



Oral Health and Wellbeing of Patients with Idiopathic Pulmonary Fibrosis

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Abstract

Background: Idiopathic pulmonary fibrosis (IPF) is a chronic progressive lung disease that significantly impacts everyday life. To date, little is known about oral cavity health in patients with IPF.

Aim: The study aimed to evaluate the condition of the oral cavity in patients with IPF and to assess their quality of life concerning oral cavity health.

Methods: The study was a cross-sectional one, collecting clinical data of patients with IPF and control subjects without pulmonary disorders. Data collection included baseline characteristics, oral cavity inspection results, and 12 answers provided in the GOHAI questionnaire. Periodontal status was investigated, and PD, CAL, BoP, API, CPITN and OHI were analyzed. Saliva secretion, halitosis, and oral lesions were also assessed.

Results: A total of 85 subjects – 40 patients with IPF and 45 controls – were enrolled in the study. In patients with IPF, both lower PD [0.54 (0.36–0.96) vs. 1.1 (0.6–1.44); $p=0.001$] and CAL [0.54 (0.3–1.26) vs. 1.43 (1.04–1.91); $p=0.006$] were found, and those patients also had lower saliva secretion [1.08 (0.33) vs. 1.28 (0.39); $p=0.01$]. Patients with IPF received periodontal treatment less frequently [2 (2.24%) vs. 15 (17.6%); $p=0.001$], and dental instruction was shown to them less often compared to the controls [13 (32.5) vs. 26 (57.78); $p=0.02$]. Moreover, IPF patients had significantly higher GOHAI scores [50.68 (5.24) vs. 44.37 (5.94); $p<0.001$] compared to the control subjects.

Conclusions: Our study findings prompt the need for regular dental consultations and careful observation of dental prophylaxis in patients with IPF. The differences noted in the quality of life assessed using a GOHAI questionnaire need a further validation in larger cohort studies.

Key words: idiopathic pulmonary fibrosis, IPF, oral cavity health, periodontal status, GOHAI questionnaire

Introduction

Idiopathic pulmonary fibrosis (IPF) is the most common type of idiopathic interstitial pneumonias (IIPs) belonging to the large and heterogenous group of interstitial lung diseases (ILDs) [1–3]. This chronic and progressive fibrotic lung disease of unknown etiology is known to have outcomes worse than many neoplastic diseases, with a median survival time of 3 to 5 years since diagnosis, based on the data before the introduction of antifibrotic therapy. Many risk factors for IPF have been identified, with male gender and smoking being the most prominent ones; however, other factors including microaspirations, infections, or air pollution also play a role [1, 4–6]. An inevitable adverse prognosis in IPF is mostly due to limited pharmacological treatment options, although antifibrotic medications have been shown to slow the decline of lung function in patients with IPF and are associated with a survival benefit [7, 8]. Moreover, there is a growing body of scientific evidence that IPF comorbidities significantly impact patients' quality of life and prognosis⁹. In light of limited therapeutic options for patients with IPF, it should be emphasized that a better understanding of the cofactors and comorbidities of IPF may improve the overall health outcomes of IPF [10]. To date, relatively little is known about oral cavity health in patients with IPF. Furthermore, no previous research has investigated oral cavity conditions in this particular patient population.

In the present study, we aimed to evaluate the oral cavity health and well-being of patients with IPF and compare the findings with age-matched controls without a history of chronic respiratory conditions.

Material and methods

Study population

In this study, a total of 85 volunteers, including 40 patients with IPF and 45 age-matched controls without a history of chronic respiratory conditions, were examined. IPF was diagnosed according to the Polish guidelines on

diagnosis and treatment of IPF [2]. The studied groups were not statistically different in terms of age, sex, and education. Clinical examination was conducted by a dentist specializing in periodontology. Patients were examined in the Department of Pneumology and the Department of the Pathology of Oral Cavity of the Medical University of Lodz.

Methods

All study participants underwent clinical evaluations including medical history, oral health, and well-being assessments. Oral cavity status was investigated by using a periodontal probe. The stage of destruction and periodontitis advancement was analyzed on pocket depth (PD – Pocket Depth index) and distance between the pocket bottom and the cemento-enamel junction (CAL – Clinical Attachment Level index). The Community Periodontal Index of Treatment Needs (CPITN index) was used to determine the treatment needs for periodontal diseases. The intensity of dental caries limited to enamel or penetrating into the dentine or/and pulp (DMF – decay-missing-filled), the level of dental hygiene by controlling the presence of dental plaque (API – Approximal Plaque Index), and the presence of calculus and debris (OHI – Oral Hygiene Index) were analyzed. The condition of the gingiva was evaluated by bleeding on probing (BoP – Bleeding on Probing index). All visible pathological lesions in the oral cavity were evaluated. The organoleptic method of halitosis according to Rosenberg was verified. Quantitative salivation was estimated. The level of stress was recorded by individuals, based on the subjective feeling, according to the analog scale: 0 – no stress, 10 – enormous stress. The interview included questions on smoking at present or in the past and professional periodontal procedures as well as home care oral hygiene practices.

Using the GOHAI questionnaire (General Oral Health Assessment Index), study participants answered 12 questions on their well-being, which focused on oral health (Supplementary Table 1). GOHAI is a subjective, self-assessment tool. The questions are related to potential problems while eating, swallowing, and speaking, concerns about the condition of the oral cavity,

discomfort, pain, and medications taken. The questionnaire assessment period is 3 months. The answers to choose from include: *never, seldom, sometimes, often, and always*, and were scored according to the Likert scale from 1 to 5. The total score was interpreted accordingly: 57–60 – very good quality of life; 51–56 – moderate quality of life; ≤ 50 – poor sense of the quality of life [11]. The questionnaire was translated and validated for the Polish population following WHO guidelines [12].

The present study protocol was approved by the Ethics Committee for Human Studies of the Medical University of Lodz. All participants provided written informed consent for participation in the study. All study procedures were consistent with the tenets of the Declaration of Helsinki.

Statistical analysis was performed using R software for MacOS. Continuous data were presented as the mean with SD or median with interquartile range (IQR), depending on the distribution of data. The Shapiro-Wilk test was used for determining the data distribution. Variables were compared using the unpaired Student's t-test, Welch t-test, or the Wilcoxon rank sum test with continuity correction, depending on data normality and homogeneity of variance. Categorical variables were compared using the Chi-square test or Fisher's exact eTest for count data, depending on the tests' assumptions. The significance was accepted at $p < 0.05$.

Results

A total of 85 participants, including 40 patients with IPF and 45 controls, were studied. Study groups did not differ significantly in terms of age and sex ($p > 0.05$). There was a statistically significant difference in smoking patterns between the groups ($p < 0.001$). There were more ex-smokers in IPF group [27 (67.5%) vs. 3 (6.67%)], while non-smokers were predominant in the control group [10 (25%) vs. 31 (68.89%)], and there were also more active smokers in the control group [3 (7.5%) vs. 11 (24.44%)]. Both groups had a similar number of pack-years of smoking history [25.62 (11.11) vs. 28.23 (16.38); $p = 0.55$]. Study participants' characteristics are shown in Table 1.

There was no statistically significant difference in DMF index score between IPF and controls [21 (17.75–28) vs. 24 (16–28); $p=0.83$]. Both groups showed similar deposits of calculus and debris, and OHI was similar in both groups [2 (1–3) vs. 1.5 (1–3); $p=0.97$].

Average PD as well as average CAL were significantly lower in the IPF group than in the control group [0.54 (0.36–0.96) vs. 1.1 (0.6–1.44); $p=0.001$] and [0.54 (0.3–1.26) vs. 1.43 (1.04–1.91); $p=0.006$], respectively.

There was no statistical difference in CPITN between the groups [2 (2–3) vs. 3 (1–3); $p=0.3$]. Differences in BoP score [15 (11.23–19.95) vs. 17.86 (6.25–26.64); $p=0.55$] and API [22.22 (13.07–33.18) vs. 27.27 (11.55–41.43); $p=0.9$] between patients with IPF and controls were also non-significant.

Lower secretion of saliva was found in the patients with IPF than in the controls [1.08 (0.33) vs. 1.28 (0.39); $p=0.01$] (Table 2). All assessed oral lesions were not significantly different between the study groups (Table 3).

There was no difference in stress levels between the groups as assessed using an analogue scale [5 (1–6.25) vs. 5 (0–7); $p=0.86$]. Patients with IPF had significantly higher GOHAI score than the controls [50.68 (5.24) vs. 44.37 (5.94); $p<0.001$].

IPF patients received professional periodontal treatment at dental practice in the last 6 months less frequently than the controls [2 (2.24%) vs. 15 (17.6%); $p=0.001$]. Moreover, subjects with IPF statistically significantly less often underwent professional dental hygiene instructions compared to controls [13 (32.5) vs. 26 (57.78); $p=0.02$]. In terms of home dental hygiene practices, the study groups did not differ significantly. Both groups brushed their teeth with a similar frequency [2 (1–2) vs. 2 (1–2); $p=0.33$]. There was no significant difference between the groups as far as using mouth rinses [8 (20%) vs. 15 (33.33%); $p=0.17$] or an irrigator [0 (0%) vs. 3 (3.5%); $p=0.24$] is concerned. The controls used interdental brushes and dental floss more often than the patients with IPF [10 (22.22%) vs. 0 (0%); $p=0.001$] and [7 (15.56%) vs. 1 (2.5%); $p=0.06$], respectively. Toothlessness was similar in both groups [10 (11.8%) vs. 11 (12.9%); $p=0.95$]. Prosthetics use was also similar in both study groups [25 (62.5%) vs. 27 (60%); $p=0.81$] (Table 4).

Discussion

In this study, oral cavity condition in patients with IPF regarding periodontal index and quality of life were evaluated. To date, no previous research has been published on oral cavity health in patients with IPF.

It was found that average CAL and PD were considerably higher in the control group, where active smokers predominated. Other periodontal indexes, such as BoP, API, CPITN, and OHI, were comparable between groups, whereas secretion of saliva was lower in the IPF subjects. Surprisingly, patients with IPF had significantly higher scores in the GOHAI questionnaire than controls, indicating that they have better self-perceived oral health.

Smoking is the major contributory factor to both IPF and periodontitis. Smoking affects the lungs and stimulates the development of periodontitis. Approximately 29% of adults in Poland declare smoking [13]. Although the number of smokers has decreased, Poland is still one of the world leaders in the number of active smokers. Smoking deteriorates the condition of the oral cavity, contributes to the development of inflammation of the oral mucosa and periodontium, and also leads to alveolar bone loss and tooth loss. Nicotine metabolites may result in the colonization of potentially pathogenic bacteria provoking periodontitis, such as *Porphyromonas gingivalis*, *Aggregatibacter actinomycetemcomitans*, *Bacteroides forsythus*, *Prevotella intermedia*, *Fusobacterium nucleatum* [14, 15]. In addition to tooth loss, tobacco smoking may also result in malignant and premalignant lesions [16]. Cigar, pipe, electronic cigarette, and cannabis or crack cocaine smokers were excluded from the research; however, the literature on the subject shows that they have comparable consequences in the oral cavity [15, 17]. Haber and Kent showed that smokers and former smokers ran a higher risk and had more severe symptoms of periodontitis than non-smokers [18]. Moreover, Calsina et al. proved that PD and CAL were significantly higher in active smokers [19], which is in concordance with the study findings concerning higher average PD and CAL in the control group, where active smokers were predominant. However, the obtained results of lower PD and CAL in IPF

patients may be due to small number of participants in the study groups, and therefore further research is needed in this field.

It is of note that the risk of periodontal disease in former smokers after more than 10 years of quitting is comparable to never smokers [20]. The study results suggest that smoking in the past and underlying respiratory disease do not influence periodontal status due to comparable BoP, API, CPITN, and OHI between the studied groups.

As a result of tooth loss, patients may limit the consumption of certain groups of food, which may lead to insufficient intake of nutrients, and, consequently, contribute to systemic diseases. Bailey et al. showed that nutritional deficiencies may have a negative effect on oral mucosa condition, which also involves the impact on physical and mental health. Researchers emphasize the role of nutrition specialists in interdisciplinary treatment [21]. In their survey of 200 patients, Banerjee et al. discovered that problems with food consumption, such as limits on amounts or types of food, difficulties with chewing, and reduced saliva secretion, affected the quality of life [22]. Moreover, all symptoms within the oral cavity (such as xerostomia, candidosis, burning mouth syndrome, prosthetics stomatitis, and missing teeth) may deteriorate the quality of life.

Another important finding of the study concerns high GOHAI scores in the IPF patients. Additionally, it was demonstrated that dental hygiene instruction was significantly less often presented to the patients with IPF, and, similarly, just a few of them underwent professional periodontal procedures in the last 6 months. Previous research shows that oral health is firmly correlated with general health. Oral mucosa status plays a role in general physical and psychological health, as well as well-being. Furthermore, a healthy oral cavity means not only physical well-being and no pain, but it also affects emotional zone and social relationships [2, 23].

The proper condition of the oral cavity should not be only limited to the possibility of chewing, swallowing, smiling, speaking, and not feeling pain, but also should be perceived as the basis of physical and mental health. Subjective assessment of quality of life concerning oral health is closely related to the presence of pain, discomfort, and chewing and swallowing disorders

was performed with the use of GOHAI questionnaire. The results of the self-assessment of the quality of life involving the oral cavity according to GOHAI showed a significantly higher score in patients with IPF than in the controls. The difference noted may be due to both general health problems related to IPF and also to concomitant diseases. Accordingly, problems in the oral cavity may be underestimated or neglected. Patients with IPF often suffer from many comorbidities, which may involve a need to consult different medical specialists. Consequently, dental appointments may be postponed or avoided. Patients with IPF may have difficulties performing basic daily physical activities due to impaired physical capacity; sometimes they use oxygen tanks and they may have problems with transportation. All these above mentioned aspects may be related to less frequent visits to dental surgery. Such a situation may lead to a lack of awareness of medical problems in the oral cavity, and the inability to observe dental prophylaxis or follow professional dental instruction.

In summary, surprisingly, patients with IPF reported significantly better quality of life related to oral cavity health, despite lower awareness of dental hygiene and less frequent periodontal procedures, than the age-matched controls without chronic respiratory disease.

The small size of the sample population determines the character of the present study which should be treated as a preliminary report and a hypothesis-generating one. The study's observations should be examined further using larger size population samples. Furthermore, although the investigated groups of patients differed in the number of active smokers, both groups did not differ in terms of total smoking exposition quantified in pack years.

Conclusions

The present study was the first to evaluate the oral cavity health and well-being of patients with IPF in comparison to age-matched controls without a history of chronic respiratory diseases. The study findings point out that patients with IPF underwent periodontal treatment less frequently, and professional oral hygiene instruction was presented to them less often compared to the controls,

which may result in deficiencies in proper oral cavity status and hygiene. It is plausible that less frequent dental consultations may be related to limitations in daily activities caused by IPF itself. Developing and maintaining good oral hygiene practice may lead to improvements in overall health and quality of life in IPF patients. The observed better subjective assessment of the quality of life concerning oral health in patients with IPF compared to control subjects may be directly linked to less frequent dental consultations resulting in the lack of awareness or negligence of oral cavity health problems. Moreover, the results of the study confirm the literature data, according to which PD and CAL are higher in active smokers. Oral cavity health is an important component of general health and should be regularly monitored for intervention.

Table 1. Participant characteristics

	IPF	CONTROLS	p value
Age, years, median [IQR]	70.5 [63–77]	71 [66–75]	0.92
Male, n (%)	28 (70)	24 (53.33)	0.36
SMOKING HISTORY, n (%)			
Ex-smoker	27 (67.5)	3 (6.67)	p<0.0001
Non-smoker	10 (25)	31 (68.89)	
Active smoker	3 (7.5)	11 (24.44)	
Pack years	25.62 (11.11)	28.23 (16.85)	0.55

Table 2. Comparison of oral health status of cases/controls

	IPF	CONTROLS	p value
DMF, median [IQR]	21 [17.75–28]	24 [16–28]	0.83
PD, median [IQR]	0.54 [0.36–0.96]	1.1 [0.6–1.44]	0.001
CAL, median [IQR]	0.54 [0.3–1.26]	1.43 [1.04–1.91]	0.006
BoP, %, median [IQR]	15 [11.23–19.95]	17.86 [6.25–26.64]	0.55
API, %, median [IQR]	22.22 [13.07–33.18]	27.27 [11.55–41.43]	0.9
CPITN, median [IQR]	2 [2–3]	3 [1–3]	0.3
OHI, median [IQR]	2 [1–3]	1.5 [1–3]	0.97
HALITOSIS, median [IQR]	2 [1–3]	2 [1–3]	0.86
SALIVA, ml/min (SD)	1.08 (0.33)	1.28 (0.39)	0.01

Abbreviations: DMF – Decayed, Missing and Filled Teeth; PD – Pocket Depth; CAL – Clinical Attachment Loss; BoP – Bleeding on Probing; API – Approximal Plaque Index; CPITN – Community Periodontal Index of Treatment Needs; OHI – Oral Hygiene Index

Table 3. Comparison of oral lesions in cases/controls

	IPF	CONTROLS	p value
Geographic tongue, n (%)	1 (2.5)	2 (4.44)	1
Fissured tongue, n (%)	12 (14.1)	6 (7.1)	0.06
Varicose veins of tongue, n (%)	1 (1.2)	0 (0)	0.47
Smooth tongue, n (%)	0 (0)	1 (2.2)	1
Prosthetics stomatitis, n (%)	3 (7.5)	6 (13.3)	0.49
White coating on tongue, n (%)	10 (25)	7 (15.56)	0.28
Nicotine stomatitis, n (%)	0 (0)	1 (2.22)	1
Pigmented tongue, n (%)	0 (0)	1 (2.22)	1
Keratosis, n (%)	0 (0)	1 (2.22)	1
Leukoplakia, n (%)	1 (2.5)	0 (0)	0.47
Angular cheilitis, n (%)	0 (0)	2 (4.44)	0.5
Median rhomboid glossitis, n (%)	0 (0)	2 (4.44)	0.5
Delbanco disease, n (%)	1 (1.2)	0 (0)	0.47
Hemangioma on lip, n (%)	0 (0)	1 (1.2)	1

Table 4. Comparison of oral hygiene practices in cases/controls

	IPF	CONTROLS	p value
Periodontal treatment, n (%)	2 (2.4)	15 (17.6)	0.001
Dental hygiene instruction, n (%)	13 (32.5)	26 (57.78)	0.02
Brushing, n	2 [1–2]	2 [1–2]	0.33
Mouthwash, n (%)	8 (20)	15 (33.33)	0.17
Flossing, n (%)	1 (2.5)	7 (15.56)	0.06
Irrigator, n (%)	0 (0)	3 (3.5)	0.24
Interdental brush, n (%)	0 (0)	10 (22.22)	0.001
Toothlessness, n (%)	10 (11.8)	11 (12.9)	0.95
Prosthetics, n (%)	25 (62.5)	27 (60)	0.81

SUPPLEMENTARY MATERIALS

Supplementary Table 1. General Oral Health Assessment Index (GOHAI) questionnaire

GOHAI – questions	Always	Often	Sometimes	Seldom	Never
1. How often did you limit the kind or amount of food you eat because of problems with your teeth or denture?	1	2	3	4	5
2. How often did you have trouble biting or chewing any kind of food, such as firm meat or apples?	1	2	3	4	5
3. How often were you able to swallow comfortably?	1	2	3	4	5
4. How often have your teeth or dentures prevented you from speaking the way you wanted?	1	2	3	4	5
5. How often were you able to eat without feeling discomfort?	1	2	3	4	5
6. How often did you limit contacts with other people because of the condition of your teeth or dentures?	1	2	3	4	5
7. How often were you pleased or happy with the appearance of your teeth, gums, or dentures?	1	2	3	4	5
8. How often did you use medication to relieve pain or discomfort around your mouth?	1	2	3	4	5
9. How often were you worried or concerned about the problems with your teeth, gums, or dentures?	1	2	3	4	5
10. How often did you feel nervous or self-conscious because of problems with your teeth, gums or dentures?	1	2	3	4	5
11. How often did you feel uncomfortable eating in front of people because of problems with your teeth or dentures?	1	2	3	4	5
12. How often were your teeth or gums sensitive to hot, cold, or sweet foods?	1	2	3	4	5

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