Oral hygiene habits and oral health in cystic fibrosis

J.K.M. APS*, G.O.G. VAN MAELE**, L.C. MARTENS*

ABSTRACT. Aim. The present study was designed to investigate oral hygiene habits and fluoride use in cystic fibrosis (CF) homozygotes, heterozygotes and healthy controls as a function of caries experience (DMF-T) and oral cleanliness (dental plaque, dental calculus and gingival bleeding). Methods. Oral hygiene habits in CF homozygotes (n=42), heterozygotes (n=48) and healthy controls (n=62) were used in a multivariate analysis with caries experience (DMF-T) and oral cleanliness (dental plaque, calculus and gingival bleeding) as response variables. Results. CF homozygotes had a significantly lower caries experience ($p \leq 0.001$) and less gingival bleeding sites ($p \leq 0.02$). Oral hygiene habits were not significantly different between the three groups, except for intake of fluoride supplements. Significantly more CF homozygotes had received fluoride supplements. Oral hygiene habits did affect caries experience or oral hygiene differently in each study group. Conclusion. No matter what oral hygiene habits were, CF homozygotes had an overall better oral health status. Apparently they seemed to possess intrinsic salivary compensatory mechanisms, as the significant higher use of fluoride supplements appeared not to be responsible for the better oral health. Keywords: Oral hygiene, Oral health, Cystic fibrosis

Introduction

Cystic fibrosis (CF) is the most common lethal autosomal recessive inherited disease in Caucasians. About 4% to 5% of the Caucasian population is heterozygous for the CFTR (cystic fibrosis transmembrane regulator) gene, which is located on the long arm of chromosome 7 (7q31). Although several hundreds of genetic mutations are known, the most common mutation in Western Europe is Delta-F508. The prevalence of the disease is 1 in every 2,000 live new born children. In essence, the disease affects all exocrine glands (including the salivary glands) and renders their respective secretions more viscous than under healthy conditions. CF patients consequently suffer from gastro-intestinal (due to pancreatic insufficiency) and respiratory problems. Because of this, they are compelled to have supplemental pancreas enzymes with every meal, drink and snack, supplemental vitamins (A,D,E and K) if necessary, frequent antibiotics (per os, via aerosols and IV) and daily expectorantia and mucolytica (mostly via aerosols) [Hughes and Griffith, 1984; Tsui, 1991; Webb, 1991; Aitken, 1993; Grundy et al., 1993; Hodson, 1993; Vay Liang et al., 1993; Sheppard and Ostegaaard, 1996; Hilman, 1997].

Literature published in the 1980s and at the beginning of the 1990s claimed that CF youngsters (mean age 7.0 years) had significantly less caries experience than control subjects [Kinirons, 1983; Kinirons, 1985; Kinirons, 1989; Fernald et al., 1990]. This was attributed to their higher salivary buffer capacity, higher salivary calcium concentration and their frequent use of antibiotics. A more recent age matched control study, performed on a CF group with a wider age range (mean age 16.3 years) [Martens et al., 2001], reported no significant differences in caries experience between CF homozygotes and healthy controls. Due to lack of diagnostic tools, no information on CF heterozygotes was available in the 1980s and as a consequence they were unavoidably included in the healthy control study groups.

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Recently, a study was published in which CF homozygotes, CF heterozygotes and healthy controls were compared [Aps et al., 2001]. No significant differences in caries experience between the three groups considered were found. Nevertheless, CF homozygotes had significantly less salivary mutans Streptococci counts. In a continuing study [Aps et al., 2001], on a larger sample of CF homozygotes, CF heterozygotes and healthy controls, it was shown that CF heterozygotes had significantly larger restorations than CF homozygotes, while the latter had also a significantly lower caries experience than healthy controls. CF homozygotes were also reported to have significantly less bleeding gingival sites than CF heterozygotes and controls.

Several presumptions, dealing with compensatory salivary mechanisms inherent to their disease, were mentioned in these reports, which could serve as an explanation for CF homozygotes experiencing less dental decay than others, despite the assumption of them running a high caries risk (e.g. frequent in between sucrose rich snacks and drinks and daily aerosols). From an analysis of their dietary habits [Aps et al., 2001] it was concluded that CF homozygotes may experience positive benefit from consuming lots of dairy products, whether sweetened or not. But as caries is a multifactorial infectious disease, other aspects of influence should be investigated also.

The present study, therefore, aimed to investigate oral hygiene habits and fluoride use in CF homozygotes, heterozygotes and healthy controls as a function of caries experience (DMF-T) and oral cleanliness (dental plaque, dental calculus and gingival bleeding).

Materials and methods

Patient selection. Both CF homozygotes (n=42, 16.2±8.1 years) and genetically proven CF heterozygotes (n=48, 29.5±15.9 years) were recruited through the Belgian Association for the Fight Against Cystic Fibrosis. The higher mean age of the CF heterozygote group consisted of parents and mainly older brothers and sisters of CF homozygotes. Healthy controls (n=62, 19.9±11.5 years), excluding subjects suffering from cardiovascular, genito-urinary, neurological, endocrine or infectious diseases, were recruited from the Ghent University Dental out-patient clinic and from the CF patients’ and CF heterozygotes’ environment. The study was approved by the Ghent University’s medical ethical committee and for all subjects an informed consent was obtained.

Caries experience and oral cleanliness. Caries experience was expressed as DMF-T and DMF-S and was recorded at the level of cavitation. Prior to the study, the investigator (JA) was calibrated. Oral cleanliness was expressed as the number of teeth (-T) and surfaces (-S) with dental plaque (PI-T/-S), dental calculus (CI-T/-S) and gingival bleeding (BL-T/-S). A more extensive and detailed description of the methodology was published elsewhere [Martens et al., 2001; Aps et al., 2001]. All teeth, except for the third molars, were included in the recording of the oral cleanliness parameters. Consequently, the mean number of teeth with plaque, calculus and gingival bleeding in every study group was obtained.

Patient questionnaire. To avoid misunderstandings, unanswered questions and any tendency to biases, every study subject was questioned by the same investigator (JA). By interviewing these subjects, the investigator was able to obtain objective information about their oral hygiene and dietary attitudes. All answers were dichotomized as “yes” or “no” immediately while entering the data in the database (Microsoft Access 2000, Microsoft Corporation).

Statistical analysis. Appropriate statistical analysis was performed by means of the SPSS program. A Kruskal-Wallis test was used to investigate differences in caries experience and oral cleanliness between the three groups of subjects. Subsequently a Mann-Whitney U test was used to investigate these data between two subject groups at a time. A Pearson Chi-squared test was used to investigate differences in oral hygiene habits. Regression analysis with the oral hygiene habits as co-variables and caries experience, dental plaque, dental calculus and gingival bleeding as response variables was performed. The level of significance was chosen at p=0.05.

Results

Caries experience and oral cleanliness. It can be seen from the data in Table 1 that CF homozygotes had a significant lower caries experience than CF heterozygotes (p<0.001) and healthy controls (p=0.011). This was as well as a significant lower mean number of teeth with gingival bleeding than CF heterozygotes (p=0.014) and healthy controls (p=0.019). CF heterozygotes had experienced significantly more extractions than CF homozygotes (p<0.001) and controls (p=0.008). They also had significantly more restored teeth than CF homozygotes (p=0.043).
### Table 1 - Caries experience (DMF-T) and oral cleanliness (gingival bleeding, dental plaque and dental calculus on tooth level) in CF homozygotes, CF heterozygotes and healthy controls.

<table>
<thead>
<tr>
<th></th>
<th>CF homoz</th>
<th>CF heteroz</th>
<th>Control</th>
<th>Kruskal-Wallis test</th>
<th>Mann-Whitney U test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=42</td>
<td>n=48</td>
<td>n=62</td>
<td>A→B→C</td>
<td>A→B</td>
</tr>
<tr>
<td>DMF-T</td>
<td>4.05±5.35*</td>
<td>9.94±8.12</td>
<td>6.97±6.11</td>
<td>&lt;0.001**</td>
<td>0.011</td>
</tr>
<tr>
<td>D-T</td>
<td>0.31±0.78</td>
<td>0.48±1.09</td>
<td>0.61±1.33</td>
<td>0.562</td>
<td>0.462</td>
</tr>
<tr>
<td>M-T</td>
<td>0.26±0.89</td>
<td>3.62±6.92</td>
<td>0.94±2.13</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>F-T</td>
<td>3.52±4.63</td>
<td>5.88±6.01</td>
<td>5.34±5.17</td>
<td>0.100</td>
<td>0.080</td>
</tr>
<tr>
<td>Plaque</td>
<td>3.62±5.67</td>
<td>2.63±4.44</td>
<td>2.85±3.87</td>
<td>0.514</td>
<td>0.258</td>
</tr>
<tr>
<td>Calculus</td>
<td>1.93±3.05</td>
<td>2.77±3.82</td>
<td>2.10±3.46</td>
<td>0.423</td>
<td>0.244</td>
</tr>
<tr>
<td>GB***</td>
<td>0.24±0.79</td>
<td>2.35±5.15</td>
<td>1.15±2.38</td>
<td><strong>0.033</strong></td>
<td><strong>0.014</strong></td>
</tr>
</tbody>
</table>

* = mean±SE  
** = significant at p<0.05  
*** = gingival bleeding

### Table 2 - Descriptive data on oral hygiene habits in CF homozygotes, CF heterozygotes and healthy controls and the appropriate statistical analyses results.

<table>
<thead>
<tr>
<th>Oral hygiene habits</th>
<th>CF homoz</th>
<th>CF heteroz</th>
<th>Control</th>
<th>Pearson Chi-squared test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=42</td>
<td>n=48</td>
<td>n=62</td>
<td>A→B→C</td>
</tr>
<tr>
<td>I brush ≥2/day</td>
<td>91%</td>
<td>90%</td>
<td>94%</td>
<td>0.736</td>
</tr>
<tr>
<td>I never brush my teeth</td>
<td>0%</td>
<td>2%</td>
<td>5%</td>
<td>0.306</td>
</tr>
<tr>
<td>I brush in the morning</td>
<td>76%</td>
<td>56%</td>
<td>69%</td>
<td>0.118</td>
</tr>
<tr>
<td>I brush in the evening</td>
<td>71%</td>
<td>79%</td>
<td>87%</td>
<td>0.140</td>
</tr>
<tr>
<td>I use spea size toothpaste</td>
<td>38%</td>
<td>50%</td>
<td>50%</td>
<td>0.434</td>
</tr>
<tr>
<td>Fluoride toothpaste</td>
<td>100%</td>
<td>96%</td>
<td>97%</td>
<td>0.436</td>
</tr>
<tr>
<td>Electrical toothbrush</td>
<td>24%</td>
<td>25%</td>
<td>18%</td>
<td>0.610</td>
</tr>
<tr>
<td>Fluoride rinse</td>
<td>0%</td>
<td>6%</td>
<td>5%</td>
<td>0.283</td>
</tr>
<tr>
<td>Fluoride supplements</td>
<td>64%</td>
<td>38%</td>
<td>47%</td>
<td><strong>0.037</strong></td>
</tr>
<tr>
<td>Chlorhexidine rinse</td>
<td>5%</td>
<td>2%</td>
<td>5%</td>
<td>0.725</td>
</tr>
<tr>
<td>I floss</td>
<td>10%</td>
<td>23%</td>
<td>18%</td>
<td>0.239</td>
</tr>
<tr>
<td>I use toothpicks</td>
<td>14%</td>
<td>23%</td>
<td>24%</td>
<td>0.444</td>
</tr>
</tbody>
</table>

*= significant at p=<0.05

**Oral hygiene habits.** The data in Table 2 show that only the fact of having received any fluoride supplements was significantly different between the three groups (p=0.037). Significantly more CF homozygotes than CF heterozygotes (p<0.01) had used fluoride supplements (either drops or tablets).

**Effects of oral hygiene habits on caries experience within each group.** CF homozygotes who brushed
their teeth in the morning (p=0.009), as well as those who brushed in the evening (p=0.016) or those who used toothpicks (p=0.002), had a significantly higher DMF-T. Caries experience was significantly higher in CF heterozygotes who did not receive any fluoride (p=0.028) or who used dental floss (p=0.002). Healthy controls who used a fluoride containing toothpaste (p=0.038), or those who never got fluoride supplements (p=0.050) had a significantly higher caries experience. The same was observed in control subjects who used dental floss (p=0.002) or toothpicks (p=0.033).

**Effects of oral hygiene habits on oral cleanliness.** CF homozygotes who used an electrical toothbrush experienced significantly more dental calculus (p=0.042) than those who used a regular toothbrush. CF heterozygotes who did not brush in the evening presented with significantly more dental calculus (p=0.015), as did those who never received any fluoride supplements (p=0.013) or never used toothpicks (p=0.002). CF heterozygotes who did not get any fluoride supplements also experienced significantly more plaque (p=0.047), as did those who used toothpicks (p=0.036). In addition, using toothpicks also resulted in significantly more gingival bleeding (p=0.018) in this group.

Healthy control subjects who brushed their teeth in the morning (p=0.029), or who never received fluoride supplements (p=0.019), or those who used toothpicks (p=0.031) experienced significantly more dental calculus than those who did the opposite. Gingival bleeding was significantly higher in those healthy controls who brushed less than twice a day (p=0.044) or never received any fluoride supplements (p=0.004).

**Discussion**

It was interesting that CF homozygotes, a group of medically compromised individuals, who could be supposed to run a high caries risk due to their dietary obligations and medication intake, had a significantly lower caries experience than CF heterozygotes and healthy controls (Table 1). Recent literature suggests that CF homozygotes may in some way be protected against dental decay and that certain salivary mechanisms may be involved [Martens et al., 2001; Aps et al., 2001; Aps et al., 2002a; Aps et al., 2002b]. On the other hand, it was remarkable to note that CF heterozygotes, who are not clinically affected by the CFTR gene, apparently ran a higher caries risk than healthy controls and CF homozygotes. They also had experienced significantly more extractions than the others, and in a previous report [Aps et al., 2002b] it was recorded that the extensiveness of their restorations (factor F-S in the DMF-S index) was significantly larger.

The number of teeth with hypertrophic and/or hyperaemic gingival margins was significantly lower in CF homozygotes than in CF heterozygotes. On the other hand it should be emphasised that the number of teeth covered with plaque was the highest in CF homozygotes, although the difference between the three groups was not significant. While plaque in general is expected to induce gingival inflammation, it was suggested earlier that dental plaque in CF homozygotes is probably composed of other microorganisms than in CF heterozygotes and control subjects [Aps et al., 2002b], which could explain why they had significantly less bleeding sites than CF heterozygotes and controls. Perhaps this supposed less pathogenic plaque flora could also be responsible for CF homozygotes experiencing significantly less dental decay. Undoubtedly, medication intake (for example antibiotics) plays an important role in this, it but remains a domain which needs further research [Van Nieuw Amerongen, 1990; Kinirons, 1992; Maguire et al., 2002].

This study showed that very little differences can be found between these three groups regarding their oral hygiene habits. Only the fact of having received fluoride supplements of any kind (droplets or tablets) was significantly different. Sixty four percent of CF homozygotes, against 38% CF heterozygotes and 48% healthy controls had received fluoride supplements. Probably their paediatricians may have prescribed this “medication” additionally to their already extensive list of obligatory medications, inherent to their medical condition. This could be interpreted as a kind of overtreatment or reassurance of the patients’ parents. However, the effect of fluoride supplements within the CF homozygote group did not result in a significant lower caries experience. It can therefore be concluded that the importance of oral hygiene habits should not be exaggerated too much when explaining the significant differences in caries experience and overall oral health between CF homozygotes, CF heterozygotes and healthy controls.

The effects of oral hygiene habits on caries experience and oral cleanliness in every study group were rather unexpected, illogical and consequently no clear conclusions could be drawn. It should not be forgotten that oral hygiene measurements are the result of certain oral cleanliness features. It may well be possible that certain individuals had started using
dental floss or toothpicks quite recently, because their dentist had advised them to do so. Other oral hygiene habits, except for the use of fluoride supplements, may have had an influence in the same way. Caries experience provides information about an individual’s past and present experience with dental decay, while an enquiry into oral hygiene attitudes reports mainly the present habits; this in turn could be based on advice from the dentist, who decided to do so after numerous repetitive dental treatments. Consequently, looking for explanations and relations between caries experience and current oral hygiene habits may be confusing.

Using the illustrative device of a pentagon, the impact of brushing habits, fluoride supplements, use of dental floss and toothpicks on caries experience and oral cleanliness can be visualised. The surface area of the pentagon is a measure of these oral hygiene habits on oral health (Fig. 1, 2). These pentagons can be drawn for all oral cleanliness parameters. When brushing habits, use of fluoride supplements, dental floss and toothpicks were considered, whatever the oral hygiene habits of CF homozygotes were, they seemed to be of little influence on caries experience. The latter illustrated once more possible intrinsic compensatory mechanisms, mentioned before.

The same may hold true for dental calculus and gingival bleeding. CF homozygotes seemed however to generate, although not significantly, more plaque.

**Fig. 1** - Schematic representation of the effect of: a) NOT brushing in the morning or NOT brushing in the evening or NOT having had fluoride supplements or NOT using dental floss or toothpicks on caries experience (mean DMF-T); b) brushing in the morning or brushing in the evening or having had fluoride supplements or using dental floss or toothpicks on caries experience (mean DMF-T), in a population of children who were CF homozygotes, CF heterozygotes or healthy controls.

**Fig. 2** - Schematic representation of the effect of: a) NOT brushing in the morning or NOT brushing in the evening or NOT having had fluoride supplements or NOT using dental floss or toothpicks on dental plaque (mean PI); b) brushing in the morning or brushing in the evening or having had fluoride supplements or using dental floss or toothpicks on dental plaque (mean PI), in a population of children who were CF homozygotes, CF heterozygotes or healthy controls.
than the other subjects (Fig. 2), irrespective of their oral hygiene habits.

Although the only significant difference in oral hygiene habits between the three groups was the use of fluoride supplements, this did not seem to influence caries experience differences between the three groups (Fig. 3). These quadrangles show that whether CF homozygotes did receive fluoride supplements or not did not affect their caries experience significantly. The fact that CF homozygotes who received fluoride supplements showed, although not significantly, more teeth with calculus should be interpreted as coincidental. No correlations between fluorides and dental calculus have been reported before.

**Conclusion**

These present findings reinforce once more the assumption that CF homozygotes may possess some, as yet not identified, intrinsic salivary compensatory mechanisms [Martens et al., 2001; Aps et al., 2002a, 2002b], which render them less vulnerable for poor oral health status, as it did not seem to matter what oral hygiene habits they had. Fluoride supplements did not make the difference either between these three study groups. Nevertheless, it should always be remembered that caries is a multifactorial infectious disease and that many other factors, such as medication [Van Nieuw Amerongen, 1990; Kinirons, 1992; Kankaala et al., 1998; Kargül et al., 1998], which in CF patients in particular will play an important role, should be included in assessing caries risk in every population of medically compromised patients.

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**References**

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