

The Comparison of Various Oral Hygiene Strategies in Neuromuscularly Disabled Individuals

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Abstract

Background: This study aims to investigate the effect of various oral hygiene strategies on the symptoms of inflammation in neuromuscularly disabled patients and to define the optimum hygiene method.

Methods: Fifty-nine neuromuscularly disabled participants, suffering from cerebral palsy, were randomly divided into five groups as follows: Group M: manual toothbrush (n=14), Group E: electrically powered toothbrush (n=9), Group MC: manual toothbrush and chlorhexidine gluconate (CHX) spray (n=13), Group EC: electrically powered toothbrush and CHX spray (n=9), and Group C: CHX spray (n=14). The oral hygiene applications were provided by the parents and staff. At baseline and after 21 days the plaque index (PI), the gingival index (GI), and bleeding on probing (BOP) were recorded.

Results: In intra-group comparisons of the pre- and post-application scores, in all groups the PI and GI scores and BOP percentages, except in Group C, were found significantly different ($p<0.05$). There were significant differences among the post-application scores, between Group M and Group E and between Group C and Group E in PI scores; between Group C and Group E the difference in GI scores were found statistically significant ($p<0.05$).

Conclusions: Although all oral hygiene strategies reduced plaque and gingival inflammation, the results of our study suggested the electrically powered toothbrush could be more recommendable to neuromuscularly disabled people in these strategies, while the combined procedures appeared to be neither beneficial nor favorable.

Keywords: Disabled, plaque removal, electrically powered toothbrushes

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Introduction

Handicap is the loss or limitation of opportunities to take part in the normal life of the community on an equal level with others due to physical and social barriers.¹ According to the data from the 1988 National Interview Survey there are nearly 11 million children, aged 17 and under, with developmental, learning, or emotional disorders. The most common major handicaps are disorders of the central nervous system, the cardiovascular system, and the mind.² Cerebral palsy is one of these neuromuscularly handicaps, which has specific motor skill problems, delay in developmental milestones, as well as physical findings that might include abnormal muscle tonus, reflexes, and persistent infantile reflexes.^{3,4}

In disabled individuals the process of developing gingival/periodontal diseases does not differ from non-disabled individuals. There are no differences in prevention of the diseases and the treatment modalities between these groups. The main factor related to gingival/periodontal problems in disabled individuals is the inadequacy of the plaque removal from the teeth. Motor coordination problems and muscular limitation in neuromuscularly disabled individuals along with the difficulty in understanding the importance of oral hygiene in mentally disabled individuals have resulted in the progression of inflammatory diseases.^{5,6,7}

The mechanical control of dental plaque in disabled individuals generally causes some difficulties, is found to be time-consuming, and sometimes ineffective.^{8,9} Advances in manual (M) and electrically powered (E) toothbrushes have increased their ability to remove plaque. Haffajee et al.¹⁰ compared the efficacy of M and E toothbrushes on clinical parameters. They stated the E toothbrushes significantly reduced the mean Gingival Index (GI) and probing attachment level in a 6 month time interval. Their results are in concordance with numerous studies¹¹⁻¹⁹ which suggested that E toothbrushes deliver superior plaque removal compared to M toothbrushes.

However, the effectiveness of M and E toothbrushes is limited by the manual dexterity and skill of the user.²⁰ As a result, chemical plaque control has been recommended as an alternative and adjunctive to mechanical plaque control in

these special patient groups.^{21,22} It has been suggested chlorhexidine gluconate (CHX) may be the only possible answer to the oral hygiene problem of the disabled patients.²³ The effectiveness and the effect mechanisms of CHX have widely been investigated in various patient populations, including the disabled, and the results have led CHX to be defined as the "gold standard."²⁴⁻²⁸ The CHX mouthwash technique caused many problems when used in a disabled population. Previous investigators estimated only 22% of institutionalized disabled patients were able to rinse effectively.²⁹ In spastic cerebral palsy patients, the CHX spray application exhibited ease of use, effective plaque control, reduced adverse effects, and swallowing problems.^{3,30}

The combination of mechanical and chemical plaque control seemed to be even more beneficial than only using a mouthwash.^{31,32} When the main volume of the dental plaque is removed by mechanical actions, the oral chemopreventive agents only have to combat sparse biofilm remnants.³³ Consequently, mouthrinses are recommended as adjuncts to mechanical oral hygiene.³⁴⁻³⁸

The aim of this study was to investigate the effect of various oral hygiene strategies on the symptoms of gingival inflammation, define the optimum hygiene method, and to examine combined oral hygiene strategies (CHX as adjunct to M and E toothbrushes) to determine the efficacy for removing dental plaque in neuromuscularly disabled individuals.

Materials and Methods

This was a randomized controlled, single blind parallel group trial. The study population consisted of 59 neuromuscularly, but not mentally, disabled clients, suffering from spastic cerebral palsy, going to private rehabilitation centers 5 days a week in Isparta. The age of the population varied between 7 and 21 years of age. None of the individuals has had any systemic disease (cardiovascular system and respiratory system disorders, etc.) except for being neuromuscularly disabled and were totally unable to brush their own teeth. This was due to their inability to use their upper extremities.

During the first visit subjects were accompanied by the persons responsible for oral cleaning. At the dental clinic, the subjects were seated on the den-



tal chair or remained seated in their wheelchair. Instruments used for the plaque scoring consisted of an operating light, mouth mirror, explorer, and cotton pellets. In the pre-application period, the clinical parameter (plaque index- PI³⁹, gingival index- GI⁴⁰, bleeding on probing (%)-BOP (%), probing depth- (PD) recordings were made by a calibrated examiner with the Williams round tipped periodontal probe. The PD recording was only made for the periodontal screening. The recordings included all of the teeth present in the oral cavity.

The parents and institution staff received visual education about the importance of oral hygiene, plaque and its appearance, the plaque control in disabled person, the methods of plaque removal, and the usage of toothbrushes (M or E) before the beginning of the study. Horizontal toothbrushing with M and E toothbrushes was demonstrated on casted models and on the individuals by the dentists. The effects and features of CHX were explained and the usage of CHX spray was demonstrated to the parents and staff.

The sample consisted of volunteers and informed consent has obtained. The individuals were randomly divided according to five different oral hygiene applications into five groups as follows:

1. Group M: Manual toothbrush (Colgate®) (n= 14)
2. Group E: Electrically powered toothbrush (Colgate Actibrush®) (n=9)
3. Group MC: CHX spray (Klorhex®, Drogan, Ankara) (0.2%) and manual toothbrush (n=13)
4. Group EC: Electrically powered toothbrush and CHX spray (0.2%) (n=9)
5. Group C: CHX spray (0.2%) (n=14)

A toothbrush (M or E-Colgate Actibrush®) was provided for each subject according to the oral hygiene groups and retained by their teacher or therapists to be used at the institute. The same type (M or E, same as in the institute) of toothbrush was provided and given to the parents to be used at home. Toothbrushing was performed twice a day by the parents and staff (once at the institute and once at home). The available time for the brushing was 30 s per quadrant, made up of approximately 15 s for the buccal and approximately 15 s for the lingual surfaces. The full mouth brushing score was representative of approximately 2 min of brushing.¹⁷ The parents or staff applied the CHX spray, a total of 12 sprays were applied, one each to the buccal and lingual sextants of the arches (1.4 ml), on a twice daily basis. During the study period no toothpaste was used. The five different oral hygiene strategies were applied for 21 days by the parents or staff. After 21 days, the clinical parameters were recorded.

The comparisons between the pre- and post-application data in each group were evaluated using the the “paired t test.” Levene’s test was used to evaluate homogeneity of variances. One-way ANOVA was applied to compare among the groups. Post-hoc tests (Bonferroni test) were also applied to identify the significant differences between the groups.

Results

All of the individuals completed the study. The mean (\pm SD) values of clinical parameters in pre- and post-application measurements are presented in Table 1. No statistically significant difference among the pre-application scores of the groups was found ($p < 0.01$). After the applications, the scores of all of the groups showed statistically significant decreases in PI and GI ($p < 0.05$); and in BOP percentages ($p < 0.05$), except in Group C ($p > 0.05$).

In comparison of the post-application scores among the groups (Table 2), the lowest post-application scores of PI, GI, and BOP percentage were observed in Group E. The significant differences between the groups were between Group M and Group E and Group C and Group E in PI scores ($p < 0.05$) and between Group C and Group E in GI scores ($p < 0.05$). Also, the MC and EC

Table 1. The intra-group comparisons of the clinical parameter values in the groups.

Groups	PI			GI			BOP (%)		
	pre-app	post-app	p	pre-app	post-app	p	pre-app	post-app	p
M	1.97±0,47	1.59± 0.55	* 0.001	0.49± 0.26	0.41± 0.24	* 0.002	32.18±24.1	20.7± 20.1	* 0.001
E	1.58±0,44	1.03±0.58	* 0.001	0.44± 0.191	0.26± 0.19	* 0.001	28.17±25.6	15.36±20.7	* 0.044
MC	1.65±0.59	1.23± 0.43	* 0.002	0.45± 0.20	0.33± 0.18	* 0.009	27.83±21.8	19.12±21.2	* 0.001
EC	1.91±0.47	1.28± 0.402	* 0.036	0.58±0.24	0.42±0.23	* 0.015	32.15±24.5	16,51±12.1	* 0.023
C	1.96±0.39	1.52±0.44	* 0.0002	0.61± 0.25	0.53± 0.25	* 0.0001	23.05±18.1	21.21±15.4	* 0.478

PI (plaque index), GI (gingival index) and BOP (bleeding on probing), pre-app: pre-application, post-app: post-application.

* statistically significant differences p<0.05.

Table 2. The differences between the post-application scores.

Groups	PI	GI	BOP(%)
M	1.59± 0.55 †	0.41± 0.24	20.7± 20.1
E	1.03±0.58 †,‡	0.26± 0.19 ¶	15.36±20.7
MC	1.23± 0.43	0.33± 0.18	19.12±21.2
EC	1.28± 0.40	0.42±0.23	16.51±12.1
C	1.52±0.44 ‡	0.53± 0.25 ¶	21.21±15.4

PI (plaque index), GI (gingival index) and BOP (bleeding on probing)

†, ‡, ¶: statistically significant differences p<0.05.

groups in PI and GI had lower post-application scores than those in the M and C groups. But no significant difference was found.

In comparison of the post-application scores among the groups (Table 2), the lowest post-application scores of PI, GI, and BOP percentage were observed in Group E. The significant differences between the groups were between Group M and Group E and Group C and Group E in PI scores (p<0.05) and between Group C and Group E in GI scores (p<0.05). Also, the MC and EC groups in PI and GI had lower post-application scores than those in the M and C groups. But no significant difference was found.

Discussion

According to recent literature, disabled individuals usually have poor oral health because of the

problems related to dental management in comparison with the general population.^{5,6,28,41} The disabled person has difficulties in the mechanical control of dental plaque.^{8,9}

The effectiveness of the M toothbrush is limited by the manual dexterity and skill of the users.²⁰ In many studies toothbrushes were evaluated for the plaque removal efficiency in disabled people.⁷ Bratel et al.⁴² reported the E toothbrush was not superior to the M toothbrush in mentally disabled adults, while the brushing was done by the patient with the aid of their parents or the staff. In another study, the use of E and M toothbrushes were observed to reduce the PI and GI scores in moderately mentally disabled adults. However, no superiority between the toothbrushes was reported.⁴³ Rapley et al.⁴⁴ indicated the oscillating counter/rotational E toothbrush was significantly

better than the M toothbrush in terms of plaque removal. Numerous studies have evaluated the effectiveness of E toothbrushes in healthy people. Aass et al.⁴⁵ reported no clinically significant differences in plaque reducing and gingivitis controlling ability were observed between M and E powered toothbrushes. Crawford et al.⁴⁶ suggested that there was no significant difference in the improvement of plaque scores between the motivated children using M or E toothbrushes. There are other studies which have not found statistical significance in favor of the various E powered brushes.⁴⁷⁻⁴⁹

In this study, after application, Group M had the highest mean PI value. Although the M toothbrush was performed by the staff and parents, its application still caused inconvenience for neuromuscularly disabled people. Colgate Actibrush[®] was chosen for Group E and EC because of its availability. Colgate Actibrush[®] features a small round brush head with an oscillating/rotating action and was found superior with respect to both plaque removal and control of gingivitis than a range of the M toothbrushes.^{10,18,50} In the present study Group E has presented with the least mean PI, GI, and BOP values. The mean values of Group E were found to be statistically different than Group M and Group C in PI scores and different than Group C in GI scores. These results have led to the fact E toothbrushes could be recommended to disabled persons.

The use of CHX mouthwashes is the most effective chemical method to control plaque accumulation and the development of chronic periodontitis.⁵¹ CHX spray formulations have been found to be as effective as mouthrinsing when delivered under supervised optimal conditions. In addition the reduced dose⁵² compared to mouthwash (one fifth to tenth dose) offers advantages like reduced adverse effects, i.e. taste disturbance, discoloration of the teeth, and the exfoliation of the oral epithelium.⁵³⁻⁵⁵ The spray application delivered approximately 2 ml (0.2% CHX/ two times a day), which is between one-fifth or one-tenth of the oral rinsing dose for effective plaque reduction.⁵³ Francis et al.⁵⁶ evaluated different formulations of CHX and found the gel form was superior to both the mouthwash and spray. In the present study we chose the spray form of CHX because of its simple use and effectiveness on plaque control.



Furthermore, the neuromuscularly disabled individuals in this study were cerebral palsy patients who typically have swallowing defects and drooling problems.^{3,30} CHX spray, alone and combined with M and E toothbrushes, reduced the PI and GI scores, although after the applications, the reduction in BOP percentages was not significant. There are no significant differences especially between the CHX plus toothbrushes groups and toothbrushes groups in the PI and GI scores. The combined applications CHX spray plus toothbrushes (M and E) have not presented any additional benefit in reducing PI and GI scores and BOP percentages.

The clinical findings indicated all of the hygiene applications resulted in reduction of periodontal parameters in the neuromuscularly disabled individuals. While the parents and staff were trained on hygiene applications, the necessity to perform this routine regularly placed an extra burden on them. In addition two stage procedures were considered to be time-consuming and embarrassing. Some of the staff and parents have stated that two stage procedures (E/M toothbrush and spray) were hard to apply and found less tolerable by children. Thus, it appeared any method proven extremely beneficial could fail when causing difficulties, as in the case with two-stage procedures. The results of this study suggested the E toothbrush could be recommended to neuromuscularly disabled people, while combined procedures appeared to be neither beneficial nor favorable. Although alternative delivery methods of CHX were not investigated in the present study.

In the present study no classification of age groups or no comparison between gender were made because the applications were provided by

the parents and trained staff. Furthermore, it was reported there was no difference between the age groups in an oral hygiene program related to disabled children in terms of plaque removal.⁵⁷

The study time was limited to three weeks following the recommendations of Chilton and Fleiss⁵⁸ to undertake trials regarding gingival inflammation with a study period longer than 2 weeks. On the other hand, Francis et al.⁵⁹ reported long-term studies with CHX resulted in side effects like staining and taste disturbances and long-term benefits of using CHX spray was doubtful. McKenzie et al.⁶⁰ evaluated the reduction in PI, GI, and PD scores in mentally disabled adults with using CHX mouthrinse over a year period. Despite highly motivated staff, the GI scores showed a statistically significant improvement only at month 1. Kalaga et al.⁶¹ reported 0.2% CHX spray used as an adjunct to toothbrushing in a group of physically and mentally disabled adults reduced plaque and bleeding scores at the end of 31 days.

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Conclusions

In the disabled population a tendency has been shown to develop gingival/periodontal diseases in several studies.^{5,7}

If dental care and health awareness is instituted early and supported by parents, home efforts or complicated treatment needs can be kept to a minimum.

Also, the amount of plaque removed from the teeth of disabled institutionalized children can be increased through an in-service educational program for institutional attendants. Further studies are necessary to assess more effective modalities of controlling inflammatory periodontal disease in this population. As mentioned above, the dental problems and the needs of the disabled population have to receive proper attention to avoid special workforce, financial loss, and to improve the quality of life in this population.



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