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Periodontal health status of patients with Maxillary Chronic Rhinosinusitis (Part 3: Associated factors and Correlations)

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Abstract

Background: Gingivitis and periodontitis are most often periodontal diseases which are inflammatory conditions of the supporting tissues of the teeth that are caused by bacteria. Dental plaque is the primary etiological factor of periodontal diseases. Maxillary rhinosinusitis: is the inflammation of the maxillary sinuses. Hence, Maxillary Chronic rhinosinusitis (MCRS) is the inflammation which lasts longer than three months. Common bacteria related to chronic rhinosinusitis include: *Haemophilus influenza; Streptococcus pneumoniae; Staphylococcus aureus; Moraxella catarrhalis; Pseudomonas aeruginosa; Streptococcus pyogenes.* **Aims of the study**: Distribution of patients with maxillary chronic rhinosinusitis and periodontal diseases (gingivitis and different severities of chronic periodontitis) according to different associated factors of maxillary chronic rhinosinusitis. Correlation between clinical periodontal parameters and microbiological findings from the plaque samples of maxillary chronic rhinosinusitis patients. **Materials and Methods:** 150 males and females patients (25-45 years), suffer from maxillary chronic rhinosinusitis which is either associated with allergy, anatomical variations (include: Deviated nasal symptoms, Paradoxical Middle turbinate and Concha bullosa), polyps or others (air pollution and mass) factors were participated in this study. Clinical periodontal parameters recorded for all patients as it was mentioned in first part of the study. The patients participated in this study were divided into four subgroups: clinically Healthy periodontium, Gingivitis, chronic periodontitis (CP.1) when PPD mean is (4-6 mm) and chronic periodontitis (CP.2) when it is (> 6mm). Middle meatus swabs and plaque samples were obtained as it was mentioned in second part of the study. Identification of MCRS related bacteria from plaque samples and middle meatus swabs included: *Haemophilus influenza; Streptococcus pneumoniae; Staphylococcus aureus; Moraxella catarrhalis; Pseudomonas aeruginosa and Streptococcus pyogenes* by morphological appearance, light microscope, biochemical tests or Vitech-2 machine. **Results:** Patients with MCRS caused by Allergy and Anatomical variations revealed the highest percentages in Gingivitis subgroup, while, Polyp showed a highest percentage in CP.1 subgroup (52.63%). The Healthy subgroup demonstrated strong correlations between *Streptococcus pyogenes* and *Streptococcus pneumoniae* with GI, while Gingivitis subgroup, revealed strong correlations between PLI and GI with *Staphylococcus aureus*, *Moraxilla catarrhalis* and *Pseudomonas aeruginosa.* InCP.1 subgroup, *Moraxilla catarrhalis* and *Pseudomonas auroginosa* demonstrated strong correlations with GI,PPD and CAL, while, it was moderate correlations between *S.pyogenes* with GI and CAL, as well as, *Staphylococcus aureus* with CAL, on the other hand, *Streptococcus pneumoniae* showed strong correlations with PLI, GI, and BOP score1. In CP.2 there were strong correlations between *Streptococcus pneumonia* with PLI, GI, and CAL, while it was moderate with BOP score1. **Conclusion:** Allergy represented the highest percentage of associated factors of MCRS. There were almost correlations between clinical periodontal parameters and microbiological findings. Two way relations between maxillary chronic rhinosinusitis and periodontal diseases concluded.

Keywords: Periodontal diseases, Maxillary chronic rhinosinusitis related bacteria.

Introduction

Periodontal diseases are one of the major dental pathologies that affect human populations worldwide at high prevalence rates (Petersen, 2003). It includes a group of inflammatory conditions of the supporting tissues of the teeth that are caused by bacteria and most often gingivitis and periodontitis (Mealey, 2006 and Hamid et al, 2007).Dental plaque defined as a true biofilm which consists of bacteria in a matrix of extracellular bacterial polymers and salivary and/or gingival exudate products. This microbial community attached to the tooth surface, epithelial tissues or any hard surface inside oral cavity (Niklaus et al, 2008).

Two types of plaque can be detected:

1. Supra-gingival plaque: which can be seen on clinical crown of the teeth, when it is in small amount cannot be detected unless scraping of the tooth surface along the gingival margin by the end of probe (Hans. 2003).

2. Sub-gingival plaque: which is located in the gingival sulcus or periodontal pocket, it is separated from supra-gingival plaque by the gingival margin(Hans. 2003).

Maxillary sinuses: are the largest paranasal sinuses, located in the maxillary bones, drains into the middle meatus of the nose, there is continuity of respiratory mucosa from the nose (Daniel et al, 2010).

Maxillary Chronic rhinosinusitis (MCRS) is the inflammation of the maxillary sinuses which lasts longer than three months. Due to the proximity of the maxillary teeth to the floor of the sinus, a periodontal infection or periapical infection of maxillary posterior teeth lead to MCRS, once an odontogenic infection occur there will be a drainage of the inflammatory exudate superiorly through the bone to drain into the maxillary sinus, then involves the maxillary sinus (Palmer, 2006). For sinusitis lasting more than 12 weeks clinical symptoms are used to make a positive diagnosis. The evaluation ofsino-nasal anatomy, nasal mucosa, and nasal pathology can be performed in the otolaryngologist's office by using nasal endoscopy which is either a flexible fiber optic endoscope or a rigid endoscope that use a magnified high quality view to evaluate the nasal and sinus passages by direct vision(Amy et al. 2014).

Common bacteria related to chronic rhinosinusitis include *Haemophilus influenzae; Streptococcus pneumoniae; Staphylococcus aureus; Moraxella catarrhalis; Pseudomonas aeruginosa; Streptococcus pyogenes* (Michael et al, 2008).

Susanna et al. in 2003 detected same bacterial species in the maxillary sinus and in saliva, showed that the direct connection between these two sites may allow oral bacteria to contribute to non-oral inflammatory conditions.

The MCRS associated factors are: Allergy, anatomical variations (include: Deviated nasal septum, Paradoxical Middle turbinate and Concha bullosa), polyps and others (air pollution and mass). The aims of this study was to determine the periodontal health status of patients with MCRS according to associated factors and to correlate between MCRS related bacteria and clinical periodontal parameters.

Materials and Methods

The steps were carried out at part 1 (Sohair et al, 2015) and part 2 (Sohairet al, 2016) studies which were as follows:

150 males and females patients collected from Otorhinolaryngology out patients clinic in AL-Karama Teaching Hospital in AL- KUT \ Wasit\ Iraq, at age range between 25-45 years complaining of bilateral MCRS more than 12 weeks examined by ENT specialist and detect the MCRS associated factors which is either Allergy, anatomical variations (include: Deviated nasal septum, Paradoxical Middle turbinate and Concha bullosa), polyps and others (air pollution and mass), all patients must have 20 teeth presents. Smokers, alcoholic drinkers, pregnant ladies and those on contraceptive pills or hormonal medications, patients with systemic diseases, patients on anti-inflammatory or anti-microbial therapy during the last 3 months, patients with orthodontic appliance, removable or fixed prostheses, patients who have undergone periodontal treatment in the 3 months period prior to the study and patients without maxillary posterior teeth were excluded from the study. Measuring of clinical periodontal parameters including plaque index (PLI**)** (Silness, 1964)gingival index (GI) (Löe, 1967)probing pocket depth (PPD) (Lang et al, 1999),bleeding on probing (Carranza et al, 2012) and clinical attachment level (CAL)(Carranza et al, 2012) were carried out (Sohair et al, 2015).

These patients divided into four subgroups according to their clinical periodontal parameters measurements: **Healthy** periodontium subgroup, **Gingivitis** subgroup,

chronic periodontitis with pocket depth 4-6 mm (**CP.1)**subgroup and chronic periodontitis with pocket depth more than 6 mm(**CP.2)**subgroup.

Plaque samples and middle meatus swabs were obtained from the patients as described in part 2 (Sohair et al, 2016)of this study in addition to transport media and using of Blood Agar and MacConky Agar media for culturing of bacteria under aerobic condition for 24 hrs.

Statistical analysis was done by using of numbers and percentages, persons correlation coefficients (r). Graphical presentation by using: Column and pie charts. All the statistical analyses are significance at P-value ≤0.05,Highly significance at P-value ≤0.01and non- significance at P-value > 0.05.We certify that this study involving human patients is in accordance with the Helsinky declaration of 1975 as revised in 2000 and that it has been approved by the relevant institutional Ethical Committee.

Results

In patients suffering from MCRS, table (1) and figure(1), showed that the percentages of patients with Allergy in Healthy, Gingivitis, CP.1 and CP.2 were (33.68%, 51.57%, 14.73% and 0%) respectively, the highest percentage in Gingivitis subgroup followed by Healthy subgroup and not present in CP.2 subgroup .While Anatomical variations revealed the highest percentage in Gingivitis subgroup (53.33%) followed by (33.33%) in CP.1 subgroup and in both Healthy and CP.2 subgroups with equal percentages (6.67%). Polyp showed a highest percentage in CP.1 subgroup (52.63%), then (31.58%) in Gingivitis subgroup and (15.79%) in CP.2 subgroup, while, (0%) in Healthy subgroup. There were other different associated factors (air pollution and masses), the highest percentage was in Healthy subgroup (50%), in CP.1subgroup was (33.33%) and (16.67%) in Gingivitis subgroup, while it was (0%) in CP.2subgroup.

Table (1): Distribution of patients with MCRS at each subgroup according to MCRS associated factors

Patients with MCRS Subgroups	MCRS associated factors							
	Allergy		Anatomical variation		Polyp		Others	
	No. of patients	%of patients	No. of patients	% of patients	No. of patients	% of patients	No. of patients	% of patients
Healthy	32	33.68 %	2	6.67 %	0	0 %	3	50 %
Gingivitis	49	51.58 %	16	53.33 %	6	31.58 %	1	16.67 %
CP.1	14	14.74 %	10	33.33 %	10	52.63 %	2	33.33 %
CP.2	0	0	2	6.67 %	3	15.79 %	0	0 %
Total	95	100 %	30	100 %	19	100 %	6	100%

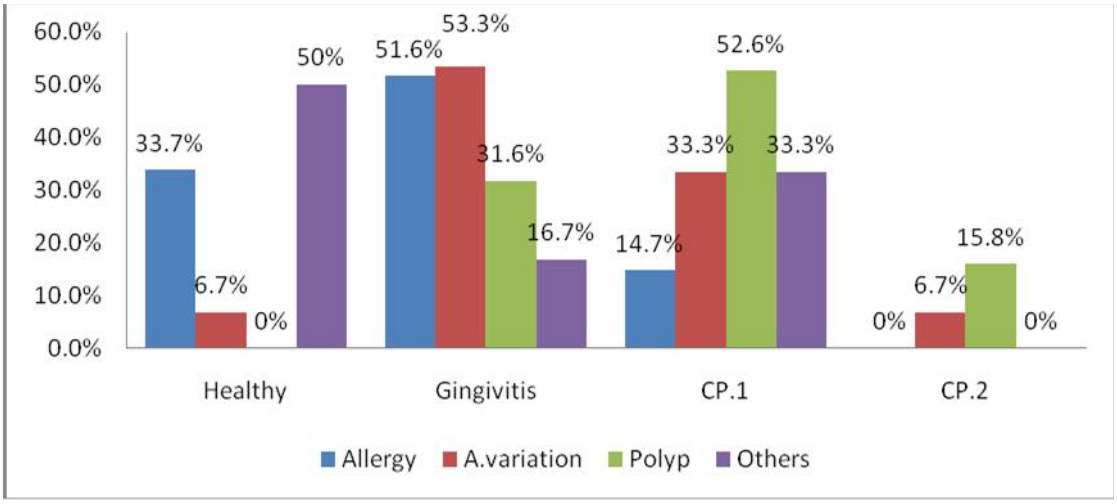

Figure (1):Bar chart for the percentages of patients with MCRS at each subgroup according to MCRS associated factors

In patients with MCRS, the total percentage of patients suffer from Allergy associated factor of MCRS was (63.33%) which is the highest one while, the total percentage of patients with Anatomical variations equal to (20%), followed by patients with Polyp (12.67%). The least percentage was (4%) for patients had other associated factors of MCRS, as demonstrated in figure (2).

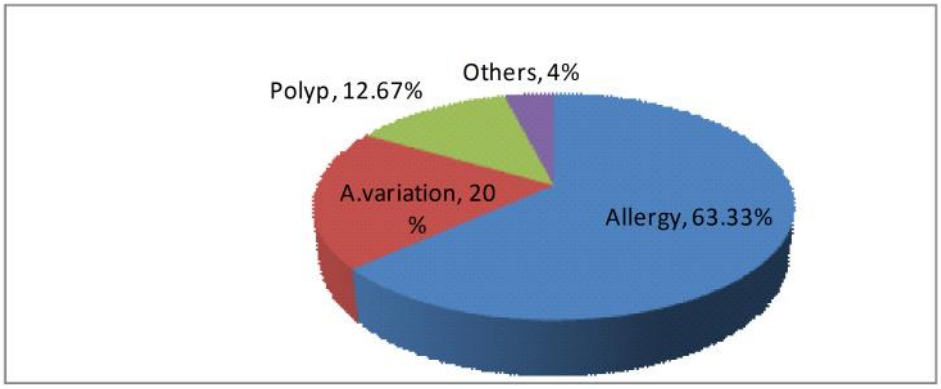

Figure (2): Pie chart for the percentages of patients with MCRS group according to MCRS associated factors

Correlation between Clinical Periodontal Parameters and MCRS related bacteria

1. Healthy subgroup:

From table (2), PLI showed non-significant weak positive correlations with MCRS related bacteria (*S.pyogenes*, *S.aureus* and *S.pneumoniae*). On the other hand, the correlation of GI with *S.pyogenes* was significant strong negative, while with *S.pneumoniae* was strong positive but, it was weak positive correlation with *S.aureus*.

Table (2): Correlation between clinical periodontal parameters (PLI, GI) with MCRS related bacteria of Healthy subgroup

Clinical periodontal parameters	*S. pyogenes*			*S. aureus*			*S. pneumoniae*		
	r	p-value	Sig.	r	p-value	Sig.	r	p-value	Sig.
PLI	0.065	0.878	NS	0.163	0.653	NS	0.449	0.372	NS
GI	-0.741	0.036	S	0.008	0.983	NS	0.651	0.161	NS

2. Gingivitis subgroup

In table (3), *S.pyogenes* showed generally weak positive correlations with PLI and GI, while, *S.aureus* showed highly significant strong positive correlations with both PLI and GI, hence, *S.pneumoniae* showed generally weak correlations which were negative with PLI and positive with GI. On the other hand, *M.catarrhalis* showed highly significant positive strong correlations with PLI and GI, while *P.auroginosa* showed highly significant strong positive correlation with PLI and significant strong positive correlation with GI. All MCRS related bacteria showed no significant correlations with BOP score1.

Table (3): Correlation between clinical periodontal parameters (PLI, GI and BOP score1)with MCRS related bacteria of Gingivitis subgroup

Clinical periodontal parameters	*S. pyogenes*		*S. aureus*		*S. pneumoniae*		*M. catarrhalis*		*P. aeruginosa*	
	r	P-value Sig.	r	p-value Sig.	r	p-value Sig.	r	P-value Sig.	r	P-value Sig.
PLI	0.39	0.025 S	0.71	0.006 HS	-0.085	0.841 NS	0.642	0.004 HS	0.755	0.005 HS
GI	0.208	0.253 NS	0.7	0.007 HS	0.49	0.215 NS	0.756	0.000 HS	0.658	0.020 S
BOP Score1	0.14	0.44 NS	-0.13	0.67 NS	0.208	0.621 NS	0.192	0.44 NS	-0.25	0.429 NS

3. CP.1 subgroup

From table (4), *S.pyogenes* showed generally weak correlations with PLI, PPD and BOP score1 but, they were significant moderate positive correlation with GI and moderate negative correlation with CAL. While, *S.aureus* showed weak correlations with PLI, GI, PPD and BOP score1, hence, it was moderate negative correlation with CAL. On the other hand, *S.pneumoniae* showed significant strong positive correlations with PLI and GI, but, weak correlations with both PPD and CAL were demonstrated with highly significant strong negative correlation with BOP score1. *M.catarrhalis* showed weak correlations with both PLI, and BOP score1, while, they were significant strong positive correlations with GI, PPD and CAL. Furthermore, *P.auroginosa* showed weak correlations with both PLI and BOP score1 while, significant strong positive correlations with GI and CAL and significant strong negative correlation with PPD were revealed.

Table (4): Correlation between clinical periodontal parameters (PLI, GI, PPD, CAL and BOP score1) with MCRS related bacteria of CP.1 subgroup

Clinical periodontal parameters	*S.pyogenes*		*S.aureus*		*S.pneumoniae*		*M.catarrhalis*		*P.aeruginosa*	
	r	p-value Sig.	r	p-value Sig.	r	p-value Sig.	r	p-value Sig.	r	p-value Sig.
PLI	0.019	0.952 NS	0.004	0.990 NS	0.764	0.046 S	0.116	0.733 NS	0.351	0.562 NS
GI	0.573	0.040 S	0.226	0.531 NS	0.772	0.042 S	0.694	0.018 S	0.871	0.049 S
PPD	0.079	0.79 NS	0.018	0.961 NS	0.481	0.274 NS	0.685	0.020 S	- 0.701	0.035 S
CAL	-0.522	0.067 NS	-0.500	0.141 NS	0.134	0.775 NS	0.611	0.046 S	0.711	0.032 S
BOP Score1	-0.451	0.122 NS	-0.091	0.802 NS	-0.978	0.004 HS	0.015	0.966 NS	0.049	0.937 NS

4. CP.2 subgroup

In table (5), *S.pneumoniae* showed weak positive correlation with PPD, and moderate negative correlation with BOP score1, but they were strong positive correlation with GI and strong negative correlation with PLI and CAL. *S.pneumoniae* was the only type of MCRS related bacteria found in this group.

Table (5): Correlation between clinical periodontal parameters(PLI, GI, PPD, CAL and BOP score1) with MCRS related bacteria of CP.2 subgroup

Clinical periodontal parameters	*S.pneumoniae*		
	r	p-value	Sig.
PLI	-0.889	0.302	NS
GI	0.978	0.135	NS
PPD	0.279	0.820	NS
CAL	-0.737	0.472	NS
BOP score1	-0.596	0.593	NS

Discussion

The MCRS associated factors

Allergy was the main MCRS associated factor in patients with MCRS (63.33%) and this result agreed with (Wheatley et al, 2015) who found that Allergic rhinitis is a risk factor for MCRS because it leads to thickening of the mucosal linings of sinuses and prevents drainage of discharge which result in secondary bacterial sinusitis.

Patients with Polyp did not have Healthy periodontium but, (52.63 %) of them had CP.1, (31.58) had Gingivitis and (15.79 %) had CP.2, which indicates a clear relation between Polyp with chronic periodontitis and Gingivitis in addition, the total percentage of patients suffer from polyp was (12.67%)and this in agreement with Ingemar et al. in 1986 who found the incidence of polyp was 13.1% in odontogenic sinusitis.

About 51.58% of Allergic patients and 53.3% of patients with Anatomical variations had Gingivitis and this is explained by mouth breathing results from MCRS which lead to dry mouth, as well as, patients with allergy had lower salivary Immunoglobulin A (IgA) level, hence, inflamed tissues, including gingivitis presents more vasodilated and increased permeability of blood vessels, therefore increase invasion of microorganisms and antigens, thus, the IgA is mandatory as a first barrier to infection. On the other hand, dental plaque control therapy had beneficial effect to children suffered from allergic rhinitis, sinusitis and asthma. Collaborated study which included dental practitioners, pediatrician and children allergic experts revealed that dental plaque therapy without medication lead to disappearing of clinical asthmatic symptoms; even after two months later (Seno, 2008).

Correlation between clinical periodontal parameters with MCRS related bacteria

1. Healthy subgroup:

The *S.pyogenes* showed significant strong negative correlation with GI, this is indicating a reverse effect of these bacteria on gingival health condition because these bacteria need to interact with *M.catarrhalis* in order to adhere to epithelial cells and cause damage to human tissue cell lines (Eric et al, 2004)

2. Gingivitis subgroup:

There were weak positive correlation of *S.pyogenes* with PLI and GI. In addition, highly significant strong positive relation of *S.aureus* with PLI and GI, and these results explained by the ability of these two bacteria to produce enzymes which destroy the periodontal tissues (Beres *et al*, 2006) This is accepted because (Egwari *et al*. 2009) found that the dental plaque of patients with gingivitis contained higher percentage of *S.pyogenes* followed by *S.aureus*. On the other hand, *S.pneumoniae* had week relation with both PLI and GI. But, *M.catarrhalis* had highly significant strong positive relations with PLI and GI, hence, no other study before detected this type of bacteria in plaque samples, but a study by (Melanie in 2004) found that *M. catarrhalis* may produce an extracellular polysaccharide lead to detectable change in its outer membrane protein result in biofilm formation, this study concluded that *M. catarrhalis* had the ability to form plaque film and could play important roles in formation of dental plaque. While, *P.aeruginosa* had highly significant strong positive relation with PLI and significant strong positive relation with GI, which explained by its ability to adhere to periodontal tissues and releasing of toxic products lead to acute infection which by time change to chronic disease (Smiley, 2006).

3. CP.1 subgroup

The *S.pyogenes* showed significant moderate positive correlation with GI, while *S.aureus* showed moderate correlation with CAL, these explained by production of exotoxins by these bacteria which cause tissue destruction (Beres *et al*, 2006) *S.pneumoniae* showed strong relation with PLI, GI and BOP score 1, Since, *S.pneumoniaeis* one of normal oral and oropharyngeal flora but it became infectious when it reaches eustachian tube and nasal sinuses and cause otitis media and sinusitis respectively (Walter et al, 2010).

On the other hand, *M.catarrhalis* and *P.aeruginosa* showed significant strong correlations with GI, PPD and CAL. So, increase in the percentages of these bacteria with the increase in the severity of periodontal diseases, which means that these bacteria play an important role in periodontal diseases by secretions of exotoxins lead to periodontium destruction, again this is agreed with other study (Silva et al, 2013)who improved that *P.aeruginosa* strongly correlated with PPD ≥5 mm and clinical attachment loss and associated with periodontal diseases. Also agreed with Andrea et al. in 2013 who detected *P. aeruginosa* in 50% of patients with PPD ≥6 mm and clinical attachment loss.

4. CP.2 subgroup

The *S.pneumoniae* had strong relations with PLI, GI and CAL, also moderate relation with BOP score1. Although Walter et al. in 2010 found that *S.pneumoniae* is one of normal oral flora but it became infectious when it reaches nasal sinuses and cause sinusitis, it plays a role in formation of plaque with consequent gingival inflammation and attachment loss (Carranza et al, 2012).

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