bacterial load and specific pathogens determined using Real Time PCR

Results
- 13.5% of sites experienced disease progression
- Clinical parameters could not predict disease progression
- Close link between *P. gingivalis*, *T. denticola* and *T. forsythia*
- *P. gingivalis*, *T. denticola* and *T. forsythia* closely linked with periodontal pocket depth
- Probability of site breakdown increased with *P. gingivalis* and *T. denticola* levels

Byrne et al. Progression of chronic periodontitis can be predicted by the levels of *Porphyromonas gingivalis* and *Treponema denticola* in subgingival plaque. Oral Microbiol Immunol 24:469-477 (2009).
Bacteria as predictors of periodontal disease progression

Byrne et al. Progression of chronic periodontitis can be predicted by the levels of *Porphyromonas gingivalis* and *Treponema denticola* in subgingival plaque. Oral Microbiol Immunol 24:469-477 (2009).
*P. gingivalis* present in micro-colonies in top layer of plaque

Role of *P. gingivalis* Outer Membrane Vesicles (OMV) in chronic periodontitis

(A) High concentration of OMV, high level of host cell surface receptor, cytokine/chemokine degradation, apoptosis and inflammation,

(B) decreasing concentration of OMV resulting in decreased host cell surface receptor, cytokine/chemokine degradation and apoptosis but still a strong inflammatory response leading to bone resorption and host cell recruitment and activation,

(C) low concentration of OMV resulting in host cell stimulation and recruitment and activation of host immune cells.

Arrow 1; indicates decreasing concentration of OMV in host tissue,

Arrow 2; indicates increasing dysregulation of the immune response.

Effective oral care routines help prevent periodontal disease

- Only 2% to 10% floss regularly and effectively\(^2\)
- Average time spent brushing is 46 seconds\(^1\)

Redox potential in plaque falls if no brushing or flossing
Management of pathogenic biofilms

Physical disruption
- flossing
- brushing

Chemical control
- surfactant
- biocides
Tongue brushing with biocide paste/rinse can significantly reduced periodontal pathogen numbers and oral malodour.

# Acknowledgements

## Melbourne Dental School, The University of Melbourne

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![Oral Health CRC Logo](image)