Community Dent Oral Epidemiol 2011; 39: 378–384

COMMUNITY DENTISTRY AND ORAL EPIDEMIOLOGY

Utilizing dental hygienists to undertake dental examination and referral in residential aged care facilities

M. S. Hopcraft[1], M. V. Morgan[1], J. G. Satur[1] and F. A. C. Wright[2]

[1]Cooperative Research Centre for Oral Health Sciences, School of Dental Science, The University of Melbourne, Melbourne, Vic., Australia, [2]Centre for Oral Health Strategy, NSW Health, Westmead, NSW, Australia

Hopcraft MS, Morgan MV, Satur JG, Wright FAC. Utilizing dental hygienists to undertake dental examination and referral in residential aged care facilities. Community Dent Oral Epidemiol 2011; 39: 378–384. © 2011 John Wiley & Sons A/S

Abstract – *Objectives:* The Australian population is ageing, and a growing proportion of elderly Australians are now living in residential aged care facilities (RACFs). These residents are commonly dependent on others for their daily oral hygiene care and often display high levels of plaque and calculus. With declining edentulism rates, periodontal disease is becoming more prevalent in this population. The aim of this study was to investigate the ability of a dental hygienist to undertake a dental examination for residents of aged care facilities, devise a periodontal and preventive treatment plan and refer patients appropriately to a dentist. *Methods:* A total of 510 residents from 31 Victorian RACFs were examined, with 275 dentate residents included in this study. Between May 2005 and June 2006, residents were examined by a single experienced dental epidemiologist and one of four dental hygienists using a plane mouth mirror and periodontal probe. *Results:* A total of 510 residents from 31 RACFs had a dental examination from a dentist and one of four dental hygienists. The treatment needs of residents examined were high, with nearly all of the 275 dentate residents requiring preventive and periodontal treatment, and three-quarters requiring referral to a dentist for treatment. There was excellent agreement between the dentist and hygienists regarding the decision to refer residents to a dentist for treatment, with high sensitivity (99.6%) and specificity (82.9%). Only 8.0% of residents were referred by a hygienist to a dentist when the dentist considered that no referral was required. *Conclusions:* Dental hygienists have the skills and knowledge necessary for undertaking a dental examination for residents, correctly identifying the majority of residents who require a referral to a dentist. They are capable of formulating appropriate dental hygiene treatment plans for residents of aged care facilities. It is recommended that there should be greater utilization of hygienists in the provision of dental care to residents of aged care facilities, as a safe, efficient and effective use of health resources.

Key words: dental hygienist; dentist; nursing home; residential aged care facilities

Matthew Hopcraft, Associate Professor, Melbourne Dental School, The University of Melbourne, Melbourne, Vic. 3010, Australia
Tel.: +61 3 9341 1555
Fax: +61 3 9341 1597
e-mail: m.hopcraft@unimelb.edu.au

Submitted 10 May 2010;
accepted 6 December 2010

The Australian population is ageing, with the proportion of people aged 65+ years expected to increase from 13% in 2005 to 25% by 2051, and 50 000 people entering permanent residential aged care facilities (RACFs) each year (1–3). The average length of stay in permanent care is now 143.3 weeks (4). The dental profile of residents of aged care facilities in Australia has changed dramatically over the past 40 years, with declining edentulism rates and increasing numbers of teeth present resulting in a higher burden of oral disease. More than half of the residents are now dentate, having on average 12 teeth present (5, 6). Poor oral hygiene, dental caries and

doi: 10.1111/j.1600-0528.2010.00605.x

periodontal disease are common findings for most residents.

Previous research has been recommended that residents of aged care facilities should have an oral health assessment on admission and on a regular basis, in addition to oral hygiene care provision and ongoing practical carer support (7). RACF protocols require nursing staff to make assessments about resident oral health, oral hygiene requirements and treatment needs. However, many nursing staff are not well trained in oral and dental care, and there are often significant differences between dentists and nursing staff in the assessment of resident oral hygiene and the requirement for assistance with daily oral hygiene care (8). Screening by a dental professional is recommended (6); however, residents often have difficulties accessing dental care, and many dentists do not provide care to nursing home residents (9, 10).

The assessment of oral health depends in part on the ability of the patient to report symptoms or problems related to their teeth and mouth, and communication is critical to this process (11). This is problematic for elderly patients with cognitive impairments such as dementia, where communication and cooperation is unreliable. Screening has been shown to be effective in identifying the dental needs and oral health status of elderly residents of nursing homes (6). It can be conducted on site using simple visual tests and without the need for sophisticated equipment and can identify those in need of dental care, particularly those more dependent residents who may not be able to describe their symptoms (6).

A number of different oral health assessment tools have been developed and used in various settings by general nurses, dentists and dental hygienists. These include the Brief Oral Health Status Examination, the Geriatric Oral Health Assessment Index and the Oral Health Assessment Tool (OHAT) (11–14). These screening tools have been reported to be a validated and reliable means of assessing aspects of oral health, although there are shortcomings with their use. For example, the OHAT categorizes changes from normal and as a consequence may result in significant over-referral from nursing home staff to a dentist. It also requires referral for the presence of calculus or plaque in 1–2 areas of the mouth – a common finding in most residents (5). The utility of OHAT also decreases with increasing dementia, making it less useful in facilities with a high proportion of cognitively impaired residents (12). Therefore, these screening tools used by nondental personnel may overestimate the treatment need and result in over-referral to a dental professional.

These screening tools used by nursing staff may be useful to triage residents and monitor oral health and oral hygiene; however, the accuracy of the oral health assessment performed by nondental personnel varies considerably depending on the level of their training (15), and there is a difference between a comprehensive dental examination conducted by an oral health professional and a screening examination by nursing staff, allied health or medical professionals (12).

Dental hygienists have been used in a variety of settings to undertake epidemiological research and provide screening examinations, with most of the studies focussed on school-aged children and dental caries (16–19). Only one report in the literature has reported on the utilization of dental hygienists in nursing homes (20). In that study which compared the ability of a dental hygienist and dentist to estimate oral health status and treatment need in elderly people receiving home nursing in Sweden, the agreement between dentist and dental hygienist was considered to be clinically acceptable (20). The dental hygienist determined a higher treatment intention, although this was not significantly different from that of the dentist. The hygienist also estimated actual treatment need as significantly higher than the dentist. As a consequence, the dental hygienist referred patients to a dentist in situations where the dentist determined no dental treatment was required, although the additional number referred was small. This overestimation was considered more acceptable than the opposite (underestimation), with the dental hygienist considered to be registering 'on the safe side.'

Prior to the commencement of this study under existing legislation, dental hygienists in Australia could only undertake treatment after a patient had an oral examination and a treatment plan devised by a dentist. This model of care had two effects: (i) it limited access to dental care, particularly because most dentate residents required periodontal and preventive treatment that could be provided by a dental hygienist, and (ii) it is an inefficient use of resources.

The aim of this study was to determine whether a dental hygienist could undertake dental examinations for residents of aged care facilities, devise adequate periodontal and preventive treatment plans, and identify and refer patients who require treatment and assessment by a dentist, without the patient first being examined by a dentist.

Materials and methods

To investigate the primary care dental examination and referral capability of dental hygienists, 510 residents from 31 RACFs were examined by a dentist and one of four dental hygienists, with their referral and treatment decisions compared. The dentist had more than 10-year clinical experience in general practice and has been involved as an examiner in numerous epidemiological studies, whilst three of the hygienists had diploma qualifications and one had a bachelors' degree, and had graduated between 1988 and 2003. Neither the dentist nor the hygienists had undergone extra training in special needs or gerodontology or had significant experience working in nursing homes. The hygienists were registered with the Dental Practice Board of Victoria and were working in either general practice or specialist periodontal practice. No additional training was undertaken for the dental hygienists for this project.

Residents who consented to participate in the project were examined by a dentist and one of the four hygienists. The dental examination was conducted using a plane mouth mirror, periodontal probe and sickle probe, with lighting provided by a headlamp. The dentist and hygienist were blinded to the other's findings until the case had been documented. Examinations were conducted in a variety of locations within the nursing home, including in residents' beds, wheelchairs or sitting in a regular chair. The medical history was assessed independently by both the dentist and dental hygienist prior to the dental examination, particularly to determine whether antibiotic prophylaxis for infective endocarditis would be required. No periodontal probing was undertaken for subjects considered at risk.

For each participant, the dental examination and follow-up treatment were conducted between May 2005 and June 2006. The dental examination measured coronal and root caries for each tooth surface and assessed periodontal disease using the Community Periodontal Index (21–23). After completing the dental examination, the dentist and hygienist independently devised a referral plan and an oral hygiene care plan for treatment to be performed by the hygienist using a series of binary (Yes/No) decisions. These were then compared for agreement between dentist and hygienist. The referral plan required the clinician to determine whether the subject required treatment that was beyond the permitted scope of practice of a dental hygienist as determined by the Dental Practice Board of Victoria Code of Practice for Dental Hygienists and could only be provided by a dentist. If it was determined that a referral was required, a series of options was provided to indicate which treatment categories were required – extraction(s), restoration(s), denture(s), complex medical history, periodontal management and oral pathology. The oral hygiene care plan required both the dentist and hygienist to choose what treatment the patient required that should be provided by a dental hygienist from a list of treatment categories – scaling and/or root planning, oral hygiene instruction, denture cleaning, topical fluoride application, dietary advice/counselling, management of dry mouth or no dental hygiene treatment required. Once an appropriate oral hygiene care plan was decided on by the dentist, treatment was provided by a dentist and/or hygienist as required.

In this study, the diagnosis and treatment decisions of the dentist were considered the gold standard (in other words, the known level of disease present or absent), and comparisons were made with the treatment decisions of the dental hygienists (or the test). The model to be tested was whether a dental hygienist could (i) examine a resident of an aged care facility and refer residents for dental treatment appropriately, and (ii) plan appropriate oral hygiene care on the basis of this examination. A number of statistical measures were used to compare the examination and treatment plans of the hygienists with the dentist – these were sensitivity, specificity and Cohen's Kappa coefficient, positive predictive value (PPV) and negative predictive value (NPV) (24, 25). Sensitivity, specificity, Kappa, PPV and NPV are reported with 95% confidence intervals.

Ethics approval was obtained from The University of Melbourne Human Research Ethics Committee and Dental Health Services Victoria Human Research Ethics Committee, and informed consent was obtained from all participants. Statistical analysis was conducted using SPSS 17.0 (IBM, Somers, NY, USA).

Results

A total of 510 residents from 31 RACFs received a dental examination from a dentist and one of four dental hygienists. Women comprised 68.8% of the sample population, and female residents were significantly older than male residents, with the

mean age for women being 85.7 years (SE = 0.5) compared with 77.8 years (SE = 1.1) for male residents ($F = 61.66$, $P < 0.001$). More than half of the residents had lived more than 2 years in residential care, with the average length of stay of 33.8 months (SE = 1.5). Residents were medically compromised, with 84.8% having three or more chronic medical conditions and 47.5% having five or more chronic medical conditions; 78.6% taking five or more medications and 35.3% taking nine or more medications; 38.0% with a diagnosed dementia and 18.0% with a history of stroke.

Just over half of the residents were dentate (53.9%), with significantly more males (60.4%) than females (51.0%) having at least one natural tooth ($\chi^2 = 61.36$, $P < 0.001$). Dentate residents had an average of 14.4 teeth present, with slightly higher numbers for female residents, younger residents, those without dementia, subjects not eligible for Government subsided public dental care and those with private health insurance, although none of these differences were statistically significant.

The treatment needs of residents were high, with most dentate residents requiring preventive and periodontal treatment that could be provided by a dental hygienist (Table 1). Three-quarters of residents required a referral to a dentist for treatment, with a significantly higher proportion of males than females requiring referral. Only 4.0% of dentate residents were assessed as requiring a referral for oral pathology. There were no significant differences in treatment needs for residents with a diagnosed dementia, compared to those without dementia. Edentulous residents had relatively low treatment needs compared with dentate residents, with most requiring professional cleaning of their dentures, 12.3% referral for denture-related problems and 18.3% referral for oral pathology (mostly denture stomatitis, oral candidiasis and ulcers associated with dentures). There was a single case of oro-pharyngeal cancer. Significantly fewer residents with a diagnosed dementia required their denture to be cleaned than residents with no dementia.

Table 1. Treatment needs by sex and dementia (%) – dentate residents

	Male (n = 96)	Female (n = 179)	Dementia (n = 104)	No dementia (n = 171)
Periodontal treatment	79.2[a]	92.2	89.0	87.1
Refer to dentist	84.4[b]	69.3	73.0	76.1
Dentures	18.8[c]	8.9	10.0	12.9
Extractions	60.4[d]	39.7	45.0	48.5
Restorations	51.0	49.7	44.0	54.6
Oral pathology	7.3[e]	1.7	1.0	4.8

[a] $\chi^2 = 9.77$, $P = 0.002$.
[b] $\chi^2 = 7.51$, $P = 0.006$.
[c] $\chi^2 = 5.55$, $P = 0.018$.
[d] $\chi^2 = 10.81$, $P = 0.001$.
[e] $\chi^2 = 5.62$, $P = 0.018$.

There was excellent agreement between the dentist and hygienists regarding the decision to refer residents to a dentist for treatment, with high sensitivity and specificity (Table 2). A comparison indicates that 99.6% of residents who were judged by the dentist as requiring care by a dentist were subsequently referred by the hygienist, whilst 82.9% of residents who did not require a referral were not referred to a dentist. Only 8.0% of residents were referred to a dentist by a hygienist when it was determined that no referral was required. In most cases, these referrals were to check potential soft tissue pathology or for review of inadequately fitting dentures.

There was only a single case where the dentist determined that a referral to a dentist was necessary and the hygienist assessed the subject as not requiring such a referral. This case had an asymptomatic periodontally involved tooth where the dentist recommended extraction and the hygienist did not. Sensitivity for the four hygienists regarding the decision to refer to a dentist ranged from 99.4% to 100%, specificity ranged from 78.9% to 100%, Kappa ranged from 0.761 to 1.000, PPVs ranged from 0.778 to 1.000 and NPVs ranged from 0.992 to 1.000 (Table 3).

For dentate residents only, there was a lower level of agreement between dentist and hygienist in deciding when to refer to a dentist for treatment. Although sensitivity was high (99.5%) and agreement was substantial (Kappa = 0.776), there was a lower level of specificity (71.0%). Hygienists referred 20 of 69 residents when the dentist judged

Table 2. Resident requires referral to dentist

	Dentist		
Hygienist	Yes	No	Total
Yes	269	41	310
No	1	199	200
Total	270	240	510

Sensitivity = 99.6% (98.1–99.9).
Specificity = 82.9% (81.2–83.3).
Kappa = 0.833 (0.800–0.840).
Positive predictive value = 0.868 (0.854–0.870).
Negative predictive value = 0.995 (0.974–0.999).

Table 3. Agreement between dentist and individual hygienists for decision to refer to a dentist (95% CI)

	Hygienist 1	Hygienist 2	Hygienist 3	Hygienist 4
Sensitivity	99.4 (96.9–99.9)	100 (96.9–100)	100 (74.3–100)	100 (84.1–100)
Specificity	81.9 (79.4–82.5)	83.3 (78.0–83.3)	100 (87.2–100)	78.9 (67.2–78.9)
Kappa	0.814 (0.763–0.824)	0.864 (0.777–0.864)	1.000 (0.615–1.000)	0.761 (0.494–0.761)
Positive predictive value	0.848 (0.826–0.852)	0.912 (0.884–0.912)	1.000 (0.743–1.000)	0.778 (0.654–0.778)
Negative predictive value	0.992 (0.961–0.999)	1.000 (0.936–1.000)	1.000 (0.872–1.000)	1.000 (0.851–1.000)

that no referral was required. This over-referral tended to be for restorative care (11 residents), to assess oral pathology (six residents) and for denture problems (four residents). The lower specificity was also a function of fewer dentate patients not requiring referral to a dentist. The over-referral rate was 7.3%.

There was extremely good concordance between the hygienists and the dentist when assessing whether dentate residents required periodontal treatment to be performed by a hygienist (Table 4). Nearly 90% of dentate residents were assessed as requiring periodontal treatment; a reflection of the overall poor levels of oral hygiene displayed by the dentate residents. Similar high levels of agreement existed for the decision to refer for tooth extraction or restoration, to review for potential oral pathology or for patients with a complex medical history.

Despite the prevalence of polypharmacy and comorbidity, only three of the residents were assessed by the dentist as having a medical history that necessitated referral. All three of these residents required antibiotic prophylaxis for invasive dental procedures, and all were correctly identified as requiring referral to a dentist by the hygienists. Only 21 residents (4.1%) were assessed as requiring antibiotic prophylaxis prior to invasive dental treatment (such as periodontal probing, scaling and extractions). There was 100% agreement between dentist and hygienist for this referral decision.

Discussion

Dental hygienists have been utilized to provide care to residents of aged care facilities in many countries, including Japan, Sweden and the United States of America. However, only one study has previously been conducted, which demonstrated that hygienists are capable of undertaking screening dental examinations for residents. This study was conducted in Sweden where dental hygienists have more independence and a broader scope of practice than in Australia (20). For more than 15 years, Swedish dental hygienists have been able to work independently, including the ability to diagnose dental caries and periodontal disease (26).

Residents in aged care facilities have poor oral health and oral hygiene, with moderate levels of oral disease and an overall sense of dental neglect (5, 12, 27). Access to oral health services is limited, and many dentate residents have untreated dental caries and mild–moderate periodontal disease. In Australia, this situation has arisen because of an inadequately resourced and staffed public dental sector and a lack of engagement by private dentists in the provision of care to residents of aged care facilities (9, 10). A focus on disease prevention and periodontal treatment is a role ideally suited to a dental hygienist. However, in Australia prior to the commencement of this study, dental hygienists were only allowed by law to provide treatment on the prescription of a dentist. The current study

Table 4. Agreement between dentist and hygienists for treatment decisions (95% CI)

	Requires periodontal treatment	Referral for extraction	Referral for restoration	Referral for oral pathology	Referral for complex medical history
Sensitivity	99.2 (97.9–99.7)	92.2 (88.7–94.5)	92.8 (84.4–95.7)	100 (84.1–100)	100 (50.4–100)
Specificity	94.1 (85.5–97.7)	95.9 (92.7–97.8)	77.9 (73.6–81.0)	78.9 (67.2–78.9)	99.8 (99.5–99.8)
Kappa	0.933 (0.834–0.974)	0.883 (0.815–0.924)	0.708 (0.621–0.768)	0.761 (0.494–0.761)	0.856 (0.428–0.856)
Positive predictive value	0.992 (0.979–0.997)	0.952 (0.915–0.975)	0.810 (0.773–0.836)	0.778 (0.654–0.778)	0.750 (0.378–0.750)
Negative predictive value	0.941 (0.855–0.977)	0.933 (0.902–0.952)	0.914 (0.863–0.949)	1.000 (0.851–1.000)	1.000 (0.997–1.000)

investigated the potential for hygienists to make appropriate treatment and referral decisions.

Nederfors et al. (2000) found that dental hygienists overestimated treatment need for 6.8% of residents (20). They concluded that it is possible to use an experienced dental hygienist as the professional of the dental team to act as a consultant in long-term care facilities and that this would be preferable from both an economic and pedagogical point of view. The results of the present study confirm the findings of Nederfors et al. (2000) and demonstrate that dental hygienists play an important role in the delivery of oral health care to residents of aged care facilities (20). Importantly, neither the dentists nor the hygienists in both these studies were calibrated, which would normally occur to minimize interexaminer variability in clinical studies. A model of care that utilizes a dental hygienist to undertake dental examinations and referral to a dentist, as well as providing periodontal and preventive treatment and oral health education to nursing staff, is likely to improve access to care for residents and has a positive impact on their oral health and quality of life.

It is advantageous to use screening tests in high-risk populations, because the predictive value of a test is higher when disease prevalence is greater (28). Because dental caries and moderate–severe periodontal disease are prevalent in this population, the strategy of utilizing a dental hygienist to undertake examinations appears to be entirely appropriate. Indeed, the high prevalence and severity of disease present in this population was likely to influence the high sensitivity values reported.

Variations in clinical decision-making are important in the context of the appropriateness of the dental care provided. Conceptually, clinical decision-making can be thought of in three distinct phases, with variation likely at each step: (i) diagnosis or detection of the disease, (ii) the decision about the intervention (in essence a yes/no question, although dentists often indicate uncertainty by 'watching' a condition), and (iii) determining the treatment from a list of alternatives (29). Variability in clinical decision-making amongst clinicians, including diagnosis of dental caries and treatment decisions for carious lesions, is common (30, 31). Differences may be because of diagnostic thoroughness or strongly held personal opinions about appropriate treatment (30). Bader and Shugars (1993) state that 'most treatment decisions have been considered a function of dentists' traditionally unassailable clinical judgement' (30). There is also variation in periodontal diagnosis and treatment planning amongst dentists, periodontists and dental hygienists, particularly regarding the interpretation of clinical findings, periodontal diagnosis and treatment planning (32). With variation amongst dentists appearing to be the norm, a degree of variation would also be expected between dental hygienists and dentists, as found in the present study. However, this observed variation was minimal, with high levels of agreement in the decision to refer residents for dental treatment.

The evidence from this study suggests that the benefits of hygienists providing services directly to nursing home residents far outweigh any potential risks. Patients with dental caries and other hard tissue disorders, advanced periodontal disease beyond the scope of the hygienist, potential soft tissue pathology, problems with dentures, complex medical histories and those requiring antibiotic prophylaxis were referred appropriately to a dentist for management. Many of these patients would not have had access to any dental care if this pilot project was not providing dental examinations and periodontal management.

One of the key strengths of this study is that it did not require additional education or training for dental hygienists prior to their participation in the study. Four dental hygienists educated in different jurisdictions, with no prior experience working in nursing homes or with frail and functionally dependent elderly patients, were all shown to be capable of making appropriate clinical decisions. This model of dental service provision indicates that currently registered and practising dental hygienists in Australia are capable of undertaking this role without undertaking specific further education or training.

The increased utilization of dental hygienists as part of the multidisciplinary team has been clearly recognized as an approach to improve dental service delivery. Dental hygienists have been shown to be capable of undertaking a dental examination for residents, correctly identifying the majority of residents who require a referral to a dentist as well as formulating appropriate dental hygiene treatment plans for residents. With a greying population who are retaining more natural teeth, it is important that public dental policy embraces a model of care that places dental hygienists at the frontline of dental service provision in RACFs. Dental hygienists can be utilized to provide dental examinations for residents on admission to an RACF, develop oral hygiene care

plans for residents, provide dental hygiene services, refer to a dentist and provide ongoing support and oral health education to carers.

Acknowledgements

The research described in this study was supported by the Victorian Department of Human Services and the Cooperative Research Centre for Oral Health Sciences (CRC-OHS). The CRC-OHS's activities are funded by the Australian Government's Cooperative Research Centres program.

References

1. Australian Bureau of Statistics. Population projections, Australia, 2004 to 2101. ABS cat. no. 3222.0. Canberra: ABS; 2006.
2. Australian Institute of Health and Welfare. Australia's welfare 2005. AIHW cat. no. AUS65. Canberra: AIHW; 2005.
3. Australian Institute of Health and Welfare. Residential aged care in Australia 2005–06: a statistical overview. Aged care statistics series 24. Cat. no. AGE 54. Canberra: AIHW; 2007.
4. Australian Institute of Health and Welfare. Residential aged care in Australia 2004–05: a statistical overview. AIHW cat. no. AGE 45. Canberra: AIHW (Aged Care Statistics Series no. 22); 2006.
5. Chalmers JM, Hodge CP, Fuss JM, Spencer AJ, Carter KD. The Adelaide dental study of nursing homes 1998. AIHW cat. no. DEN 83. Adelaide: AIHW Dental Statistics and Research Unit (Dental Statistics and Research Series No. 22); 2000.
6. Stubbs C, Riordan P. Dental screening of older adults living in residential aged care facilities in Perth. Aust Dent J 2002;47:321–6.
7. Chalmers JM. Oral health promotion for our ageing population. Aust Dent J 2003;48:2–9.
8. Nordenram G, Ljunggren G. Oral status, cognitive and functional capacity versus oral treatment need in nursing home residents: a comparison between assessments by dental and ward staff. Oral Dis 2002;8:296–302.
9. Chalmers JM, Hodge C, Fuss JM, Spencer AJ, Carter KD, Mathew R. Opinions of dentists and directors of nursing concerning dental care provision for Adelaide nursing homes. Aust Dent J 2001;46:277–83.
10. Hopcraft MS, Morgan MV, Satur JG, Wright FAC. Dental service provision in Victorian residential aged care facilities. Aust Dent J 2008;53:239–45.
11. Kayser-Jones J, Bird WF, Paul SM, Long L, Schell ES. An instrument to assess the oral health status of nursing home residents. Gerodontologist 1995;35:814–24.
12. Chalmers JM, Pearson A. A systematic review of oral health assessment by nurses and carers for residents with dementia in residential care facilities. Spec Care Dentist 2005;25:227–33.
13. Thai PH, Shuman SK, Davidson GB. Nurses' dental assessments and subsequent care in Minnesota nursing homes. Spec Care Dentist 1997;17:13–8.
14. Chalmers JM, King PL, Spencer AJ, Wright FAC, Carter KD. The Oral Health Assessment Tool – validity and reliability. Aust Dent J 2005;50:191–9.
15. Kayser-Jones J, Bird WF, Redford M, Schell ES, Einhorn SH. Strategies for conducting dental examinations among cognitively impaired nursing home residents. Spec Care Dentist 1996;16:46–52.
16. Kwan SY, Prendergast MJ, Williams SA. The diagnostic reliability of clinical dental auxiliaries in caries prevalence surveys – a pilot study. Community Dent Health 1996;13:145–9.
17. Kwan SYL, Prendergast MJ. The use of clinical dental auxiliaries as examiners in caries prevalence surveys in the United Kingdom: a feasibility study. Community Dent Oral Epidemiol 1998;26:194–200.
18. Ohrn K, Crossner C-G, Borgesson I, Yaube A. The accuracy of dental hygienists in diagnosing dental decay. Community Dent Oral Epidemiol 1996;24:182–6.
19. Wang NJ, Riordan PJ. Recall intervals, dental hygienists and quality in child dental care. Community Dent Oral Epidemiol 1995;23:8–14.
20. Nederfors T, Paulsson G, Isaksson R, Fridlund B. Ability to estimate oral health status and treatment need in elderly receiving home nursing - a comparison between a dental hygienist and a dentist. Swed Dent J 2000;24:105–16.
21. World Health Organisation. Oral health surveys: basic methods, 4th edn. Geneva: World Health Organisation; 1997.
22. National Institute for Dental Research. Oral health of United States adults: national findings. Bethesda, MD: US Department of Health and Human Services; 1987. NIH Publication No. 87-2868.
23. Hopcraft MS, Morgan MV, Satur JG, Wright FAC, Darby IB. Oral hygiene and periodontal disease in Victorian nursing homes. Gerodontology; doi: 10.1111/j.1741-2358.2010.00448.x.
24. Pretty IA, Maupome G. A closer look at diagnosis in clinical dental practice: part 1. Reliability, validity, specificity and sensitivity of diagnostic procedures. J Can Dent Assoc 2004;70:251–5.
25. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33:159–74.
26. Gatermann-Strobel B, Perno-Goldie M. Independent dental hygiene practice worldwide: a report of two meetings. Int J Dent Hyg 2005;3:145–54.
27. Saub R, Evans RW. Dental needs of elderly hostel residents in inner Melbourne. Aust Dent J 2001;46:198–202.
28. Gordis L. Epidemiology. Philadelphia, PA: WB Saunders Co; 1996.
29. Bader JD, Shugars DA. Variation in dentists' clinical decisions. J Pub Health Dent 1995;55:181–8.
30. Bader JD, Shugars DA. Agreement among dentists' recommendation for restorative treatment. J Dent Res 1993;72:891–6.
31. Espelid I, Tveit AB, Fjelltveit A. Variations among dentists in radiographic detection of occlusal caries. Caries Res 1994;28:169–75.
32. Lanning SK, Pelok SD, Williams BC, Richards PS, Sarment DP, Oh T-J et al. Variation in periodontal diagnosis and treatment planning among clinical instructors. J Dent Educ 2005;69:325–37.