Clinical relevance of dexterity in oral hygiene

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Key points

- Suggests dexterity, as well as motivation and awareness, can be a major factor in poor oral hygiene.
- Discusses effective and specific instruction for oral hygiene by evaluating patients' dexterity.
- Highlights how the design of oral hygiene instruction can be informed by the measurement of an individual's dexterity.

Introduction Dental plaque is a major aetiological factor in the development of periodontal disease; thus, it is essential to remove dental plaque to maintain good oral health. We used a simple method to visually evaluate a patient's dexterity to assess their oral care efficiency. The aim of this study was to evaluate dexterity and the effect it has on plaque control. **Materials and methods** A total of 80 patients, aged between 18 and 60 years, participated in this study. Participants were asked to pick up peas using chopsticks, and transfer them from one box (box A) to an empty box (box B), within one minute. The numbers of peas in box B were then counted. The plaque index score was recorded before and after standardised oral hygiene instructions (OHI) were given to each participant. Age, sex, dominant hand, and the result of the dexterity test were compared. **Results** Dexterity was the only significant predictor of improvement in oral hygiene after the OHI. All other variables were included in the model but none were reliable predictors. **Conclusion** Dexterity might be a good predictor of improvement in oral hygiene. We conclude that dexterity should be assessed in order to provide tailored instructions to each individual.

Introduction

Dental caries and periodontal disease are the two most common diseases found in the oral cavity. The major aetiology for these two diseases is dental plaque, which presents as a biofilm on the surface of the tooth and consists of a diverse community of microorganisms found in the soft tissues. Biofilm formation is a complex interaction between bacteria in the oral cavity with teeth, and among the oral flora themselves. Hence, the efficient and routine removal of this biofilm from soft tissue and tooth surfaces is a pivotal part of obtaining good oral health. Almost all dental patients clean their teeth once a day.[1] However, the efficiency of plaque control in individual patients varies. According to the *Cambridge English Dictionary*, dexterity is defined as the ability to perform a difficult action quickly and skilfully with the hands, or the ability to think quickly and effectively.[2] Doherty *et al.* reported that there is a strong positive relationship between poor oral hygiene and individual dexterity, in elderly individuals.[3]

The two major approaches to plaque control are mechanical and chemical.[4,5] Mechanical removal of the biofilm by oral care aids is the most basic and safest method. In contrast, chemical removal of the biofilm may have negative side effects. There are several factors that may contribute to the efficiency of plaque control. Some of these factors include awareness, knowledge, motivation, and self-esteem. Physical factors and the level of dexterity may be affected by other conditions and could naturally deteriorate with the aging.[6] Health care providers see patients of various ages and differing physical and educational backgrounds. A vast majority of people have reasonable dexterity, or might be assumed to have it, especially when they walk into a clinic without any visible physical condition known to impact their dexterity. The dentist and dental hygienist spend time with the patients in order to motivate and educate them on oral hygiene, without realising the underlying factors that may be leading to poor oral hygiene. Those who are not dexterous may be at a disadvantage as they are unable to perform some manoeuvres which could have a positive effect on the oral hygiene status. Dental professionals, however, are only able to train patients up to a certain point. Ideally, the training methods should be designed and customised to each individual. Non-dexterous patients or those with limited dexterity might require more training and with greater frequency, to achieve the level of effective prevention of periodontal diseases. On the other hand, dexterous patients might need only less training for proper oral hygiene. Medical care providers must exercise not only knowledge, but also flexibility in teaching manoeuvres according to the dexterity of the patient. In this study, we used a method to easily and visually evaluate patient dexterity in order to assess the patient's efficiency of brushing and flossing. The aim of this study was to evaluate

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the relationship between a patient's dexterity and the negative or positive effect it has on the patient's oral health, specifically plaque control in adults.

Materials and methods

This study was approved by the IRB research centre of Riyadh Colleges of Dentistry and Pharmacy (approval number: RC/IRB/2016/256). Written informed consent was obtained from each patient before the examination.

A total of 80 patients (40 males and 40 females) aged between 18 and 60 years with a minimum of 18 teeth present were included in the study. Other inclusion criteria were medical stability, adequate vision, and the ability to listen and understand instructions. Patients were excluded if they were pregnant, undergoing orthodontic treatment with fixed appliances, or had an acute disease. All the participants were not habitual users of chopsticks. The dexterity test was as follows: A total of 50 peas were placed in water in box A. Some of the peas floated and some were submerged in water. Participants were asked to pick up peas using chopsticks from box A and move them to box B for a period of one minute. The peas in box B were counted and recorded. Plaque score was recorded using the O'Leary score index and following this, appropriate instructions on oral hygiene were given to the participant.[7] The participant was then asked to brush and floss for a period of 10 minutes, after which, the plaque score was re-recorded using the O'Leary score index. One designated examiner performed all the procedures and recorded the scores.

Results

The variables collected were: age of the patient in years; plaque index before and following oral hygiene instructions (OHI); and the number of peas moved from box A to box B, which is defined as dexterity. A variable was created to assess any improvement in oral hygiene. This variable was called 'improvement of oral hygiene' and it is the patient's plaque score after OHI minus the patient's plaque score before OHI. All variables were tested for normality using both the visual histogram assessment and the Shapiro-Wilk test of linearity. The age of the patients and the level of dexterity were both non-normally distributed. The mean was reported for normally distributed variables (plaque index score before OHI, plaque index score after OHI, and the improvement in oral hygiene) and the median was reported for non-normally distributed variables (age and dexterity). To compare between male and female, a t-test was performed for the normally distributed variables and Wilcoxon rank-sum test was used for the non-normally distributed variables. The correlation between age and dexterity was tested using Spearman's rank correlation. Spearman's rank correlation coefficients were reported for the entire cohort, and for males and females separately (Fig. 1). The same correlation tests were performed for dexterity and improvement in oral hygiene (Fig. 2). In order to identify the best predictor of improvement in oral hygiene, a multiple regression test was performed with specific variables in the model, namely, dexterity, sex, age, and dominant hand. Only variables with

Fig. 1 The correlation between age and dexterity. The older the participants were, the lower the dexterity score for both men and women

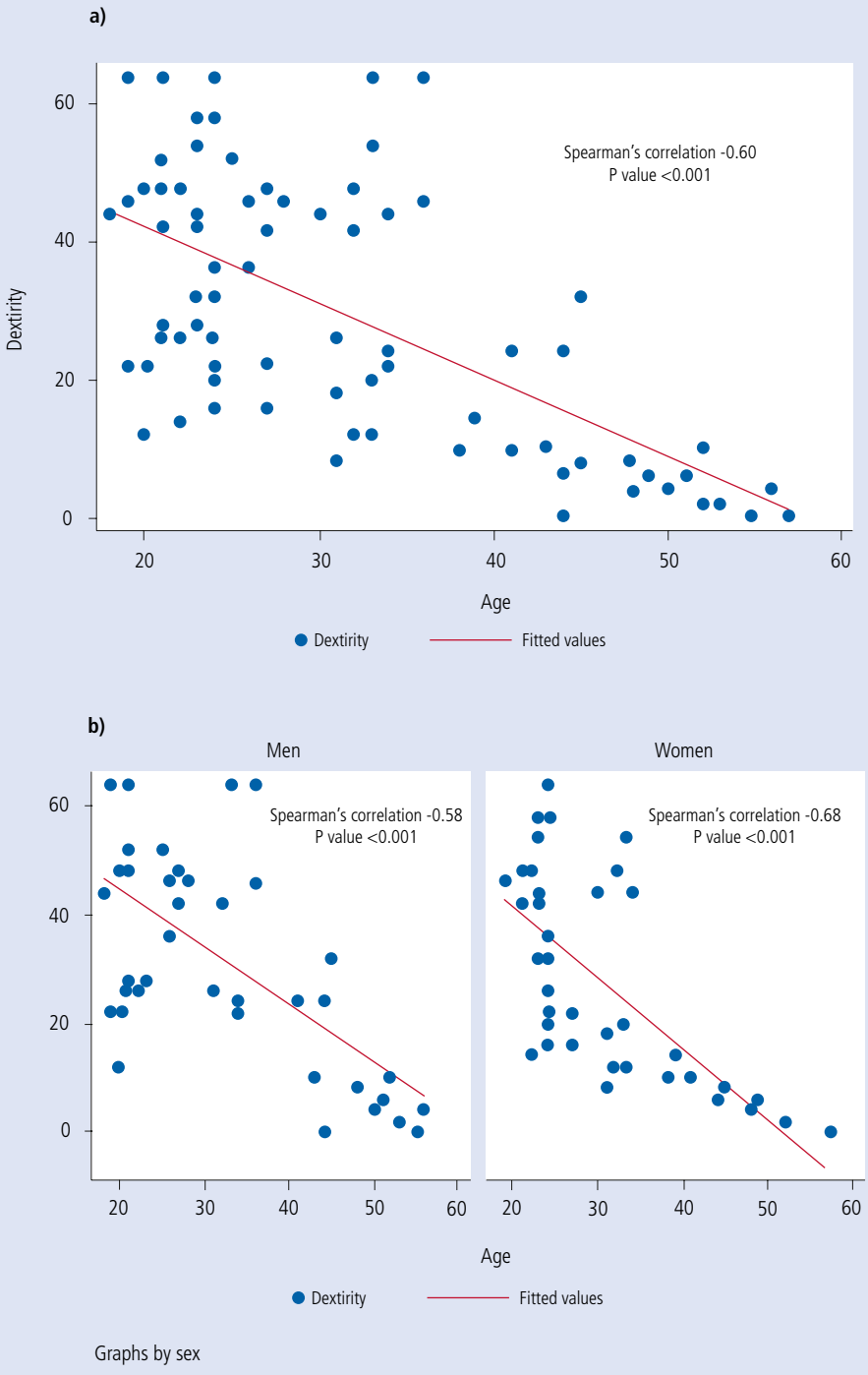

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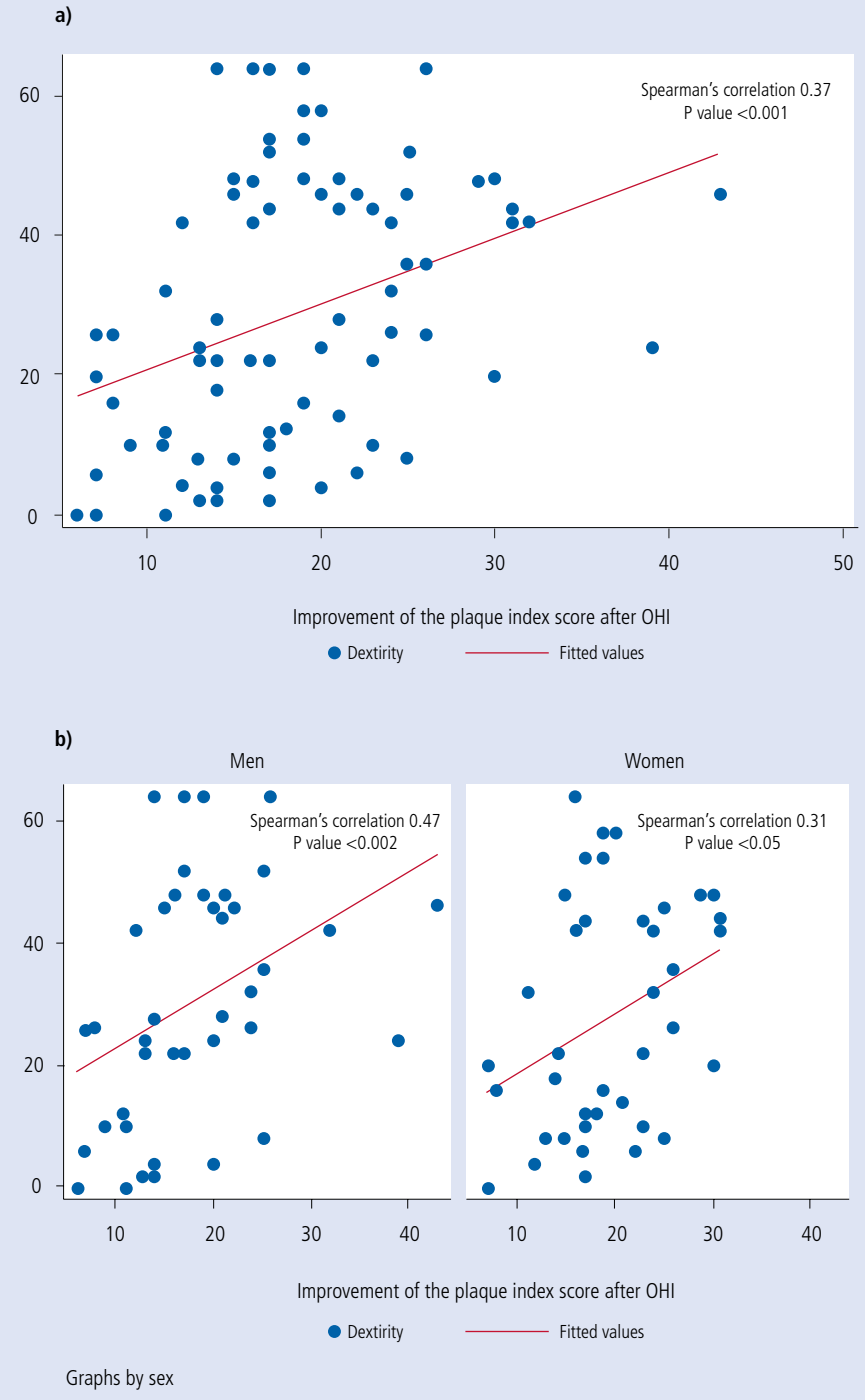
Fig. 2 The correlation between the dexterity of the subjects and the improvement in the plaque index score after OHI. The higher the dexterity score, the greater the improvement of plaque index score after OHI for both men and women



a P value <0.05 were considered predictors of an improvement in oral hygiene.

The age of the patient, plaque index before OHI, plaque index after OHI, level of improvement in the plaque index after OHI, and dexterity score did not show any significant difference between the sexes (Table 1). There was an inverse correlation between age of the participants and dexterity (Spearman correlation = 0.6, P <0.001). Older participants had a lower dexterity score. This correlation was true for both men (Spearman correlation = 0.58, P <0.001) and women (Spearman correlation = 0.68, P <0.001) (Fig. 1). Participants who had a high dexterity score showed greater improvement in the plaque index score after OHI (Spearman correlation 0.37, P <0.001). This positive correlation was evident in both sexes. However, the correlation was stronger in men (Spearman correlation = 0.47, P = 0.002) than in women (Spearman correlation = 0.31, P = 0.05) (Fig. 2). The correlation was statistically significant (P = 0.002) for right-handed subjects, but not for the left-handed subjects (P = 0.245). Multiple regression analysis showed that dexterity level was a predictor of improvement in oral hygiene and it explained 15% of the variance (R^2 = 14.6, F(4,75) = 3.22, P = 02). Dexterity was the only significant predictor of an improvement in oral hygiene after OHI (β = 0.12, P = 0.03). All the other variables were also included in the model but none were reliable predictors of an improvement in oral hygiene. Additionally, during the study we had some personal observations, participants who tried to understand the shape and structure of the dentition showed more efficient brushing movements, especially on the palatal and lingual surfaces.

Discussion

Methods of plaque control and their effectiveness are largely associated with individual compliance as well as a person's dexterity. Hence, dentists educate patients on the importance of good oral hygiene.[8] Patient compliance requires two important factors, namely, motivation and recognition. Motivation plays an essential role in adopting preventive measures.[3,9] In our study we used a method to evaluate dexterity to assess the effectiveness of brushing and flossing in men and women between the age of 18 and 60. We verified that dexterity may have a significant impact on improving oral hygiene.

Several tests have been developed to measure dexterity. Kamm *et al.* reported that the home-based dexterity training programme significantly improved manual dexterity and dexterity-related activities of daily living in moderately disabled multiple sclerosis patients.[6] The study found that hand dexterity had a meaningful influence on plaque control manoeuvres including: holding a toothbrush properly, controlling the force applied by the toothbrush onto the tooth surface, targeting and reaching the area requiring cleaning, movement of the toothbrush, speed of brushing, reaction time to recognition of discomfort, hand and arm stability, finger coordination, wrist flexion action, speed, and precision.

Elderly people tend to have poorer oral health which is reflected by the higher

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Table 1 Study participants description

Variable	Male n = 40 (50%) mean/median	Female n = 40 (50%) mean/median	P value
Age*	31.5	27	0.596
Plaque index before OHI	79.1	76.3	0.225
Plague index after OHI	61.05	56.825	0.116
Improvement of the plaque index	18	19.5	0.374
Dexterity score*	27	22	0.534

*Median is reported, as the data were not normally distributed

prevalence of dental caries and periodontal disease in this population.[10] This in turn may affect the individuals' dexterity, owing to disease or disability. Age is one of the factors that compromises proper oral care and can contribute to increased plaque resulting in gingivitis.[11] Felder *et al.* reported the ability of 58 elderly patients (aged 65 and older) who resided at a veterans' medical centre and a nursing home in Portland, USA, to brush their teeth.[11] The toothbrushing ability test (TAT) was used to predict brushing effectiveness which was measured by plaque levels. The results showed highly significant Spearman correlations between TAT scores and plaque levels ($r = 0.719$; $P < 0.000$). The authors reported that the TAT is an effective and practical tool to help determine the ability of the elderly to maintain good oral health.

The quality of plaque control directly affects the outcome of dental work, for example, when taking an impression for prosthodontic restorations, if chronic gingival inflammation exists due to poor oral hygiene, it will affect the accuracy of the impression in the gingival margin area and consequently, the quality of the final restoration will be compromised. In general, periodontal disease progresses as a result of inadequate oral hygiene. Gingival inflammation caused by inadequate oral hygiene may lead to gingival bleeding and other destructive effects. In cases where periodontal surgery is required, the quality of plaque control is a significant determining factor of the outcome of the surgery and it directly impacts the wound healing process. Proper oral hygiene helps to achieve less inflamed tissue resulting in minimal bleeding, and better visual access to the surgical site that will eventually lead to more precise surgical manoeuvres. If optimal surgical procedures were consistently performed, this would lead to less complications such as infections and/or delayed wound healing.

Mucositis may occur due to side effects of certain medications such as chemotherapy drugs. For those undergoing chemotherapy, close attention to oral hygiene is required to prevent further deterioration of the periodontal condition.[12,13] Hence, it is essential to obtain good plaque control skills for any phase of active dental treatment as well as the maintenance phase.

Our results indicate that it is important to address dexterity for the quality of plaque control. If patients have poor oral hygiene, their level of dexterity should be determined rather than assuming that it is due to lack of awareness or motivation. The method used in this research proposes an easy test, which can be incorporated into patient assessment, to assess the dexterity status. The dexterity test can be used to assess the level of plaque control, as well as to analyse the reasons for poor oral hygiene. Some may consider using peas in the clinic as inappropriate. An alternative to peas are small round-shaped glass marbles, as they have the same geometric features as peas; that is, smooth surface and round shape. For those who are not dexterous, an electric brush and/or other modalities of oral hygiene should be recommended. The result of our study clearly quantifies the relationship between dexterity and improvement of plaque score.

Conclusion

Dexterity was the only significant predictor of improvement in oral hygiene. The age of the patient showed correlation, but it was not a significant predictor of improvement in oral hygiene. Dexterity of the patient can be measured using the simple chopstick test, as described in this study, in the patient's initial assessment, even though they are non-habitual users of chopsticks.

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