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Factors influencing the wearing of protective gloves in orthodontic practice

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SUMMARY The purpose of this study was to explore how wearing, or not wearing, protective gloves affects the efficiency of orthodontists in performing certain orthodontic procedures. Thirty-six volunteers were randomly selected from members of the Taiwan Association of Orthodontists. A visual analogue scale (VAS) was used to determine the degree of convenience subjects felt in performing 11 specified orthodontic procedures, with and without gloves. In addition, the time required to bend round and rectangular archwires and to tie and untie ligature wires was recorded.

The results showed that for 10 of the 11 orthodontic tasks there was perceived to be no difference when wearing, or not wearing, gloves. Only when bending a round archwire was there perceived to be a difference. When the four orthodontic procedures were undertaken on a typodont and timed, no significant difference was found between the use of gloves/no gloves.

Introduction

Since the early 20th century, wearing protective gloves during surgical operations has been highly valued in the medical society (Burke and Wilson, 1989). In the past, dentists wore gloves only when performing oral surgery. However, by 1974 the routine use of gloves was being discussed (Crawford *et al.*, 1974). Following reports of several hepatitis B cross-infections in the USA (Rimland *et al.*, 1977; Shaw *et al.*, 1986; Centers for Disease Control, 1993), the American Dental Association (1978) released the 'Infection Control Recommendations' and formally recommended that dentists should wear gloves in practice to avoid any possible contact with a patient's saliva or blood. The Centers for Disease Control (1987) actively promoted barrier techniques and universal precautions, and the American Occupational Safety and Health Administration (1991) began to implement dental infection control measures. Since that time, the wearing of protective gloves has become mandatory for dentists in practice and is an important infection control procedure.

Among dental practitioners, however, fewer orthodontists were found to wear gloves compared with other general dental practitioners (GDPs). Woo *et al.* (1992) investigated orthodontists and other GDPs in California and found routine wearing of gloves in 59 and 97 per cent, respectively. McCarthy *et al.* (1997) compared orthodontists in Canada with other GDPs and found percentages of 85 and 92, respectively. Slightly lower figures were found in a British study, where Burke *et al.* (1992) reported glove wear in 39 per cent of orthodontists and 88 per cent of GDPs, while the figures for a Taiwanese population were 51 and 69 per cent, respectively (Cheng *et al.*, 1997).

In Taiwan, only in the last 10 years has infection control in dentistry been valued and promoted. Prior to this, few orthodontists wore gloves, as it was perceived that gloves affected the sense of touch, limited finger movements, and affected the efficiency of some delicate operations such as wire bending and tying ligatures (Starnbach and Biddle, 1980; Cooley *et al.*, 1989; Evans, 1989; Davis and BeGole, 1998). In addition, gloves are easily penetrated by wires, or may become tangled with instruments or wires, which was thought to cause inconvenience (Burke *et al.*, 1992; Woo *et al.*, 1992).

A review of the literature showed limited data on how wearing gloves affects dental efficiency or manual dexterity. Uldricks *et al.* (1985) reported that wearing gloves did not affect the scaling technique of dental hygiene students and Wilson (1986) noted that the dexterity of dental hygienists when using dental probes was not affected by gloves. Brantley *et al.* (1986) found that the wearing of gloves by dental hygiene students in the laboratory did not affect the time taken to restore a tooth and Hardison *et al.* (1988) detected no significant difference between dentists wearing and not wearing gloves when preparing canals and placing a pin.

It therefore appears that wearing gloves does not affect the efficiency of the majority of dental procedures. However, research in this area of orthodontics has rarely been undertaken. Therefore, the purpose of this study was to explore how wearing gloves may affect the performance of orthodontic procedures. The results would then serve as a reference for promoting infection control.

Materials and methods

Study subjects

Thirty-six subjects were randomly selected from members of the Taiwan Association of Orthodontists. Following their agreement to participate, a questionnaire survey and operational assessment was conducted on each subject.

Questionnaire survey

The questions assessed the subjects' perceptions of their efficiency when conducting 11 orthodontic procedures while wearing or not wearing gloves. The questionnaire (Table 1) included a total of nine questions relating to their level of experience and background; seven to their

Table 1 Questionnaire

A. Background data

1. Age: ① ≤30 ② 31–41 ③ 41–50 ④ ≥50
2. Gender: ① Male ② Female
3. Practice years: ① ≤5 ② 6–10 ③ 11–15 ④ ≥16
4. Practice place: ① Hospital ② Dental office ③Other
5. Practice type: ① Solo practice ② Group practice
6. Practice distribution:
   ① Only orthodontic practice
   ② 70 per cent orthodontic practice + 30 per cent general dental practice
   ③ 50 per cent orthodontic practice + 50 per cent general dental practice
   ④ 30 per cent orthodontic practice + 70 per cent general dental practice
   ⑤ Other
7. Patient numbers/day: ① 0–10 ② 11–20 ③ 21–30 ④ ≥30
8. Practice days/week: ① 1 ② 2 ③ 3 ④ 4 ⑤ 5 ⑥ 6 ⑦ 7
9. Main age distribution of orthodontic patients: ① ≤14 ② 15–19 ③ 20–60 ④ ≥60

B. Perception of gloves on orthodontic practices

1. Wearing gloves during orthodontic training: ① For all patients ② For none ③ For selected patients
2. Wearing gloves in current orthodontic practice: ① For all patients ② For none ③ For selected patients
3. Frequency (patient no.) of changing gloves: ① 1 ② 2 ③ 3 ④ 4 ⑤ ≥5 ⑥ No change
4. Not wearing gloves in performing orthodontic tasks: ① Wire bending ② Ligature ③ Activation ④ Try bands ⑤ Bonding and banding ⑥ Debonding and debanding
5. Main obstacle of wearing gloves in performing orthodontic tasks:
   ① Decrease in finger dexterity ② Decrease in operation efficiency ③ Increase in cost
   ④ Increase in waste ⑤ Increase in uncomfortable sensation on hand ⑥ Increase in hand hypersensitivity
   ⑦ No effect
6. Main affecting factor of gloves on performing orthodontic tasks:
   ① Size ② Fit ③ Powders ④ Thickness ⑤ Material ⑥ Other
7. Chances of sharps injury to hands during glove wearing: ① Increase ② Decrease ③ No effect

C. Convenience of orthodontic tasks when wearing and not wearing gloves

I. Wearing gloves	Very poor convenience ——— Excellent convenience
1. Trying bands	
2. Using prophylaxis	
3. Bonding	
4. Bending a round wire	
5. Bending a rectangular wire	
6. Bending a closed loop	
7. Tying a ligature	
8. Untying a ligature	
9. Changing a power chain	
10. Activating a closed loop	
11. Adjusting a retainer	

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perception of how wearing gloves might affect the performance of each task; and 11 to self-assessment of the convenience of performing the 11 orthodontic tasks when wearing and not wearing gloves. The convenience of each task was recorded using a 10 cm visual analogue scale (VAS) with 0 cm representing 'very poor convenience' and 10 cm 'excellent convenience' (Price *et al.*, 1983). The subjects marked the perceived convenience for each task directly on the VAS and the data were then converted to percentages, which constituted the so-called 'efficiency score'.

The perceived efficiency score when undertaking the tasks without wearing gloves was labelled 'a', and while wearing gloves 'b'. Therefore, the difference between a and b represents the efficiency difference between wearing and not wearing gloves.

Performance assessment

The subjects were also asked to perform four orthodontic procedures: bending round and rectangular archwires, and tying and untying ligatures, while wearing and not wearing gloves. The time taken was recorded with a stopwatch.

Each exercise involved the subject using a new pair of powder-free latex gloves (examination latex gloves, Sempermed, Hatyai Songkhla, Thailand). In the first exercise, the subjects bent a round wire (0.016 inch, UT-211-160, Tomy, Tokyo, Japan) with light bird beak pliers (60-315c, Tomy) until the wire conformed to the arch form on a cardboard template. The second exercise involved bending a pre-formed rectangular arch wire (0.016 × 0.022 inch, UT-300-934, Tomy) with light bird beak pliers until it conformed to the closed loop arch form shown on the template. The third exercise used a Mathieu needle holder (60-215, Tomy) to tie a 0.010 inch ligature wire to brackets placed on the four upper incisors of a typodont and then to use a ligature cutter (60-605, Tomy) to remove the excess wire and a ligature director (YDM-22-704, Tomy) to turn the end of the ligature inwards. Finally, the subjects were asked to use a ligature cutter (SD-60-150S, Tomy) to remove the ligature. The exercises were then repeated without the use of gloves and timed in an identical manner.

The time difference was obtained by subtracting the time spent by the subjects on each exercise without wearing gloves from that when wearing gloves. If the result was positive, it meant that more time was required to perform the task without wearing gloves and if it was negative, it meant that more time was required to perform the task when wearing gloves.

Data analysis

All statistical tests were carried out using the SAS Statistical Software Package version 6.12 (SAS Institute Inc., Cary, North Carolina, USA). The Wilcoxon rank sum test was used to compare each subject's response to the questions and also the time required for the exercises with and without gloves. The Kruskal–Wallis test was used to examine the differences with and without gloves relative to the level of experience of the orthodontist.

Results

Participants

The 36 subjects were randomly selected from members of the Taiwan Association of Orthodontists. The characteristics of these participants are shown in Table 2.

Perception of gloves on orthodontic practices

The main reasons reported for not wearing gloves in orthodontic practice were: loss of manual dexterity (27.8 per cent) and reduced efficiency (16.7 per cent). However, it was of interest that 41.7 per cent of participants considered there to be no difference between wearing and not wearing gloves. Almost 39 per cent of orthodontists did not wear gloves for bending wire and 11.1 per cent placed bonds without wearing gloves. Seventy-five per cent of subjects considered the size of the gloves to be the main factor affecting performance,

Table 2 Characteristics of the study participants (n = 36).

Items	Number	Percentage
Gender		
Male	22	61.1
Female	14	38.9
Age		
≤30	1	2.8
31–40	22	61.1
41–50	11	30.6
≥50	2	5.6
Practice years		
≤5	5	13.9
6–10	17	47.2
11–15	9	25.0
≥16	5	13.9
Practice location		
Hospital	14	38.9
Local office	22	61.1
Use of gloves in past orthodontic training		
All patients	16	44.4
None	7	19.4
Selected patients	13	36.1
Use of gloves in current practice		
All patients	26	72.2
None	4	11.1
Selected	6	16.7

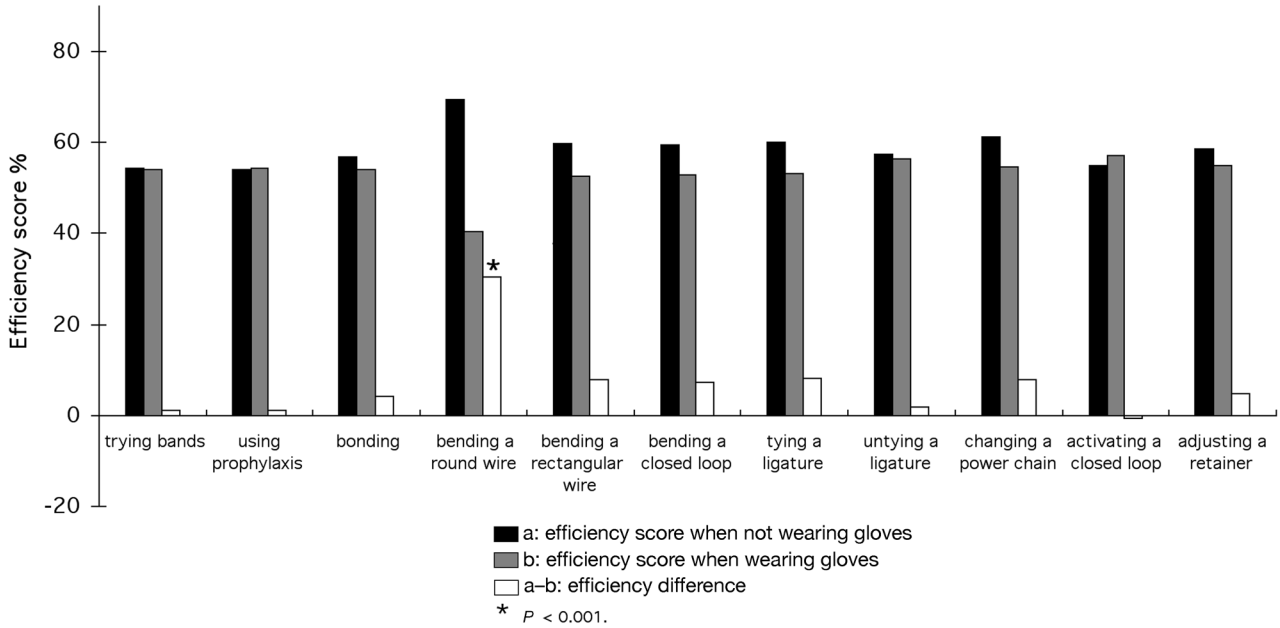

Figure 1 Efficiency score and efficiency differences when wearing and not wearing gloves for 11 orthodontic tasks.

while 38.9 per cent believed that the odds of receiving a sharps injury were reduced by wearing gloves.

Performing orthodontic tasks with and without gloves

Figure 1 shows that of the 11 orthodontic procedures rated, the lowest convenience index when wearing gloves was for bending a round archwire (40.47 per cent). In contrast, the highest convenience index for not wearing gloves was for the same procedure (69.38 per cent). This difference was significant ($P < 0.001$). For the other 10 orthodontic procedures, although the convenience index of not wearing gloves was generally higher than that when wearing gloves, there were no significant differences between the values. Thus, the wearing of gloves had a minimal influence on the perceived efficiency or convenience of performing the orthodontic tasks.

Orthodontic background of wearing or not wearing gloves

The subjects were divided into different groups based on their age, gender, years in practice, whether they had worn gloves during training, and whether they wore gloves in their current practice. For several of the 11 procedures there was a significant difference ($P < 0.05$) in terms of perceived convenience between wearing and not wearing gloves for those who were over 41 years of age when compared with the subjects below 40 years of age (Figure 2). Figure 3 shows that there was also a significant difference ($P < 0.05$) for two of the procedures between those who had been in practice for more than 11 years and the remaining subjects. The results (Figure 4) indicate that, for the majority of the orthodontic procedures, those who wore gloves during their training perceived fewer problems than those who did not wear gloves at all, or who wore them selectively, during training. For those clinicians who wore gloves for all current practices, the perceived convenience was higher for one of the 11 procedures (bending a round archwire; Figure 5) when compared with those who did not use gloves routinely.

Performance time for orthodontic tasks when wearing or not wearing gloves

The time required to bend round and rectangular wires and to ligate them was reduced when wearing gloves. However, there were no significant differences between the times spent on these tasks (Figure 6). In addition, the time taken was not influenced by the level of experience of the orthodontist.

Discussion

As most orthodontic treatment is non-invasive, the use of barrier techniques for infection control was overlooked for some time. However, there are various procedures during orthodontic treatment, from simple oral cleaning prophylaxis to complicated wire bending, and it is not unreasonable to assume that the use of gloves may have a different impact on these various treatment procedures. The unwillingness of orthodontists to wear gloves in the past was probably because they had trained at a time when the routine use of

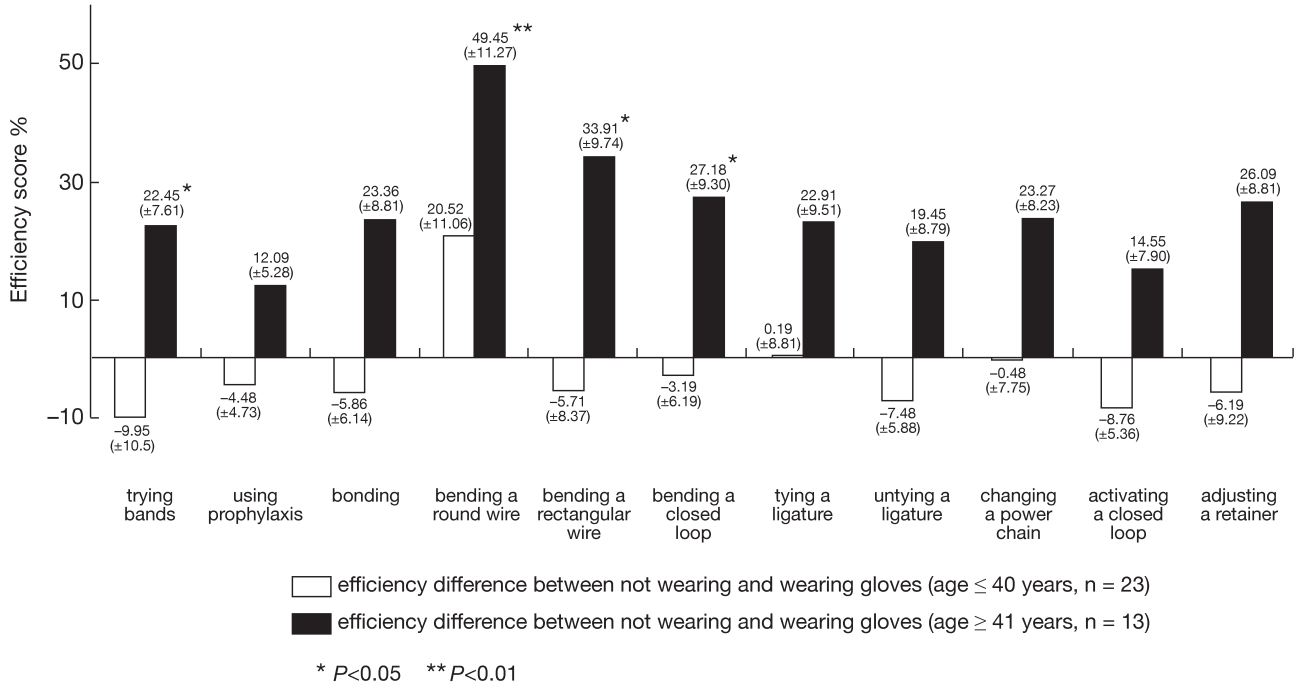

Figure 2 Efficiency difference between not wearing and wearing gloves in performing orthodontic tasks by age.

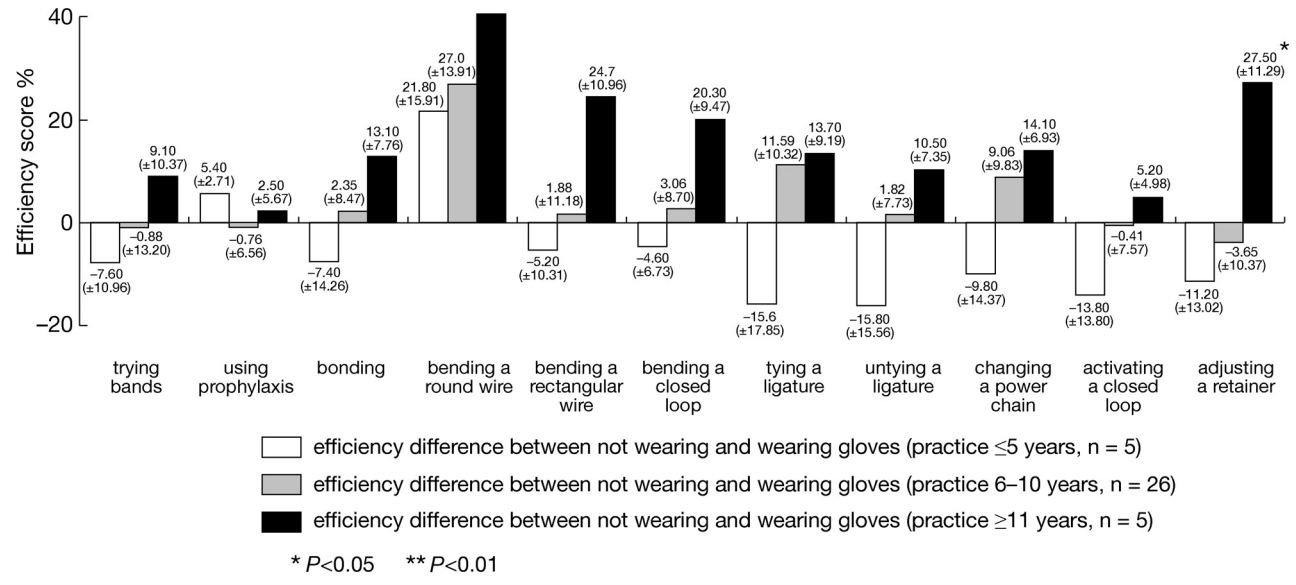

Figure 3 Efficiency difference between not wearing and wearing gloves in performing orthodontic tasks by the number of years in practice.

gloves was not commonplace. Therefore, this study allowed orthodontists to subjectively evaluate the convenience and impact of using gloves for 11 routine orthodontic tasks. The study also asked subjects to carry out four routine orthodontic procedures on a typodont, with and without gloves, and the time taken to complete the tasks was recorded. It was assumed that 'the longer the performance time, the worse the efficiency'.

The main reasons stated for not wearing gloves were similar to those in other studies (Burke *et al.*, 1992; Woo *et al.*, 1992; McCarthy *et al.*, 1997). According to the convenience assessment of the 11 treatment procedures in this study, wearing gloves tended to be perceived as being less convenient than not wearing gloves. However, the differences were not significant, except for bending a round archwire ($P < 0.001$).

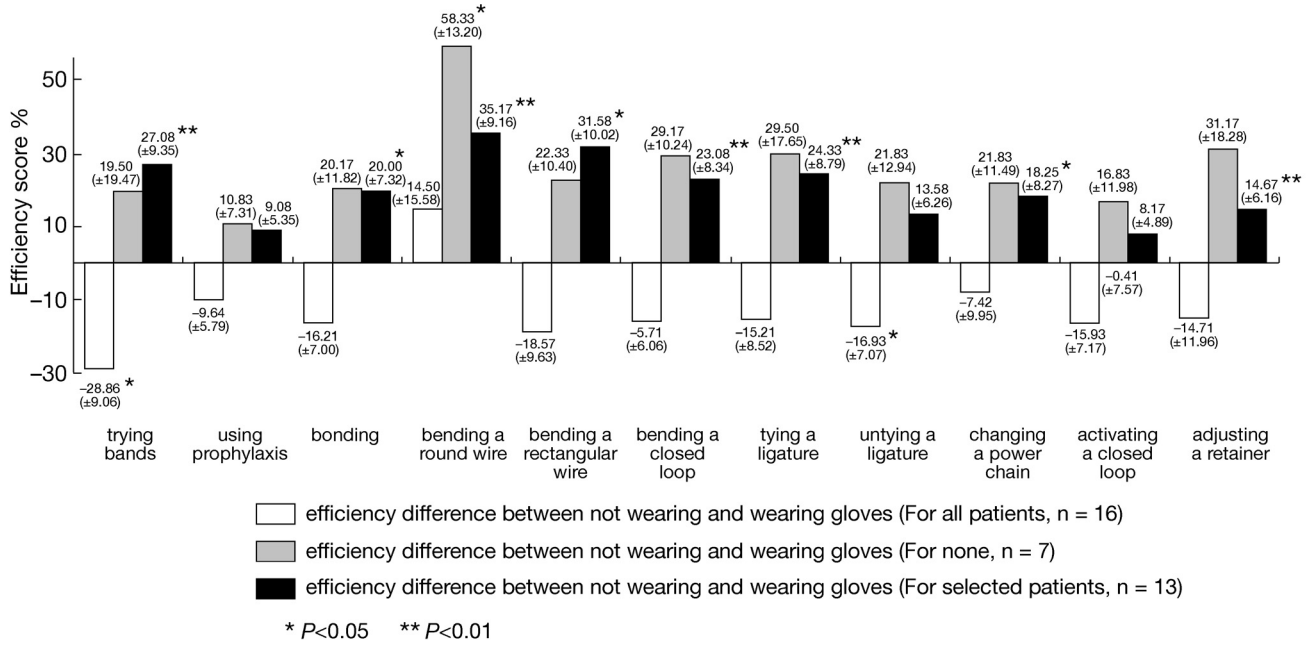

Figure 4 Efficiency difference between not wearing and wearing gloves in performing orthodontic tasks by whether orthodontists had used gloves during training.

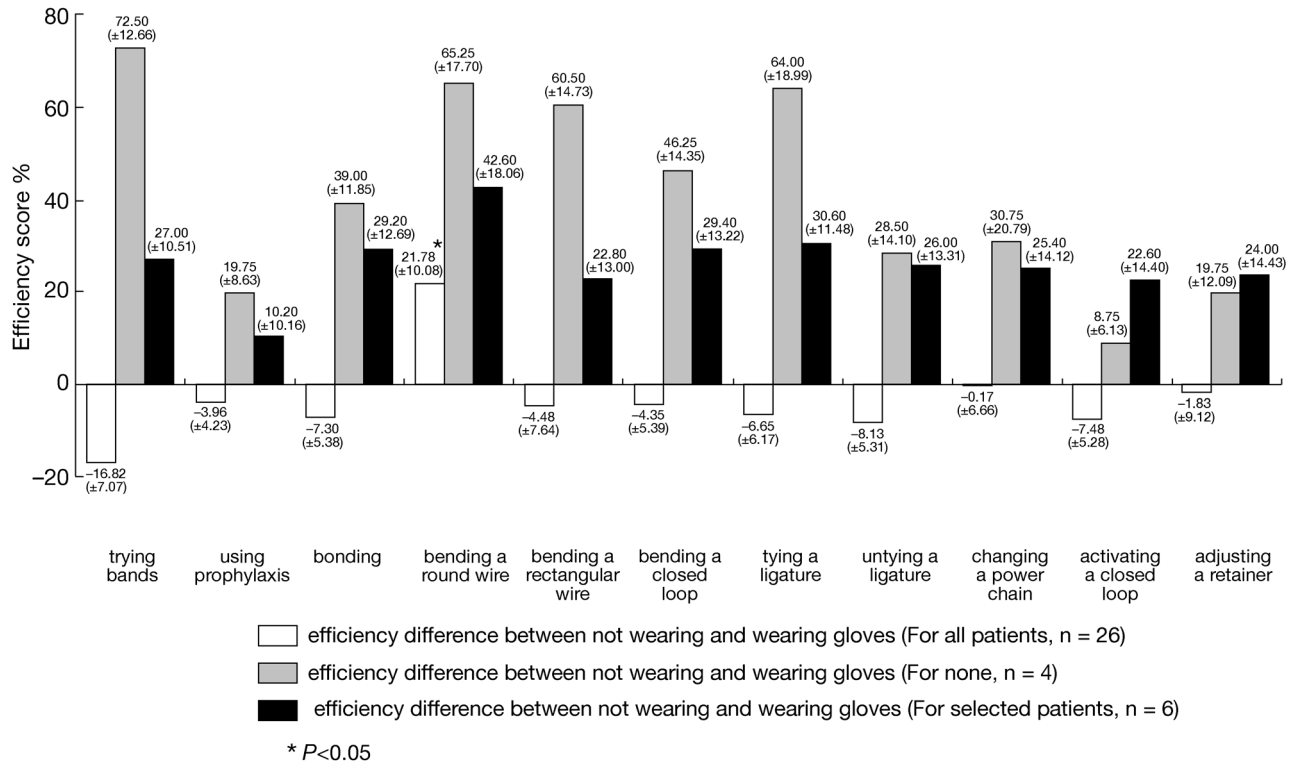

Figure 5 Efficiency difference between not wearing and wearing gloves in performing orthodontic tasks by whether orthodontists use gloves in their current practice.

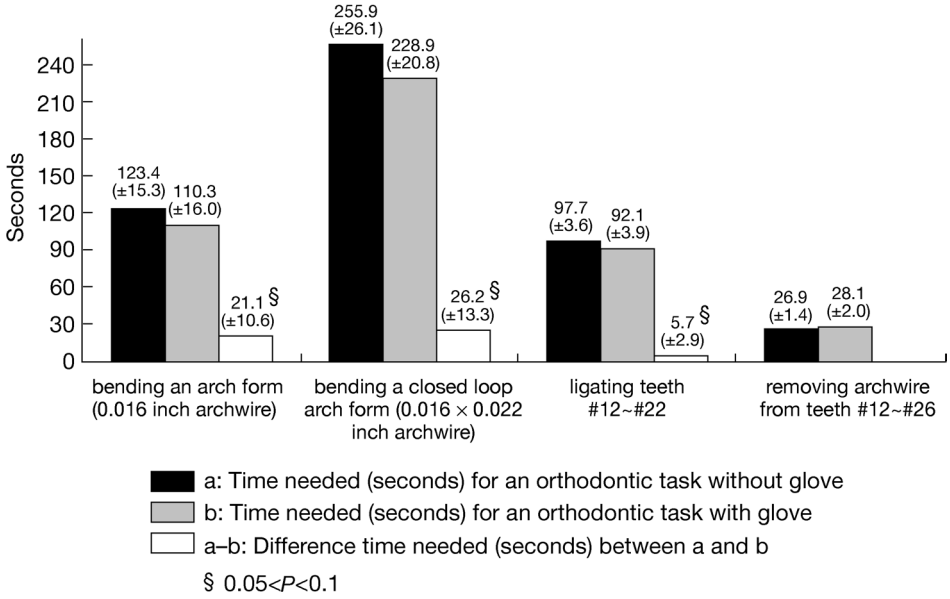

Figure 6 Performance time when wearing or not wearing gloves for different orthodontic tasks and the effects of orthodontic background.

Therefore, it appears that most orthodontists do not feel that there is a major difference between wearing and not wearing gloves.

Orthodontists who were younger (40 years of age or less), female, had fewer years in practice (5 years or fewer), had worn gloves throughout training, and wore gloves routinely in current practice, generally perceived more convenience in performing the orthodontic tasks while wearing gloves compared with not wearing them. Only for bending a round archwire was this felt not to be the case. This is probably because orthodontists are aware that the resistance of the gloves hampers the dexterity of the thumb and forefinger when bending the round wire into an arch form. From past clinical experience, bending a round wire with gloves may be made easier by wrapping the round wire with gauze while bending it into an arch, or soaking the fingertip areas of the gloves in water to lubricate them.

The study showed that older orthodontists and those with more years in practice felt more inconvenienced when wearing gloves. In addition, male orthodontists perceived more inconvenience than females. Although little documentation is found related to these issues, the outcomes of this investigation were consistent with previous studies. For example, Burke and Wilson (1991) found that of those GDPs who did not wear gloves, 91 per cent had more than 10 years' experience in practice, and males wore gloves less frequently than females (65 versus 77 per cent). Previous research (Cheng *et al.*, 1995) has also shown that older practitioners and those with more years in practice tend to wear gloves less frequently, and again, with male dental practitioners wearing gloves less often than females (64.5 versus 85.5 per cent).

After objectively recording the time required to complete the four orthodontic tasks on a typodont, the time for three of the four procedures was less when wearing gloves than when not wearing gloves, although this only reached borderline significance ($0.05 < P < 0.1$). Although some subjects undoubtedly found it inconvenient to bend wire while wearing gloves, the results refute the prejudice that wearing gloves increases operation time. Of all the orthodontic tasks, regardless of whether or not gloves were being worn, bending a rectangular wire into a closed loop was the most time-consuming and complicated procedure.

The findings of this study suggest that although the time spent performing the four orthodontic tasks with or without gloves was not affected by the different backgrounds of the orthodontists, the data collected from the self-assessment questionnaire showed the opposite viewpoint. This was probably because the questionnaire was subjective, whereas the time required for undertaking the procedures on typodonts was objective and accurately timed.

It appears that wearing gloves routinely is the best way to reduce the inconvenience, and, as the outcomes of this study show, those who wore gloves during training and in current practice had fewer reservations than those who did not. Burke *et al.* (1992) considered that 42 per cent of orthodontists were capable of getting used to wearing gloves in practice in 2 weeks, with 33 per cent requiring only 2 months to adapt. With the intensive promotion of dental infection control in

Taiwan during the past 10 years, increasing numbers of orthodontists are wearing gloves in practice. Even though some of them were reluctant to encompass these advances in cross-infection control, after limited training they did become used to it and did not experience as much inconvenience in actual practice as expected.

Therefore, in order to develop high standards of cross-infection control, continuous re-education is needed. The influence of different geographical locations, cultural backgrounds, and perceptions of infection control need to be determined through a further study.

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