Aim of the study

The aim of the present study was to evaluate the effect of smoking and periodontal disease on concentration of total glutathione in saliva and to investigate the effect of mechanical subgingival debridement on salivary glutathione level.

Material and Methods

I. Study Population

The study was including 40 individuals retrieved from the outpatient clinic of the Department of Periodontology, Faculty of Oral and Dental Medicine, Cairo University; the patients were divided into three groups as following:

Group 1:

- Was including 15 non-smoking patients with generalized moderate to severe chronic periodontitis.
- The diagnostic criteria for chronic periodontitis were in accordance with the criteria of the International Classification Workshop proposed by **Armitage, 1999**.
- This new periodontal disease classification system was recommended by the International Workshop for a Classification of Periodontal Disease and Condition in 1999 and has been accepted by the AAP.
- Changes in the classification system for periodontal diseases include:
1. Addition of a section on " Gingival disease" (Table 7, Section I).
2. Replacement of "Adult Periodontitis" with "Chronic Periodontitis" (Table 7, Section II).
3. Elimination of "Refractory Periodontitis" as a Separate Entity.
4. Replacement of "Early-Onset Periodontitis" with "Aggressive Periodontitis" (Table 7, Section III).
5. Further Subclassification of "Periodontitis" as a "Manifestation of Systemic Diseases" (Table 7, Section IV).
6. Replacement of "Necrotizing Ulcerative Periodontitis" with "Necrotizing Periodontal Diseases" (Table 7, Section V).

7. Addition of Categories for "Periodontal Abscess" and "Periodontic-Endodontic Lesion" (Table 7, Sections VI and VII).

I- Gingival diseases

8. Addition of a Category for "Developmental or Acquired Deformities and Conditions" (Table 7, Section VIII).

Table (7): Classification of periodontal diseases and conditions.

A- Dental plaque-induced gingival diseases	B- Non- plaque induced gingival lesion

1) Gingivitis associated with dental plaque only
   a. without other local contributing factors
   b. with local contributing factors (See VIII A)
2) Gingival diseases modified by systemic factors
   a. associated with the endocrine system
     i. puberty-associated gingivitis
     ii. menstrual cycle-associated gingivitis
     iii. pregnancy-associated
       1. gingivitis
       2. pyogenic granuloma
     iv. diabetes mellitus-associated gingivitis
   b. associated with blood dyscrasias
     i. leukemia-associated gingivitis
     ii. other
3) Gingival diseases modified by medications
   a. drug-influenced gingival diseases
     i. drug-influenced gingival enlargements
     ii. drug-influenced gingivitis
       1. oral contraceptive-associated gingivitis
       2. other
4) Gingival diseases modified by malnutrition
   a. ascorbic acid-deficiency gingivitis
   b. other
	1. Gingival diseases of specific bacterial origin
	   a. *Neisseria gonorrhea*-associated lesions
	   b. *Treponema pallidum*-associated lesions
	   c. streptococcal species-associated lesions
	   d. other
	2. Gingival diseases of viral origin
	   a. herpesvirus infections
	     i. primary herpetic gingivostomatitis
	     ii. recurrent oral herpes
	     iii. varicella-zoster infections
	  b. Other
	3. Gingival diseases of fungal origin
	   a. *Candida*-species infections
	    1. generalized gingival candidosis
	   b. linear gingival erythema
	   c. histoplasmosis
	   d. other
	4. Gingival lesions of genetic origin
	   e. hereditary gingival fibromatosis
	   f. other
	5. Gingival manifestations of systemic conditions
	   g. mucocutaneous disorders
	     1. lichen planus
	     2. pemphigoid
	     3. pemphigus vulgaris
	     4. erythema multiforme
	     5. lupus erythematosus
	     6. drug-induced
	     7. other
	   h. allergic reactions
	     1. dental restorative materials
	       a. mercury
	       b. nickel
	       c. acrylic
	       d. other
	     2. reactions attributable to
	       a. toothpastes/dentifrices
	       b. mouthrinses/mouthwashes
	       c. chewing gum additives
	       d. foods and additives
	     3. other
	6. Traumatic lesions (factitious, iatrogenic,
	          accidental)
	     i. chemical injury
	     j. physical injury
	     k. thermal injury
	7. Foreign body reactions
	8. Not otherwise specified (NOS)

Table (1): Continued

II. Chronic Periodontitis

A. Localized
B. Generalized

VII. Periodontitis Associated With Endodontic Lesions

A. Combined periodontic-endodontic lesions

III. Aggressive Periodontitist
A. Localized
B. Generalized

IV. Periodontitis as a Manifestation of Systemic Diseases
A. Associated with hematological disorders
    1. Acquired neutropenia
    2. Leukemias
    3. Other
B. Associated with genetic disorders
    1. Familial and cyclic neutropenia
    2. Down syndrome
    3. Leukocyte adhesion deficiency syndromes
    4. Papillon-Lefèvre syndrome
    5. Chediak-Higashi syndrome
    6. Histiocytosis syndromes
    7. Glycogen storage disease
    8. Infantile genetic agranulocytosis
    9. Cohen syndrome
    10. Ehlers-Danlos syndrome (Types IV and VIII)
    11. Hypophosphatasia
    12. Other
C. Not otherwise specified (NOS)

V. Necrotizing Periodontal Diseases
A. Necrotizing ulcerative gingivitis (NUG)
B. Necrotizing ulcerative periodontitis (NUP)

VI. Abscesses of the Periodontium
A. Gingival abscess
B. Periodontal abscess
C. Pericoronal abscess

VIII. Developmental or Acquired Deformities and Conditions
A. Localized tooth-related factors that modify or predispose to plaque-induced gingival diseases/periodontitis
    1. Tooth anatomic factors
    2. Dental restorations/appliances
    3. Root fractures
    4. Cervical root resorption and cemental tears
B. Mucogingival deformities and conditions around teeth
    1. Gingival/soft tissue recession
        a. facial or lingual surfaces
        b. interproximal (papillary)
    2. Lack of keratinized gingiva
    3. Decreased vestibular depth
    4. Aberrant frenum/muscle position
    5. Gingival excess
        a. pseudopocket
        b. inconsistent gingival margin
        c. excessive gingival display
        d. gingival enlargement (See I.A.3. and I.B.4.)
    6. Abnormal color
C. Mucogingival deformities and conditions on edentulous ridges
    1. Vertical and/or horizontal ridge deficiency
    2. Lack of gingiva/keratinized tissue
    3. Gingival/soft tissue enlargement
    4. Aberrant frenum/muscle position
    5. Decreased vestibular depth
    6. Abnormal color
D. Occlusal trauma
    1. Primary occlusal trauma
    2. Secondary occlusal trauma

Group 2:

- Was including 15 smoking patients with generalized moderate to severe chronic periodontitis.

- The diagnostic criteria for chronic periodontitis were in accordance with the criteria of the International Classification Workshop proposed by **Armitage, 1999**.

- **Buduneli et al., 2006** defined smokers as those who smoked ≥ 10 cigarettes per day for more than 5 years.

Group 3:

- Was including 10 non-smoker subjects (controls) with clinically healthy periodontium.

Patients and controls were selected free from any systemic disease or any drug administration that may alter the periodontal status according to the Modified Cornell medical index. Pregnancy and lactation was also excluded.

Also, detection of an oral mucosal inflammatory condition (e.g., aphthous, lichen planus, leukoplakia, and oral cancer) had been additional exclusion criteria.

II. Study Procedure:

The study procedure was divided into three categories:

- ### First category:

All the study individuals were subjected to comprehensive oral diagnosis using the oral diagnosis charts of Periodontology department, Faculty of Oral and Dental Medicine, Cairo University. The chart composed of 2 components:

1- Sociodemographic data:

The first part of the questionnaire included personal information, past and present medical history, past dental history, family history, personal habits and oral hygiene habits as shown in figure (2) section (I).

2- Clinical examination:

- All patient included in this study was examine to detect oral hygiene status of them.

- All the patients were examined on the dentist chair under chair light and 6 measurement were recorded :

A. Gingival condition:

Visual examination for the gingiva was done under the chair light to detect color, contour, consistency, form and surface texture as shown in figure (2) section (II).

B. Plaque Index (Silness and Löe, 1964):

-**Purpose:** measurement of the state of oral hygiene by this index based on recording both soft debris and mineralized deposits on the teeth; by assess the thickness of plaque at the gingival area.

-**Selection of teeth:** the entire dentition was evaluated.

-**Areas examined:** on each tooth four gingival areas (facial, lingual, mesial and distal) were examined systematically and visually and score recorded as shown in figure (2) section (II).

-**Procedure:**

1- The teeth were dried and examined visually using adequate light and mouth probe or explorer.

2- Probe to test surface when no plaque is visible by pass the probe tip across tooth surface in cervical 1/3 and near entrance to sulcus.

-Criteria and scoring:

For each four surfaces of all examined teeth, score from 0-3 was given according to plaque index score as shown in table (8)

Table (8): The score for plaque index

Score	criteria
0	No plaque in gingival areas.
1	Film of plaque adhering to free gingival margin and adjacent area of tooth. Plaque may be seen in situ only after application of disclosing solution or by using probe on tooth surface
2	Moderate accumulation of soft deposits within gingival pocket, or tooth and gingival margin which can be seen with naked eye
3	Abundance of soft matter within gingival pocket and/or on tooth and gingival margin. Soft debris fills interdental region.

-Scoring:

- For each of the four surfaces of teeth given a score from 0-3

- Plaque index for a tooth= scores for each area totaled / 4

- Plaque index for individual= scores for each tooth / number of tooth examined

C. Gingival Index (Löe, 1967)

-Purpose: to describe clinical severity of gingival inflammation and its location.

-Selection of teeth: all teeth were examined.

-Surface examined on each tooth: facial, lingual, mesial and distal as shown in figure (2) section (II).

-Procedure:

1- Teeth and gingiva dried.

2- Examined under chair light, using a mouth mirror and probe.

3- Probe is used to evaluate bleeding by press on gingiva to determine degree of firmness; run along soft tissue wall near entrance to gingival sulcus.

-**Criteria and scores:**

For each four surfaces of all examined teeth, score from 0-3 was given according to gingival index score as shown in table (9).

Table (9): The gingival index score

Point	Appearance	Bleeding	Inflammation
0	Normal	No bleeding	None
1	Slight change in color, Mild edema, slight change in texture.	No bleeding	Mild
2	Redness, hypertrophy, edema and glazing	Bleeding on probing/ pressure	Moderate
3	Marked redness, hypertrophy, edema and ulceration	Spontaneous bleeding	sever

-**Scoring:**

- For each of the four surfaces of teeth given a score from 0-3

- Gingival index for a tooth= scores for each area totaled / 4

- Gingival index for individual= scores for each tooth / number of teeth examined.

D-Periodontal probing depth

The probing pocket depth was measured from the free gingival margins to the base of the pocket using standard William's graduated periodontal probe to the nearest millimeter. The probe was inserted parallel to the long axis of the tooth using light force. The pocket depth measurements had been recorded at four location points; the mesiobuccal, midbuccal, distobuccal, and midlingual as shown in figure (2) section (III).

E- Gingival recession:

Gingival recession was measured from cemento-enamel junction to the free gingival margin. Measurements had been obtained using William's graduated periodontal probe with the same principles for detecting probing depth as shown in figure (2) section (III).

F-Clinical attachment level (CAL)

CAL was measured from cemento-enamel junction to the base of the pocket. Measurements had been obtained using William's graduated periodontal probe with the same principles for detecting probing depth as shown in figure (2) section (III).

Periodontal chart

1- Administrative chart:

-Name: --------------------------------------

-Age: --

-Sex: --

-Address: -----------------------------------

-Occupation: -------------------------------------

-Marital status: -----------------------

2- Past & present medical history:

-Are you undergoing any medical treatment? Yes □   No□

If yes --

-Are you taking any medication? -----------------

-Is there any history of previous hospitalization, surgeries, medicines taken for a long period of time or history of allergy?

-For female patients, are you pregnant? Yes□   No□

-Are you diabetic?   Yes□   No□

3- Past dental history:

When was your last periodontal treatment? -------------------------------------

4- Family history:

Is there any diseases running in the family? Yes □   No□

If yes ---------------------------------------

5- Personal habits:

-Smoking   Yes □   No□

-Teeth grinding or bruxism   Yes□   No□

-Tongue thrusting   Yes□   No□

-Mouth breathing   Yes□   No□

6- Oral hygiene habits:

Daily tooth brushing or the use of other oral hygiene aids: -------------------------------------

Figure (2) section (I): oral diagnosis charts of Periodontology department, Faculty of Oral and Dental Medicine, Cairo University.

Periodontal tissue examination:

- **Gingiva:**

    Color: ……………………………….

Contour: …………………………….
Consistency: …………………………
Form: …………………………..
Surface texture: …………………………..

- **Plaque index:**

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

- **Gingival index:**

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
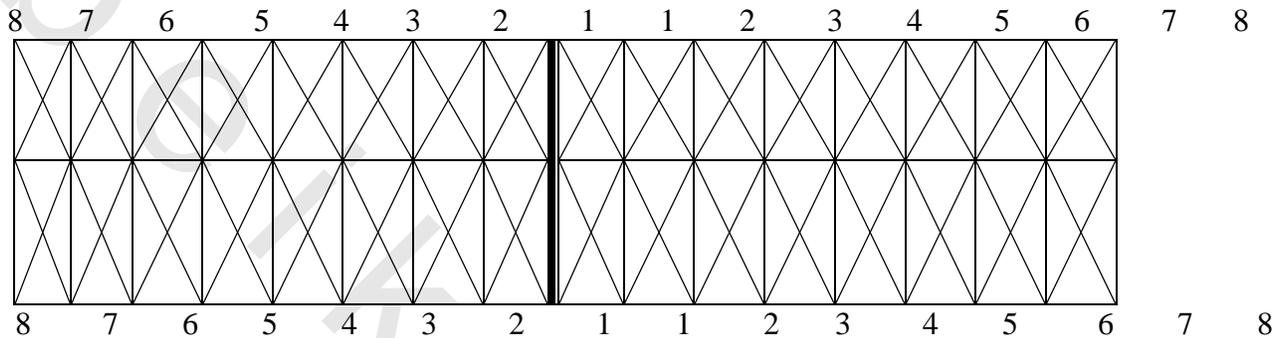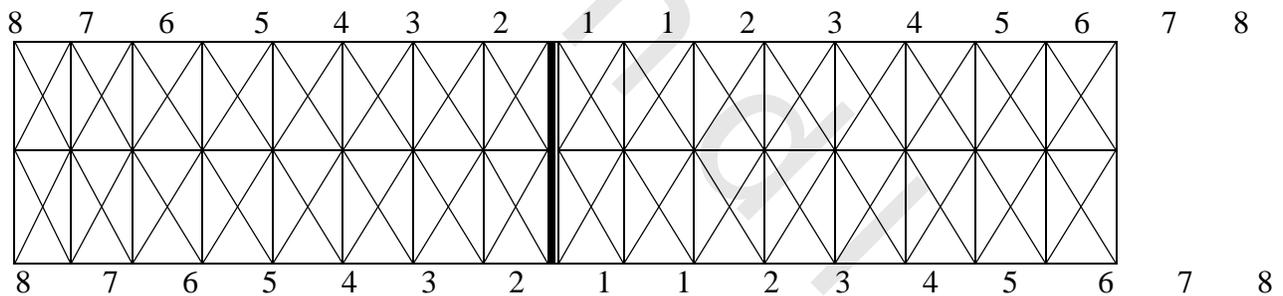
Figure (2) section (II): oral diagnosis charts of Periodontology department, Faculty of Oral and Dental Medicine, Cairo University.

- **Probing depth:**

8   7   6   5   4   3   2   1   1   2   3   4   5   6   7   8

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7

8

- **Gingival recession:**

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7

8

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7

8

- **Attachment loss:**

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7

8

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7

8
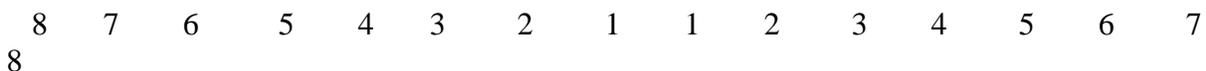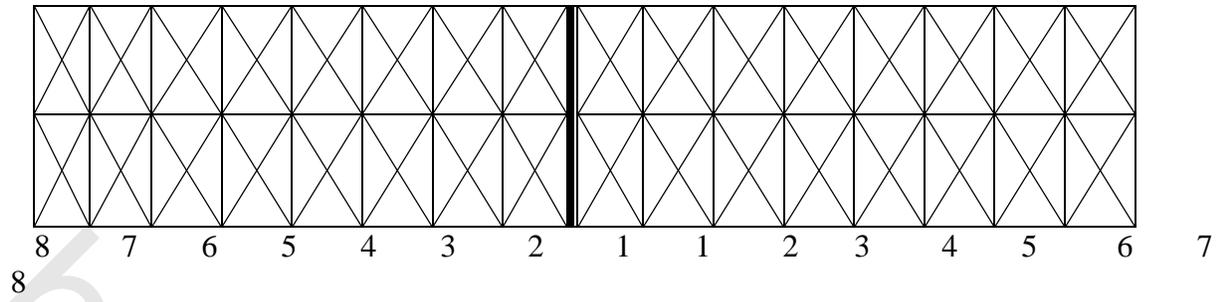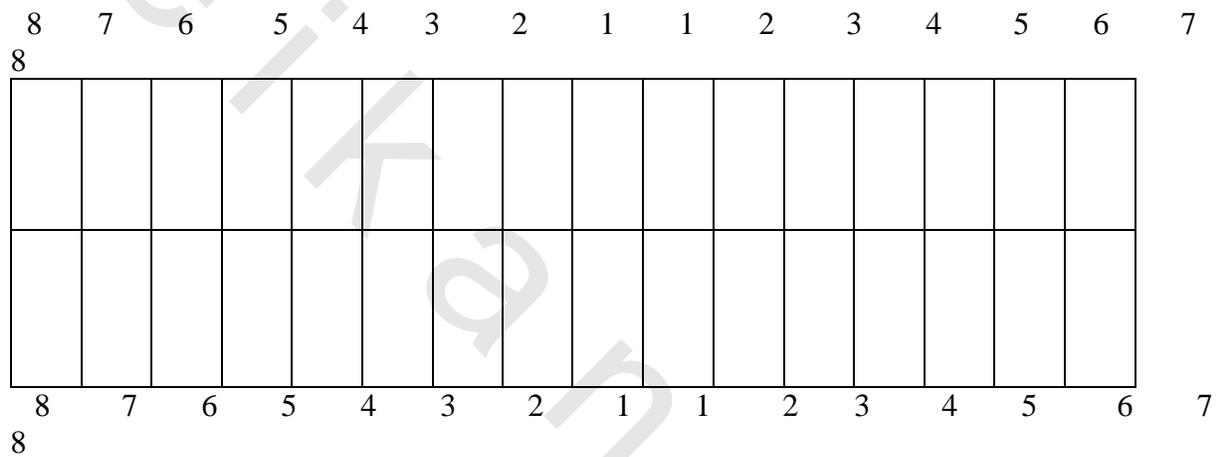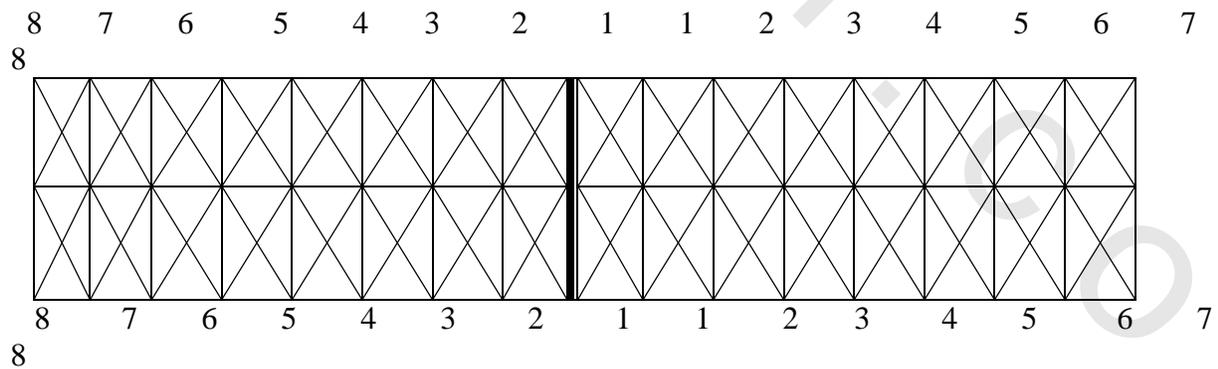
Figure (2) section (III): Oral diagnosis charts of Periodontology department, Faculty of Oral and Dental Medicine, Cairo University.

- **Second category:**

2-Radiological examination:

Full mouth periapical radiographs had been taken using the long cone parallel technique at the time of the initial examination to confirm diagnosis of chronic periodontitis.

- **Third category:**

3- Periodontal treatment:

At base line, after complete clinical and radiographic examination all patients were received:

a- Oral hygiene instructions.

b- Full mouth supragingival scaling and subgingival clinical debridement in 3-4 sessions.

- **Fourth category**

4-Saliva collection:

Unstimulated whole expectorated saliva were collected from control subjects and periodontally diseased subjects before periodontal therapy and 2 & 4 months after performing scaling and root planning. Subjects were rinsed their mouth with tap water, and then expectorate whole saliva into sterile tubes while seated in an upright position. Collected samples were placed immediately on ice and stored by freezing at -80 °C.

- **Fifth category:**

5-Total salivary Glutathione level:

- This part of the study procedure was done on the lab by the laboratory using kinetic enzymatic recycling assay according to manufacturers' instructions.

   a) **Sample Preparation**

   o Saliva samples were centrifuged at 4000g for 10 minutes and the supernatant was separated and kept frozen at -80 °C till analysis of glutathione.

   o Glutathione was determined in saliva supernatant fluid according to the method of *(Beutler et al., 1963)*.

   b) **Principle:**

   The method based on the reduction of 5, 5` dithiobis (2 - nitrobenzoic acid) (DTNB) with glutathione (GSH) to produce a yellow compound. The reduced chromogen directly proportional to GSH concentration and its absorbance can be measured at 405 nm.

   c) **Reagents:**

   1. Trichloroacetic acid (TCA) 500 mmol / L

   2. Buffer 100 mmol / L

   3. DTNB 1.0 mmol / L

d) Procedure:

0.5 ml of supernatant was added to 0.5 ml of reagent 1 Then mixed well, allowed to stand for 5 min. at room temperature then centrifuged at 2000rpm for 10 min. then supernatant was added to 1ml of reagent 2 and 1ml reagent 3 were mixed well. The absorbance was read after 10 min. at 405 nm of sample (ASample) against the blank.

e) Calculation of results:

Concentration of GSH in saliva = ASample X 66.66

Fig (3): 36 years old non smoker male suffering from chronic periodontitis
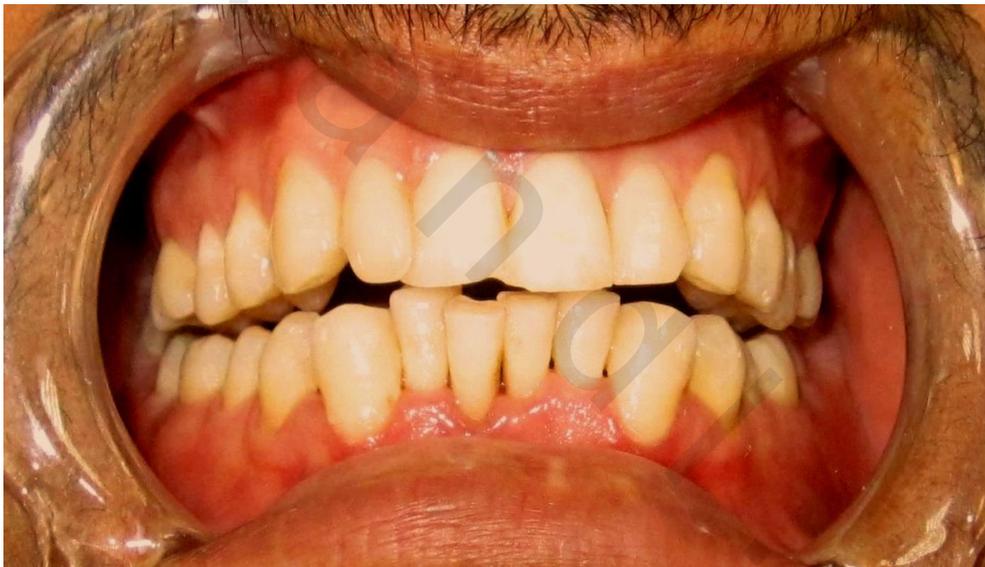
Fig (4): Same case after 4 months of scaling and root planning.

RESULTS

The purpose of this study was to evaluate the effect of smoking and periodontal disease on concentration of total glutathione in saliva and to investigate the effect of mechanical subgingival debridement on salivary glutathione level.

I- Physical Characteristics of the Subjects:

In this study, two main categories were included. Category A (periodontitis patients) was involving 30 patients with chronic moderate to severe periodontitis, they was divided into two groups equal in numbers as nonsmokers and smokers.

Category B (Control individuals): was involving ten individuals with healthy periodontium.

Table (10): Physical characteristics of patients in both categories (A&B).

Items	Periodontitis (Category A)		Control (Category B)		Comparison		S
	Mean	±SD	Mean	±SD	t-value	P-value	
Age (yrs)	40.6	±10.43	30.3	±3.6	0.45	0.65	NS
Weight (Kg)	73.46	±13.4	68.73	±13.01	0.98	0.33	NS
Height (cm)	164.46	±9.1	163.06	±11.45	0.37	0.71	NS
BMI(Kg\m^2)	27.24	±3.11	25.85	±3.71	1.1	0.27	NS

Category A (Periodontitis patients):

Thirty patients were included in this category. The data in table (10) represented their mean age (40.6±10.43) years Fig.(5), mean weight (73.46±13.4) kilograms (Kg) Fig.(6), mean height (164.46±9.1) centimeters (cm) Fig.(7), and mean BMI (27.24±3.11) Kg\m^2 Fig.(8).

Category B (Control individuals):

Ten individuals were included in this category. The data in table (10) represented their mean age (30.3±3.6) years Fig.(5), mean weight (68.73±13.01) kilograms (Kg) Fig.(6), mean height (163.06±11.45) centimeters (cm) Fig.(7), and mean BMI (25.85±3.71) Kg\m^2 Fig.(8).

There was no significant difference between both categories in their ages, weights, heights, and BMI where their t and P-values were (0.45, 0.65), (0.98, 0.33), (0.37, 0.71), and (1.1, 0.27) respectively (P-values considered significant if P < 0.05)
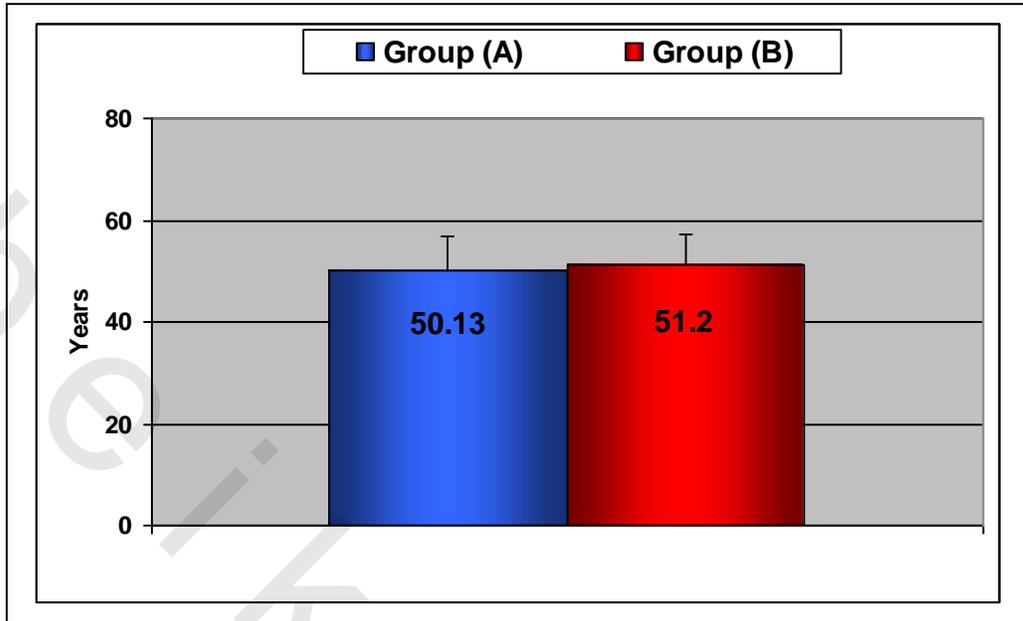
Fig. (5): Mean and ±SD of the age for both categories (A, B).
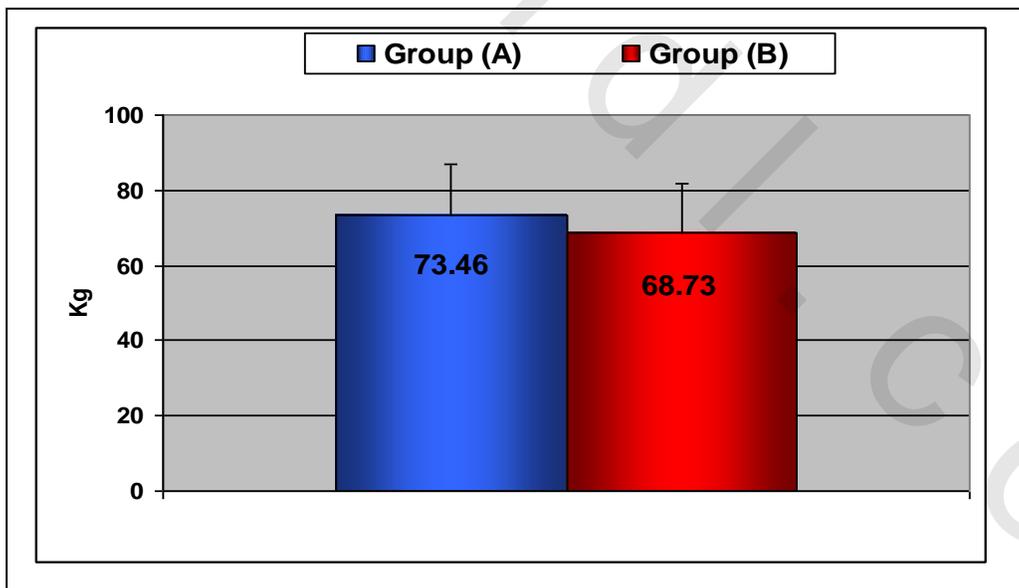
Fig. (6): Mean and ±SD of the weight for both categories (A, B).
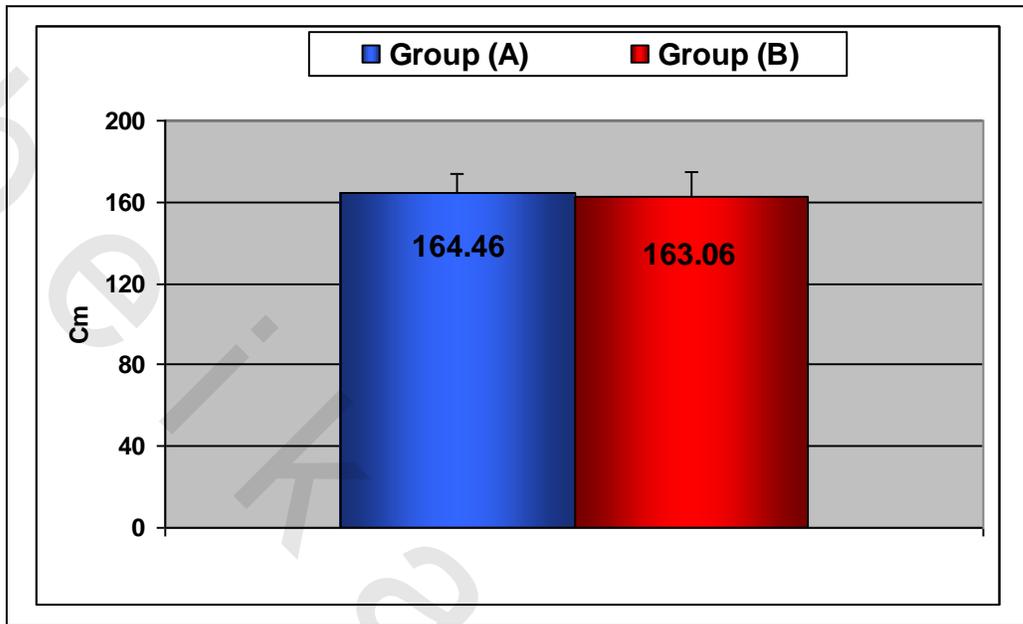
Fig. (7): Mean and ±SD of the height for both categories (A, B).
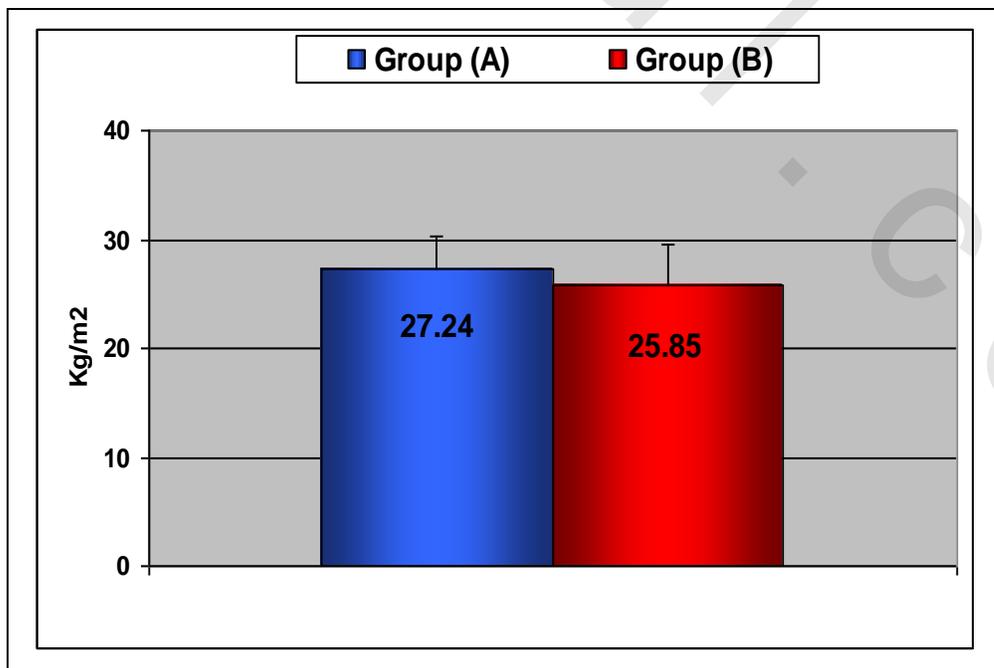
II- Analysis of Glutathione Level in chronic periodontitis patients and healthy control

Table (11): Mean and ±SD, t and P values of glutathione levels in chronic periodontitis patients and healthy controls

Items	Periodontitis (Category A)		Control (Category B)	
	Mean	±SD	Mean	±SD
Glutathione Level	6.5	± 1.9	2.39	±.465
P-value	0.0001			
Significant	S			

*SD: standard deviation, P: probability, S: significance, S: significant

Table (11) demonstrated the means and standard deviation of glutathione level in saliva in chronic periodontitis patients and healthy control subjects. There was a significant difference in the Mann Whitney test between chronic periodontitis patients and healthy control subjects as the mean value glutathione in chronic periodontitis patients were (6.5± 1.9) and from healthy control subjects were (2.39±.465) where the P-value was (0.0001) (Fig.9).
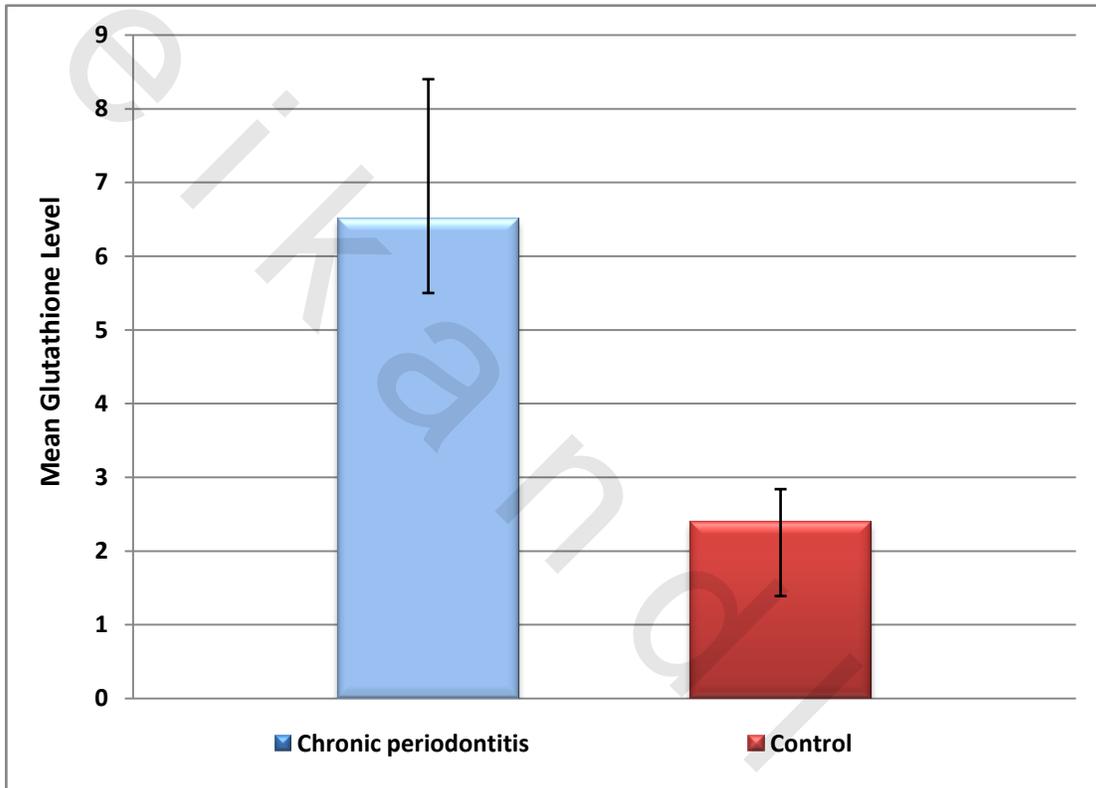
Fig (9): Mean and ±SD Glutathione Levels in Chronic Periodontitis and Control Group

III- **Comparison of the glutathione level between non smokers and smokers with chronic periodontitis before and after periodontal therapy (after scaling and root planning):**

Table (12): Mann-Whitney test between smokers and non smokers with chronic periodontitis for glutathione level pre and post treatment.

Mann-Whitney	Glutathione Level		
	Pre	2 months after treatment	4 months after treatment
Non Smokers with chronic periodontitis (Mean±SD)	4.91±1.003	3.79±1.18	3.053333± 0.83
Smokers with chronic periodontitis (Mean±SD)	8.15±1.28	4.714± .9503067	3.553333± 0.78
P-value	0.001	0.03	0.001
S	S	S	S

Table (12) revealed the Mann Whitney test results for the glutathione levels pre and post treatment between non smokers and smokers with chronic periodontitis. There was slight significant difference in pre treatment values where p-value was (0.001). And there was a significant difference 2 months after treatment with p-values (0.03) and also there was significant difference 4 months after treatment with p-value (0.001) (Fig. 10).
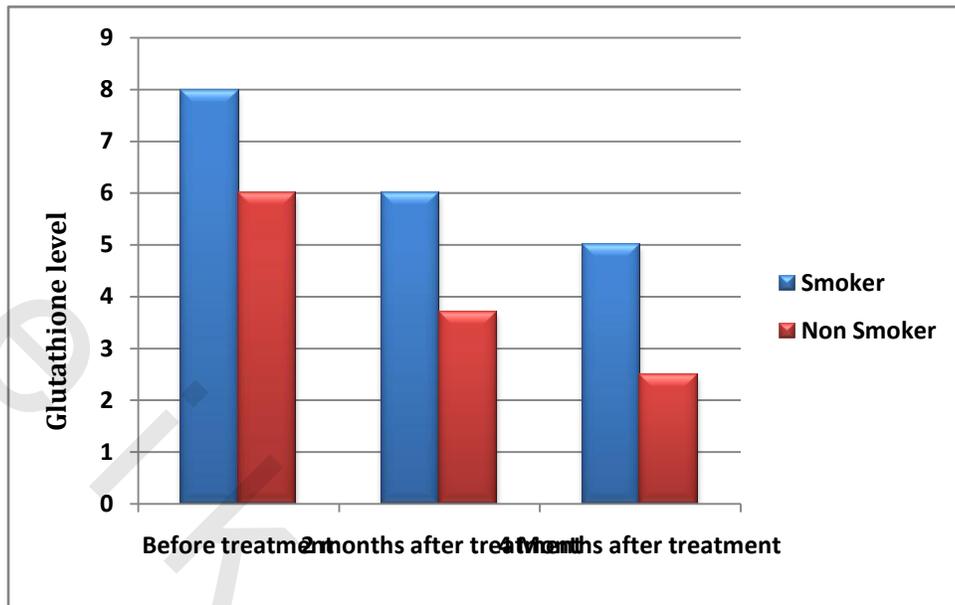
Fig. (10): Mean of Glutathione level pre and post treatment of both groups (smokers and non smokers with chronic periodontitis)

IV- Comparison of the Glutathione Levels and clinical parameters at Pre and Post periodontal Treatment in Each Group:

A-Comparison of Glutathione level, PI, GI, Mean PPD, Mean CAL and Mean Recession in the Smoker periodontitis group at pre and post treatment:

Table (13): Mean and ±SD and P values of Glutathione level, PI, GI, Mean PPD, Mean CAL and Mean Recession pre and post treatment of Smoker Periodontitis.

Smoker Periodontitis Group		Mean	±SD	P-value	S
Glutathio ne	Pre treatment	8.153	±1.28	0.0007	S
	Post treatment	3.553	±0.7881		
PI	Pre treatment	2.422	±0.272	0.0007	S
	Post treatment	0.7993	±0.249		
GI	Pre treatment	2.124	±0.299	0.0007	S
	Post treatment	0.7533	±0.1843		
PPD	Pre treatment	2.99	±0.977	0.0007	S
	Post treatment	1.626	±0.429		
CAL	Pre treatment	4.982	±1.242	0.0007	S
	Post treatment	3.170	±0.6800		
Mean	Pre treatment	2.109	±0.866	0.0007	S

Recession	Post treatment	**1.976**	**±0.9473**		

Table (13) demonstrated the Glutathione Level pre and post treatment for smoker periodontitis group. There was a significant difference in the Wilcoxon signed-rank test between pre and post treatment. As the mean value of glutathione level pre treatment was (8.153±1.28) and for post treatment was (3.553±0.7881) where the P-value was (0.0007).

Also in Table (13) demonstrated the clinical parameters pre and post treatment for smoker periodontitis group. There was a significant difference in the Wilcoxon signed-rank test between pre and post treatment in all the clinical parameters with P value equal to (0.0007).

B-Comparison of Glutathione Level, PI, GI, Mean PPD, Mean CAL and Mean Recession in the Non-Smoker periodontitis group at pre and post treatment:

Table (14): Mean and ±SD and P values of Glutathione level, PI, GI, Mean PPD, Mean CAL and Mean Recession pre and post treatment of Non-Smoker Periodontitis.

Nom-Smoker Periodontitis Group		Mean	±SD	P-value	S
Glutathione	Pre treatment	4.913	± 1.003	0007	S
	Post treatment	3.053	±.8373		
PI	Pre treatment	1.62	±.30912	0.0007	S
	Post treatment	.7073	±.2735		
GI	Pre treatment	1.706	±.5592	0.0007	S
	Post treatment	.806	±.3389		
PPD	Pre treatment	2.421	±.3732	0.0007	S
	Post treatment	1.575	±.1789		
CAL	Pre treatment	3.547	±.897	0.0007	S
	Post treatment	2.578	±.525		
Mean Recession	Pre treatment	1.418	± .6825	0.0007	S
	Post treatment	1.268	±.8547		

Table (14) demonstrated the Glutathione Level pre and post treatment for non-smoker periodontitis group. There was a significant difference in the Wilcoxon signed-rank test between pre and post treatment. As the mean value of glutathione level pre treatment was (4.913± 1.003) and for post treatment was (3.053   ±.8373) where the P-value was (0.0007).

Also in Table (14) demonstrated the clinical parameters pre and post treatment for non-smoker periodontitis group. There was a significant difference in the Wilcoxon signed-rank test between pre and post treatment in all the clinical parameters with P value equal to (0.0007).

V- **Comparison of the clinical parameters between Smokers and non smokers with chronic periodontitis following periodontal therapy (after scaling and root planning):**

A) **Comparison of Plaque index (PI) between Smokers and non smokers with chronic periodontitis following periodontal therapy:**

Table (15): Mann-Whitney test between Smokers and non smokers with chronic periodontitis following periodontal therapy for Plaque index (PI)

Mann-Whitney	Plaque Index	
	Pre	Post
Smokers with chronic periodontitis (Mean±SD)	2.42±.27	0.79±0.24
Non Smokers with chronic periodontitis (Mean±SD)	1.62±0.32	0.70±0.27
P-value	0.01	0.08
S	S	NS

Table (15) revealed the Mann-Whitney test results for the Plaque Index pre and post treatment between smoker and non smokers with chronic periodontitis. There was slight significant difference in pre treatment values where p-value was (0.01). But there was no significant difference after treatment with p values (0.08) (Fig. 11).
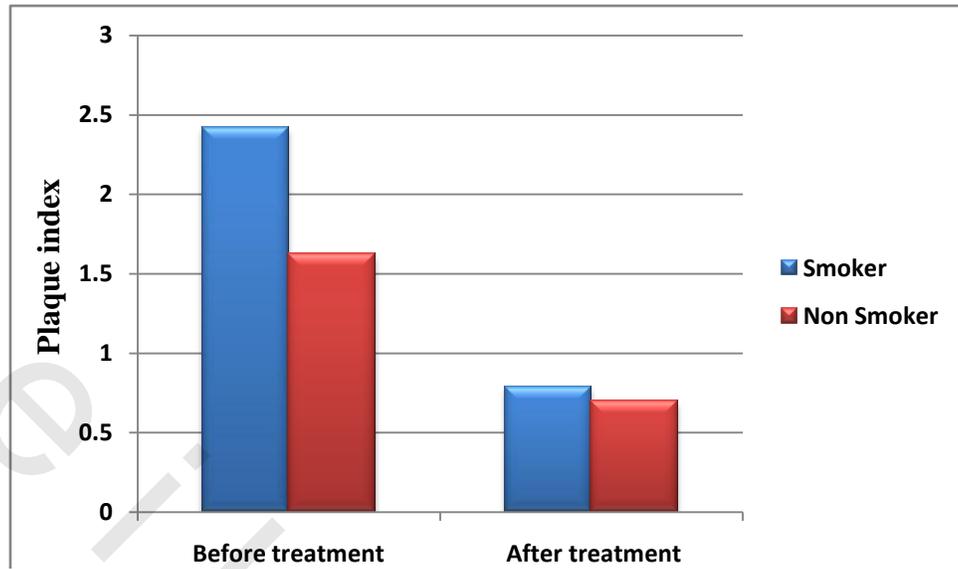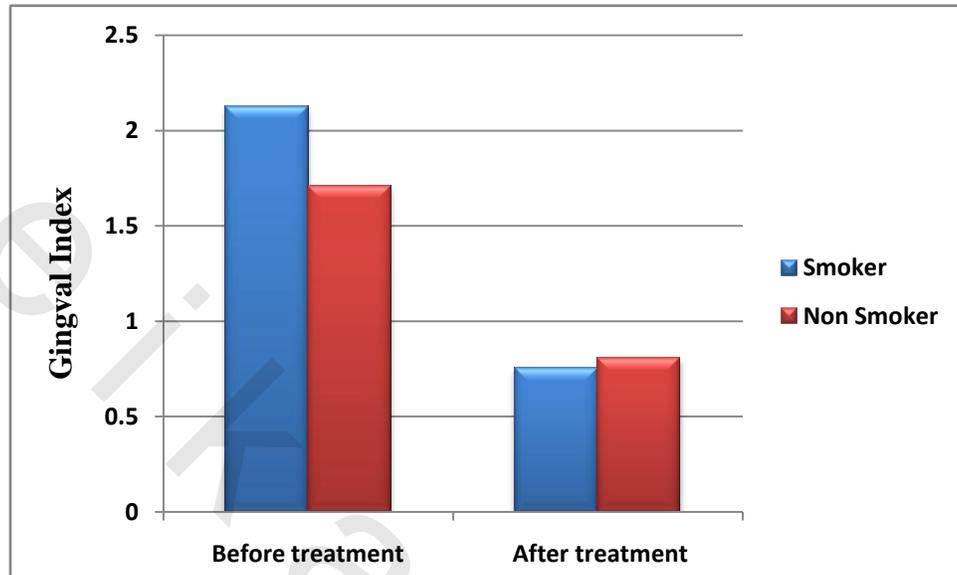
Fig.(11): Mean of PI pre and post treatment of both groups (smokers and non smokers with chronic periodontitis)

B) Comparison of Gingival Index (GI) between smokers and non smokers with chronic periodontitis following periodontal therapy:

Table (16): Mann-Whitney test between smokers and non smokers with chronic periodontitis following periodontal therapy for Gingival Index (GI)

Mann-Whitney	Gingival index	
	Pre	**Post**
Smokers with chronic periodontitis (Mean±SD)	2.124±0.299	0.7533±0.184
Non Smokers with chronic periodontitis (Mean±SD)	1.706± 0.559	0.806±0.338
P-value	0.01	0.02
S	**S**	**S**

Table (16) revealed the Mann-Whitney test results for the Gingival Index pre and post treatment between smoker and non smokers with chronic periodontitis. There was significant difference in pre treatment values where p-value was (0.01). And there was a significant difference after treatment with p values (0.02) (Fig. 12).
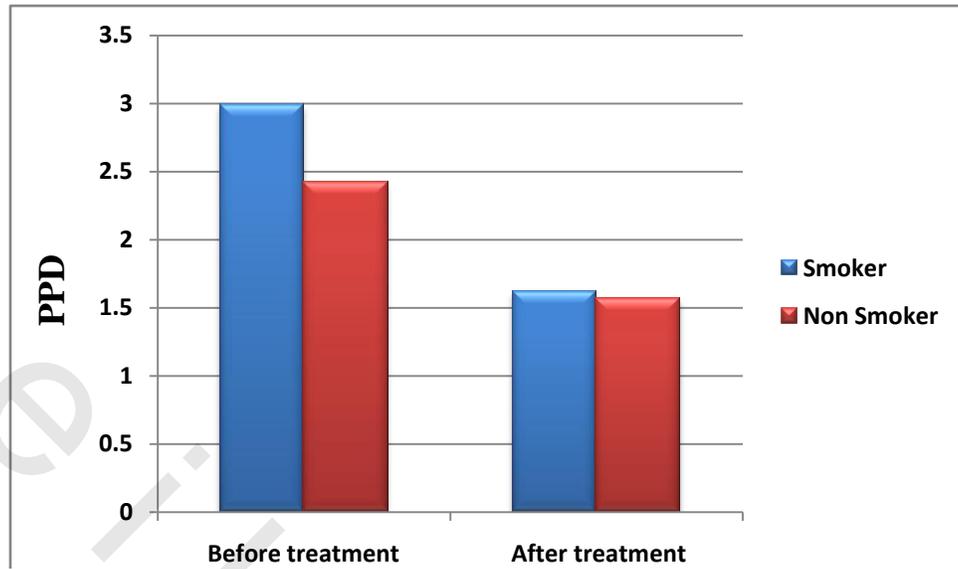
Fig.(12): Mean of GI pre and post treatment of both groups (smokers and non smokers with chronic periodontitis)

C) **Comparison of Mean PPD between Smokers and non smokers with chronic periodontitis following periodontal therapy:**

Table (17): Mann-Whitney test between Smokers and non smokers with chronic periodontitis following periodontal therapy for Probing Pocket Depth (PPD)

Mann-Whitney	Probing Pocket Depth (mm)	
	Pre	Post
Smokers with chronic periodontitis (Mean±SD)	2.99±0.977	1.62±0.429
Non Smokers with chronic periodontitis (Mean±SD)	2.42± 0.373	1.57± 0.178
P-value	0.03	0.01
S	S	S

Table (17) (Fig.13).revealed the Mann Whitney test results for the PPD pre and post treatment between smoker and non smokers with chronic periodontitis. There was significant difference in pre treatment values where p-value was (0.03). And there was a significant difference after treatment with p-values (0.01).
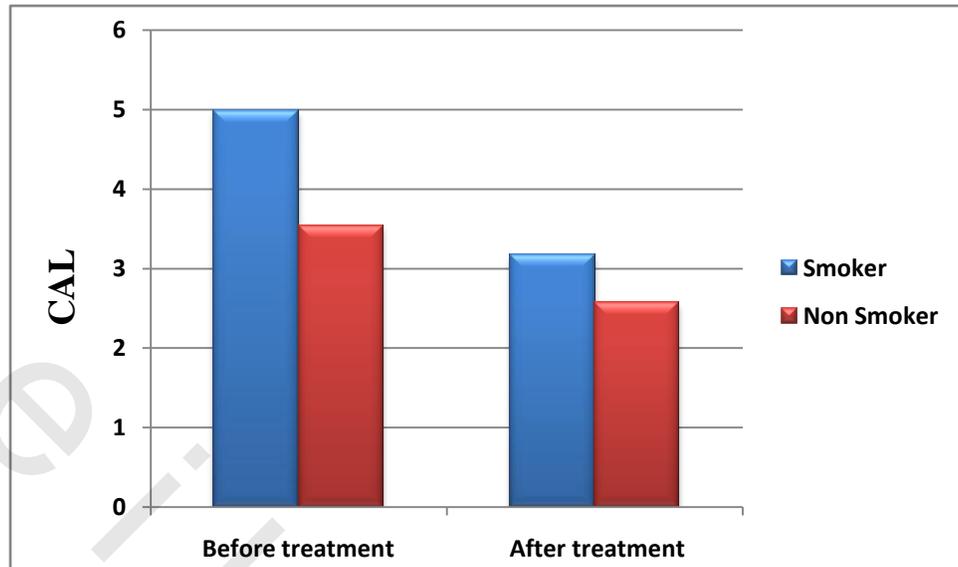
Fig.(13): Mean of PPD pre and post treatment of both groups (smokers and non smokers with chronic periodontitis)

D) **Comparison of Mean CAL between Smokers and non smokers with chronic periodontitis following periodontal therapy:**

Table (18): Mann-Whitney test between Smokers and non smokers with chronic periodontitis following periodontal therapy for Clinical attachment loss (CAL)

Mann-Whitney	Clinical attachment loss (mm)	
	Pre	Post
Smokers with chronic periodontitis (Mean±SD)	4.98 ± 1.24	3.17 ±0.68
Non Smokers with chronic periodontitis (Mean±SD)	3.54± 0.897	2.57 ± 0.525
P-value	0.001	0.01
S	S	S

Table (18) (Fig.14).revealed the Mann Whitney test results for the CAL pre and post treatment between smoker and non smokers with chronic periodontitis. There was significant difference in pre treatment values where p-value was (0.001). And there was a significant difference after treatment with p values (0.01).
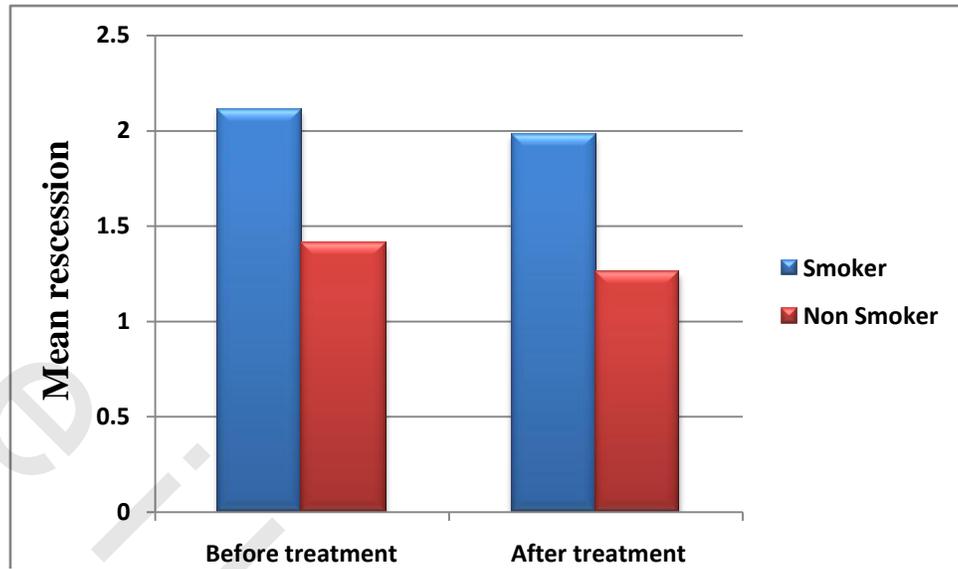
Fig.(14): Mean of CAL pre and post treatment of both groups (smokers and non smokers with chronic periodontitis)

E) Comparison of Mean Recession between Smokers and non smokers with chronic periodontitis following periodontal therapy:

Table (19): Mann-Whitney test between Smokers and non smokers with chronic periodontitis following periodontal therapy for Mean Recession

Mann-Whitney	Mean Recession	
	Pre	Post
Smokers with chronic periodontitis (Mean±SD)	2.109 ±0.866	1.976±0.947
Non Smokers with chronic periodontitis (Mean±SD)	1.41 ± 0. 682	1.26± 0.854
P-value	0.03	0.01
S	S	S

Table (19) (Fig.15).revealed the Mann Whitney test results for the Mean Recession pre and post treatment between smoker and non smokers with chronic periodontitis. There was significant difference in pre treatment values where p-value was (0.03). And there was a significant difference after treatment with p values (0.01).

Fig.(15): Mean Recession pre and post treatment of both groups (smokers and non smokers with chronic periodontitis)