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Factors related to oral hygiene in persons with scleroderma

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Abstract: *Objectives:* The purpose of this study was to assess potential risk factors for the development of poor oral hygiene and increased dental caries in individuals with scleroderma. *Methods:* Twenty-two subjects with scleroderma participated in this study. All subjects were examined with the Patient Hygiene Performance (PHP) Index, which assesses the extent of plaque and debris over a tooth surface. In addition, oral aperature, xerostomia and dominant upper extremity strength, motion, skin thickness, and dexterity were measured. *Results:* None of the subjects had good or excellent hygiene. Fifteen subjects had fair oral hygiene and seven subjects had poor oral hygiene as measured by the PHP Index. Significant differences were seen between these two groups for oral aperture, percentage of teeth with caries, skin thickness, dexterity and finger flexion. Dexterity and joint motion correlated significantly with the number of decayed surfaces and number of caries. Oral aperture correlated with the PHP Index and the number of dental caries. *Conclusions:* Subjects with poor oral hygiene required more time to complete manual dexterity task and had decreased hand strength and joint motion. Moreover, these same subjects had more contractures, scars, ulcers, and higher skin scores (more disease activity) than subjects in the fair hygiene group. In addition to frequent dental exam and routine cleaning, dental personnel may want to consider exercises to increase oral aperature and investigate toothbrush and dental floss selection used by persons with scleroderma.

Key words: oral hygiene; hand function; systemic sclerosis; scleroderma

Systemic sclerosis or scleroderma is a multisystem disease that affects primarily the connective tissue resulting in skin thickening, vascular insufficiency and fibrosis in the muscles, joints, and internal organs. There are two subsets of systemic sclerosis:

diffuse scleroderma and limited scleroderma (1, 2). In diffuse scleroderma, there is a rapid progression of symmetrical widespread (diffuse) skin involvement affecting the distal and proximal extremities and the trunk. Early involvement of the viscera occurs. In limited scleroderma, there is relatively limited (restricted) skin involvement confined to the distal extremities and the face and a delay in the appearance of visceral involvement (1, 2).

Involvement of the hands in scleroderma varies according to disease subset (3). Symptoms at disease onset often include puffy or swollen fingers, arthralgias, arthritis and Raynaud's phenomenon. Raynaud's phenomenon or vasospasm is associated with digital tip ischemic ulcerations with resultant digital pitting scars. In severe cases digital gangrene can lead to autoamputation or surgical amputation of the involved fingers (4). Subcutaneous calcium build-up on the palmar surfaces of the digits is common and may interfere with pinch and fingertip sensation (3–5). Painful tenosynovitis, rarely seen in limited disease, is common in diffuse scleroderma patients with severe joint contractures. Flexion contractures in the joints of the hands may be seen occasionally in limited scleroderma patients, but are common manifestation in those with diffuse scleroderma. The contractures seen in the hand are decreased extension of the proximal interphalangeal joint, decreased flexion of the metacarpal joint (Fig. 1), and decreased abduction of the thumb (6, 7). These contractures along with the puffy fingers, joint pain, digital ulcers and scars, and calcinosis interfere significantly with overall hand function (4, 5, 8).

Scleroderma also affects the facial skin and salivary glands. The skin on the face becomes tight and microstomia (abnormal narrowing of the oral aperture) and loss of tongue mobility may result (9–11). Xerostomia or dry mouth was reported in 70% of 31 patients with scleroderma and associated with an increased frequency of dental caries (12). Wood and Lee also found that periodontal disease, and decayed, missing and filled teeth were also more prevalent in scleroderma patients than in matched controls. However, Eversole *et al.* (11) reported xerostomia in 50% of 19 patients but did not find increased frequency of dental caries. Bone resorption and erosions of the mandible have also been observed in patients with scleroderma (13–15).

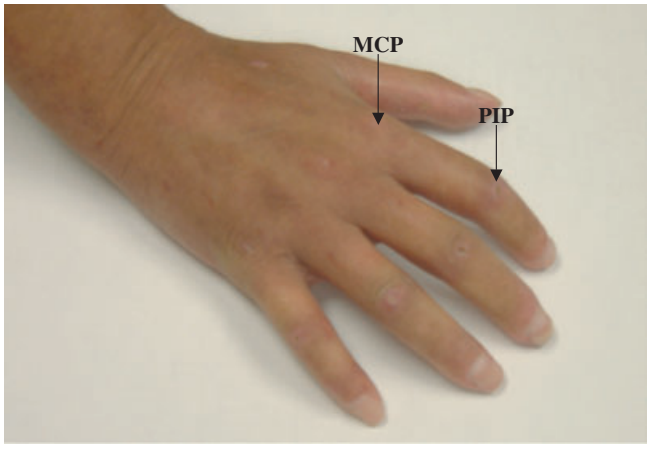

Fig 1. Hand of a woman with scleroderma showing contractures of the metacarpal (MCP) and proximal interphalangeal (PIP) joints.

Although there are studies examining oral manifestations and hygiene in scleroderma, the relationship between oral hygiene and risk factors such as decreased oral aperature and upper extremity function has not been explored. In our study, we hypothesized that decreased dominant upper extremity function and/or limited oral opening contribute to difficulty in maintaining oral hygiene. Thus, the purpose of this study was to assess potential risk factors for the development of poor oral hygiene and increased dental caries in individuals with scleroderma.

Methods

Subjects

Twenty-two subjects with scleroderma participated in this study. There were 21 females and one male, 11 with diffuse scleroderma and 11 with limited scleroderma. Inclusion criteria consisted of living within a 100-mile radius of the University of Pittsburgh Medical Center and having a minimum of 12 teeth. Subjects were excluded if they were on anticoagulation therapy or had a diagnosis of secondary Sjogrens Syndrome.

Instruments

Oral hygiene

The Patient Hygiene Performance (PHP) Index was used to measure oral hygiene (16). The PHP assesses the extent of plaque and debris over a tooth surface. Debris is defined as a soft foreign material loosely attached to tooth surfaces. The patient first swished a disclosing agent in the mouth and expectorated but did not rinse the agent out of the mouth. Six specific tooth surfaces were examined with a mouth mirror by a dental hygienist. Each tooth surface was mentally subdivided into five subdivisions. Each of the five subdivisions was scored for the presence of stain from the disclosing agent as 0 (no debris was present) or 1 (debris was definitely present). A debris score for each tooth was obtained by adding the scores for each of the five subdivisions and ranged from 0 to 5. A PHP score for the individual was obtained by totalling the scores for each individual teeth and dividing by the number of teeth

examined. PHP scores range from 0 to 5. A score of 0 is considered excellent; scores of 0.1–1.7 are considered good; scores of 1.8–3.4 are considered fair; and scores of 3.5–5.0 are considered poor (16). Subjects also received oral dental examinations for decayed, missing, and filled permanent teeth, pocket depth, and bleeding on probing. These findings were charted on standardized dental charts.

Oral aperture

Both maximum lip and teeth aperture were measured with a millimetre ruler. Lip aperture was the vertical distance from the bottom of the top lip to the top of the bottom lip with the mouth opened. Incisor aperture was the vertical distance from the bottom of the maxillary incisor to the top of the mandibular incisor with the mouth opened.

Xerostomia

Xerostomia was assessed by a questionnaire developed by Fox *et al.* (17) which asks questions about dry mouth during meals, the use of drinking water, gum and hard candy to relieve dry mouth. They validated the questions by correlating responses to salivary output and salivary flow rates. Items are scored as yes or no.

Dominant upper extremity function

Measurements of upper extremity function included range of motion, grip and pinch strength, dexterity and presence or absence of scleroderma symptoms.

The upper extremity items from the Keital functional test (KFT) were used to measure active range of motion (18). The KFT consists of 11 performance tasks such as making a fist, touching hands to shoulders and behind the neck. Scoring criteria are well defined. Interobserver agreement was reported as 0.85 and test–retest reliability as 0.96 (18). Composite finger flexion, the distance from each fingertip in centimetres to the distal palmar crease on the hand as a subject attempted to make a fist, was also used to assess hand range of motion.

Grip strength was measured with a vigorimeter. The vigorimeter was chosen for this study because it is sensitive to small amounts of pressure. The average of three consecutive measurements for the dominant hand was recorded. Lateral pinch and palmar pinch were measured with a pinchmeter. The average of three consecutive measurements for the dominant hand for each pinch was recorded.

Two measurements of dexterity were used: the button test and the grooved pegboard. The button test consists of five 5/8-inch buttons. An individual is timed buttoning and unbuttoning the five buttons. This item is part of the Arthritis Hand Function test (19). The grooved pegboard consists of 25 holes with randomly positioned slots (20). Pegs, which have a key along one side must be rotated to match the hole before they can be inserted.

Scleroderma symptoms

Skin thickness was assessed by palpating the skin on the multiple body areas and rating the thickness from 0 (normal) to 3 (extreme thickening) (21, 22). Digital scars, ulcers, and puffy fingers were scored as present or absent according to observation.

Results

None of the subjects had good or excellent oral hygiene as measured by the PHP Index (see above for description of PHP). Fifteen subjects had fair oral hygiene as measured by the PHP while seven subjects had poor oral hygiene. The PHP scores were significantly different between these groups (Table 2). Thus, to describe the demographics of the subjects and for the analysis, subjects were divided into fair and poor oral hygiene groups. Table 1 shows the demographic characteristics for each group. Diffuse scleroderma subjects were more likely to have poor hygiene ($P < 0.03$) but there were no significant differences between the fair and poor hygiene groups.

Table 2 compares the fair and poor hygiene groups on oral hygiene (PHP Index) and oral aperture. There were no significant differences between the fair and poor PHP groups in the different aspects of the dental examination. Ability to open the mouth as shown by the oral and incisor aperture was significantly decreased in patients with poor hygiene. In addition, the percentage of teeth with caries was greater in those with poor hygiene.

Table 1. **Demographic characteristics by Patient Hygiene Performance Index**

Characteristic	Fair hygiene ($N = 15$)	Poor hygiene ($N = 7$)	*P*-value
Female (*n*)	15	6	NS
Male (*n*)	0	1	
Diffuse scleroderma (*n*)	5	6	0.03
Mean age (years)	49	55	NS
Mean disease duration (years)	11	10.5	NS

Table 2. **Patient hygiene performance (PHP), oral hygiene and oral aperture scores by PHP Index**

Variable	Fair hygiene ($N = 15$)	Poor hygiene ($N = 7$)	*P*-value
PHP Index	2.9	3.8	0.05
Mean no. missing teeth	6.0	10.0	NS
Mean no. decayed surfaces	2.0	5.7	NS
Mean no. filled surfaces	35.0	27.0	NS
Mean no. sites with bleeding on probing	1.9	3.8	NS
Mean sites with pocket depth ≥4 mm	4.5	15.9	NS
Mean oral aperture	5.2	4.1	0.003
Mean incisor aperture	4.0	3.3	0.02
% Teeth with caries	55	74	0.05
% With xerostomia	7.0	0	NS

Table 3 compares the fair hygiene and poor hygiene groups on upper extremity functioning. Interestingly, only the button test ($P < 0.01$) and the composite flexion function, finger to palm measurements ($P < 0.02$) were significantly different between the two groups. Strength did not appear to influence the PHP scores. Table 4 shows the mean skin scores and mean percentage for the presence of clinical scleroderma features for the fair and poor hygiene groups. The poor hygiene groups had more severe features, but because of the small numbers, only the skin score reached significance.

Pearson correlation coefficients were calculated between oral hygiene and oral aperature measures and upper extremity scores and clinical scleroderma features. Buttoning times ($r = 0.76$, $P < 0.002$) and the KFT items for the dominant hand ($r = 0.83$, $P < 0.002$) correlated significantly with the number of decayed surfaces and the number of caries. Grooved pegboard scores correlated significantly with the PHP scores ($r = 0.55$, $P < 0.04$). None of the other upper extremity measures correlated with PHP scores nor did any of the clinical scleroderma features. The width of the oral aperture correlated significantly with PHP scores ($r = 0.59$, $P < 0.01$) and the number of dental caries ($r = 0.47$, $P < .05$).

Table 3. **Mean upper extremity functioning scores for the fair and poor hygiene groups**

Variable	Fair hygiene ($N = 15$)	Poor hygiene ($N = 7$)	*P*-value
Dexterity (mean s)			
Grooved pegboard	93	105	NS
Buttoning	39	55	0.01
Strength (mean pounds)			
Grip	50	47	NS
Lateral pinch	17.1	17.9	NS
Palmar pinch	14.9	17.0	NS
Range of motion			
Keital test (mean score)	7.1	10.6	NS
Finger to palm (cm)	0.93	2.2	0.02

Table 4. **Mean percentage for presence of clinical scleroderma features for the fair and poor hygiene groups**

Clinical feature	Fair hygiene ($N = 15$)	Poor hygiene ($N = 7$)	*P*-value
Contractures	67%	100%	NS
Digital pitting scars	67%	100%	NS
Digital tip ulcers	60%	71%	NS
Puffy fingers	93%	57%	NS
Maximum mean skin score	18	38	0.04

Discussion

The esophageal reflex and xerostomia experienced by those with scleroderma has been reported to chemically erode the enamel of the teeth (23). In addition, persons with scleroderma lack normal salivary pooling under the tongue (23). These may all lead to increased dental caries. Furthermore, the hand contractures and changes in the oral cavity such as microstomia (small mouth) may make oral hygiene difficult. In our study, none of the subjects had good to excellent oral hygiene. Overall, subjects with poor oral hygiene required more time to complete manual dexterity tasks and had decreased joint motion relative to subjects with fair hygiene. Moreover, these same subjects had more contractures, scars, ulcers, and higher skin scores (more severe disease) than subjects in the fair hygiene group. The results from this study suggest that there are certain factors associated with poor oral hygiene. Fine dexterity as measured by buttoning and upper extremity motion as measured by the KFT were related to the numbers of decay and caries. Although this is the first study to identify factors outside the oral cavity itself that are associated with poor oral hygiene in scleroderma, the results are in agreement with Felder *et al.* (24) who also found that dexterity predicted oral care ability in older subjects. However, findings from another study for persons with rheumatoid arthritis showed no correlation between grip, joint motion and periodontal measures (25).

For persons with scleroderma, dental personnel may want to consider frequent dental exams and routine cleaning. As these individuals have problems with exposure to cold, dental personnel may want to supply blankets. If the offices are especially cold, clients should be advised to bring gloves, socks and/or hats. Because of the decreased oral aperature, paediatric size intraoral films, head lamps, drills with small heads, and triple angle instruments (26). Dental personnel

could teach patients exercises to increase oral aperature before or during the exam in order to make the visit to the dentist and hygienist easier. Several studies have shown stretching (placing the thumbs in opposite corners of the mouth and pulling outward) and oral augmentation (tongue depressors between the back molars) exercises can increase oral aperature (27, 28). Dental personnel may also want to investigate toothbrush and dental floss selection used by their clients with scleroderma. Nauert (29) suggests child size soft toothbrushes, wide flat handles, and pulling out all but the end two rows of bristles on a child size soft toothbrush to make it easier to clean the cheek sides of the upper and lower teeth. He also provided a list of helpful dental products specifically for persons with scleroderma. Adapted equipment, ordered from equipment catalogues may make it easier for an individual with decreased dexterity and range of motion to brush and floss one's teeth.

In summary, persons with scleroderma have significant problems with oral hygiene which are primarily related to hand function. Health care workers need to emphasize improved dental care for all persons with scleroderma.

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