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RESEARCH ARTICLE

CLINICAL IMPACT OF DIODE LASER ON TRUENESS, PRECISION, AND QUALITY OF LIFE OF COMPLETE DENTURE WEARERS (CLINICAL STUDY)

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Abstract

Background: Candida Albicans (*C. albicans*) is a major fungal infection affecting the majority of complete denture wearers and causes denture stomatitis (DS) which has many local treatment modalities, such as Chlorohexidine mouthwash and the Diode Laser. Their clinical impact on denture Accuracy, Retention, and the Patient's ability to utilize dentures normally has not yet been discussed. Hence, a complete denture's Accuracy titled Trueness and Precision is a vital hidden key for achieving its success post-disinfection.

Objectives: This study's objective was to evaluate and compare Diode Laser and Chlorhexidine mouthwash's impact on Trueness, Precision, Retention, and the Patient's oral health-related quality of life (OHRQoL) in complete denture wearers.

Materials and Methods: An overall of 16 complete edentulous patients were elected, dentures constructed from Heat-cure acrylic resin, and grouped equally owing to the antifungal disinfectant employed into Group I (Diode Laser) and Group II (Chlorhexidine). Assessments were carried out pre- and post-disinfectant application in both groups. The Pre-Disinfectant assessments of Trueness and Precision took place before delivery whereas, those of Retention and OHRQoL were carried out immediately post-delivery. All the Post-Disinfectant assessments were carried out 60 days following delivery.

Results: There was an insignificant difference between Diode Laser and Chlorhexidine mouthwash regarding Trueness, Precision, Retention, and OHRQoL in maxillary complete dentures.

Conclusion: It has been concluded that the Diode Laser beam and the 2% Chlorhexidine mouthwash are safe antifungal Heat-cure CD disinfectants regarding Trueness, Precision, Retention, and the OHRQoL.

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Introduction:-

Aging inhabitants' augmentation is correlated to extended life expectancy. The edentulism most recent rates exceed 69 percent of the adult population globally, and geriatrics comprise the majority. Even though, the advancement of

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implant treatments and the versatility of innovative approaches for tooth substitution and enduring oral structure conservation, the Poly methyl methacrylate (PMMA) complete denture bases are still in demand and are currently fabricated. Although the variable procedures employed for complete denture (CD) construction comprise chemicals, light, heat, milling, sandblasting, thermo-pressing, and computer numerical control (CNC), the traditionally fabricated heat-cure CD is still frequently employed^(1,2).

A wide range of CD patients frequently grieve from multiple oral complications such as; Denture stomatitis (DS) which is clarified as a chronic inflammatory syndrome accompanying CD candidates' palatal mucosa. The existence and evolution of DS is multifactorial where *Candida albicans* (*C. albicans*) is the chief contributing pathogen that adheres to both mucosal and denture surfaces together with numerous predisposing reasons. Deprived oral and denture hygiene, xerostomia, and ill-fitting dentures are local factors. Whereas, systemic influences comprise senility, prolonged intake of corticosteroids and broad-spectrum antibiotics, organ transplantation, diabetes, immune suppression, and malignancy^(3,4).

The deprived denture sanitation allows CD hibernation to a wide scale of microbes, pathogens, and fungi as permitting *C. albicans* colonization which induces DS, sequentially denture hygiene is crucial. The optimum oral and denture hygiene by *C. albicans* biofilm breakdown can be achieved by enormous methods. Mechanically by denture brushing beneath running tap water and chemically by employing mouth rinses such as; Ozonated water and Chlorhexidine mouthwash or gels as Nystatin oral gel besides denture nocturnal withdrawal, soaking in a sanitizing solution, and changing if poorly fitted are models of conventional therapies. Whereas, denture disinfection with a microwave, Blue LED light in a visible spectrum of 405nm wavelength, Low-Level Laser Treatment (LLLT), and Diode Laser have a swiftly fungicidal impact on *C. albicans* by inhibiting its biofilm construction on the prosthesis surface than the conventional methods⁽⁵⁻⁷⁾.

Even though Chlorhexidine mouthwash is a conventional therapy, it is realized as the gold standard anti-fungal agent for its vastly prevalent broad-spectrum anti-pathogenic impact in controlling plaque and accordingly diminishing *C. albicans* colonization. Lately, the Diode Laser has attained general popularity in dentistry and precisely in removable prosthodontics for its numerous merits such as; minimal invasiveness, diminished size, invisible, superior exactness, vibrationless, effortlessness, and wavelength versatility (810-980 nm). Furthermore, its capability for inducing negligible discomfort, rapid curing, avoiding direct soft or hard tissue contact, and minimizing denture tissue surface porosity are auxiliary qualities that sequentially demarcate its fungicidal impact. Consecutively, the Diode Laser has been considered one of the recent eccentric antifungal therapies by abolishing *C. albicans* biofilm⁽⁷⁻⁹⁾.

Complete denture effectiveness and clinical success is a frequently prevalent multifactorial challenge among fully edentulous individuals seeking rehabilitation. Possessing means of accuracy, retention, support, stability, functionality, comfort, aesthetics, and hygiene are critical successful signs. Owing to the International Organization for Standardization (ISO 5725-1) Accuracy embraces Trueness and Precision. The digital defining of the discrepancy between the scan dimensions and the similar object's exact value provides Trueness, while the digital approximation of the object's test scans to each other affords Precision. Denture's superior retention not only vastly enhances muscle activity but also remarkably progresses chewing efficiency, denture functionality, and guaranteeing an exceedingly satisfying prosthesis^(10,11).

Moreover, Oral health-related quality of life (OHRQoL) is a subjective valuation of an individual's corporal, public, and emotional welfare by demonstrating his overall health, and health-related quality of life, as well as signifies clinical research's massive consequences. A reliable, effective, satisfactory, and the most extensively employed OHRQoL questionnaire is the OHIP-14 (Oral Health Impact Profile) embracing fourteen self-rated sections and is split into seven fields. Even though the superior impact of variable denture fungicidal hygienic methods in abolishing *C. albicans* biofilm, they vastly affect the denture's Physiomechanical criteria, thus the CD's effectiveness, success, and patient's quality of life are remarkably intimidated^(3,12).

Sequentially, the existing consideration was meant to evaluate and compare the Diode Laser and chlorhexidine mouthwash's impact on Trueness, Precision, Retention, and the OHRQoL in CD candidates. It was hypothesized that the Diode Laser exposure as a recent antifungal denture disinfectant was much better than the Chlorhexidine mouthwash one regarding Trueness, Precision, Retention, and OHRQoL for Heat-cure maxillary CD patients.

Patients and Methods:-**Materials:-**

1. Alginate Impression Material (Cavex; Fustweg 5, 2031 CJ Haarlem, Holland, The Netherlands).
2. Dental plaster (Type 3 model dental stone; Elite Rock Stone- Zhermack Clinical, Italy).
3. Separating Medium (Acrostone Cold Cure, Acrostone Dental and Medical Supplies, Cairo, Egypt).
4. Pink Wax (Cavex set up wax; Fustweg 5, 2031 CJ Haarlem, Holland, The Netherlands).
5. Self-Cure Acrylic-Resin (Acrostone Cold Cure, Acrostone Dental and Medical Supplies, Cairo, Egypt).
6. Green Stick Compound (Pyrax Tracing Sticks; PyraxPolymars, 1142/2, Krishan Kunj, 7 Civil Lines, Roorkee-247667, (UK.) India).
7. Zn/O Eugenol Impression Material (Cavex; Fustweg 5, 2031 CJ Haarlem, Holland, The Netherlands).
8. Type IV Dental Stone (Type 4 model dental stone for models in a removable prosthesis; Elite Rock Stone-Zhermack Clinical, Italy).
9. Heat-Cure Acrylic-Resin (Acrostone Cold Cure, Acrostone Dental and Medical Supplies, Cairo, Egypt).
10. Acrylic Resin Teeth (Vita-Pan Acrylic Teeth, Vita Bad Sackingen, Germany).
11. Diode Laser (Lasotronix, Diode Laser DiodeLX model, Electroniczna 2A,05-500 Piaseczno, Poland).
12. Chlorhexidine mouthwash (Anabond Stedman (AnabondAsep-Rc); 2% Chlorhexidine Gluconate Solution, Primera Dental, Bangalore, Karnataka, India).

Study Design:

Complete dentures were constructed for sixteen healthy middle-aged (40-50) male completely edentulous patients from heat-cure acrylic resin denture base material. All patients were given the usual home care instructions about wearing, caring, and disinfecting their dentures. Grouping was based on the antifungal disinfectant utilized in Group I (Diode Laser) and Group II (Chlorhexidine) and each group comprised 8 patients. Assessments of Trueness and Precision, for both groups patients' maxillary dentures took place earlier to denture insertion (Control). The Retention and the OHRQoL assessment for all patients' maxillary dentures were carried out immediately after insertion (Control). Furthermore, all the assessments took place next to delivery within 60 days (Modified). All the outgoing measurements for patients in both groups were assembled and compared.

Ethical Approval:

The recent investigation has been stratified to the "Code of Ethics of the World Medical Association", succeeding the ethics definite in the Declaration of Helsinki in 1975. This consideration has been legalized by the "Medical Research Ethical Committee of the National Research Centre, Cairo, Egypt" with contract number 03410724. All participants were frequently notified of all the prevailing study's practical stages and contracted the final consent.

Sample Size Calculation:

The sample size was assessed based on preceding research as a reference ⁽²⁾. Accordingly, the nominally permissible sample size was 6 patients for every group (12 patients in both groups), the mean \pm standard deviation of Retention next to 1 month in group I was 14.75 ± 0.89 while the valued mean difference with the other group was 1.25, with 80% and 0.05 type I error probability. Thus, the total sample size was expanded to 8 patients for each group to reward the 25% dropout.

Patient's Grouping:

This research comprised a total number of 16 patients who were arbitrarily divided into two groups. Grouping was created on the antifungal disinfectant utilized in Group I (Diode Laser) and Group II (Chlorhexidine) as each group comprised 8 patients; (8 patients/Group). Each group was further subdivided owing to the assessment timing applied into 2 main subgroups; **Pre-Disinfection (Control)** and **Post-Disinfection** where each included 4 assessments; Trueness, Precision, Retention, and OHRQoL. Were all the assessments applied Pre-and Post-denture disinfection on the 8 patients in each group as follows;

Group I(Diode Laser): 8 patients whose dentures were disinfected by 980 nm Diode Laser beam.

Group II(Chlorhexidine): 8 patients whose dentures were disinfected by 2% Chlorhexidine mouthwash.

Inclusion and Exclusion Criteria:

The inclusion criteria comprised completely edentulous male patients aged 45-50 years with well-developed ridge, regular bone anatomy, firm attached overlying mucosa, Kennedy class I maxillary arch, and their oral mucous membrane was sound, healthy, and free from any fungal or bacterial infections. Nevertheless, smokers,

uncooperative and non-systemically free participants besides those with immunosuppressive illnesses, TMJ syndromes, parafunctional habits, and radiotherapy or chemotherapy history were entirely excluded.

Methods:-

Patients' Examination:

Along with appropriate patient selection, proper clinical intra- and extra-oral examinations were performed. Also, the patient's personal, medical, and dental history were documented, together with their versatile clinical examinations to explore any inflammatory conditions including the tongue, mucous membrane, and remaining ridges of the oral cavity.

Complete Denture Construction:

Upper and lower primary impressions were constructed for each patient consuming a suitable-sized stock tray and acceptably intermingled an alginate impression material (**Cavex; Fustweg 5, 2031 CJ Haarlem, Holland, The Netherlands**) ensuring the manufacturer's guidelines. The attained final impression was poured with dental plaster type 3 (**Type 3 model dental stone; Elite Rock Stone- Zhermack Clinical, Italy**) establishing the primary cast which was then coated with a very fluffy film of separating medium (**Acrostone Cold Cure, Acrostone Dental and Medical Supplies, Cairo, Egypt**) and a sheet of pink wax (**Cavex set up wax; Fustweg 5, 2031 CJ Haarlem, Holland, The Netherlands**) as a spacer which was reduced 2 mm all-around the vestibular areas. An adequate amount of self-cure acrylic resin (**Acrostone Cold Cure, Acrostone Dental and Medical Supplies, Cairo, Egypt**) was then mixed owing to the manufacturer's instructions, placed and adjusted on the whole assembly forming the special tray.

Each special tray was inspected for any sharp edges, and then border molding was performed employing green stick compound (**Pyrax Tracing Sticks; PyraxPolymers, 1142/2, Krishan Kunj, 7 Civil Lines, Roorkee-247667, (UK.) India**) and any pressure areas were adequately scratched prior to the secondary impression which was then fabricated utilizing the zinc oxide and eugenol (Zn/O Eugenol) impression paste (**Cavex; Fustweg 5, 2031 CJ Haarlem, Holland, The Netherlands**). Sequentially, type IV dental stone (**Type 4 model dental stone for models in removable prosthesis; Elite Rock Stone- Zhermack Clinical, Italy**) was mixed based on the manufacturer's directions and poured into the final impression after its boxing at room temperature then master cast was obtained, through which the occlusion bite blocks were fabricated by employing a thin coat of separating medium and accustoming a satisfactory mixed quantity of self-cure acrylic resin on the terminal cast followed by placing suitable adjustable layers of pink wax representing the occlusion blocks for both arches.

A face-bow (**Bio-Art Elite Face Bow, Bio-Art, São Carlos, Brazil**) record and maxillary-mandibular bite registration record took place intra-orally for each patient employing wax wafer procedure (**Cavex set up wax; Fustweg 5, 2031 CJ Haarlem, Holland, The Netherlands**) were accomplished for rising both casts on a semi-adjustable articulator (**A7 plus Articulator, Bio-Art, São Carlos, Brazil**) in centric relation utilizing the check bite technique and then setting up of acrylic resin anatomic teeth (**Vita-pan acrylic teeth, vita Bad sackingen, Germany**) with a bilateral balanced occlusion scheme and a cusp angle of 45 degrees. Try-in for each denture was applied and any errors that might have occurred throughout processing were overcome by clinical and laboratory remounting. Denture processing was performed by the hot water bath curing technique, ending up with the upper and lower heat-cure acrylic resin complete dentures which were profoundly finished and polished. Complete denture insertion then took place and was left in the patient's mouth for almost 2 hours to improve its intra-oral settling and adaptation in advance of the initial (Control) valuations, as presented in Figure (1).

Throughout that period, all the usual post-denture insertion instructions about denture wearing, hygiene, and caring were specified to all patients, besides sticking to their frequent follow-up visits. Furthermore, the proper elimination of all the causative influences that might initiate any means of inflammation or pain from the prosthesis was carried out, then they were randomly allocated into two groups.

Application of Antifungal Denture Disinfectants:

1. Diode Laser Disinfection:

The Diode Laser (**Lasotronix, Diode Laser DiodeLX model, Electroniczna 2A,05-500 Piaseczno, Poland.**) exposure was applied on Group I patients' dentures fitting surfaces with a wavelength of 980 nm, as displayed in Figure (2).



Figure (1):- Upper and lower Heat-cure complete denture.



Figure (2):- Diode Laser device.

The laser was operated continuously at a 5-10 mm distance perpendicular to the maxillary denture's fitting surface and was applied for 15 seconds with air- and water-cooling spray and the average output power was 2 Watts. The application was repeated two times/visit, and the denture required 2 visits as a total duration of Diode Laser exposure. Exposure of the upper denture's fitting surface for Group I patients with Diode Laser beam took place immediately 3 hours and 15 days post-denture insertion^(9,13); as revealed in Figure (3).

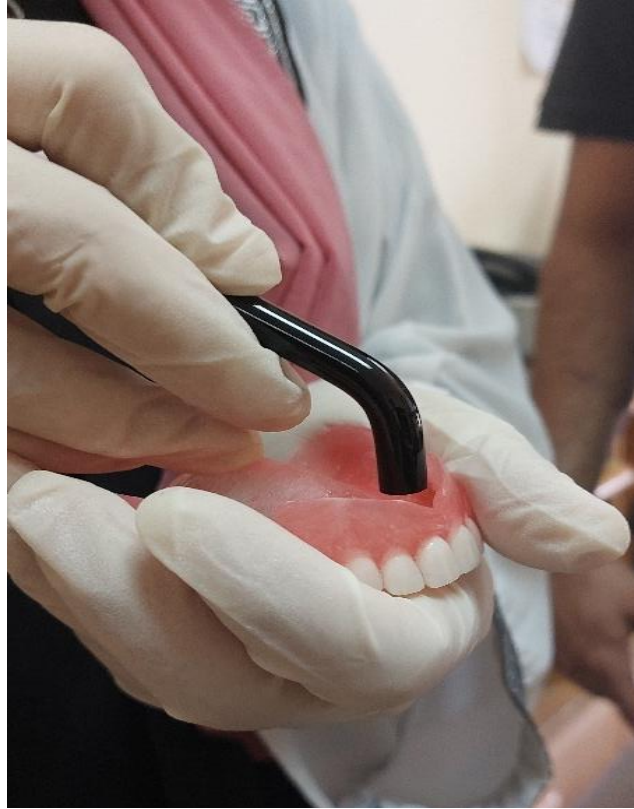


Figure (3):- Maxillary Complete Heat-cure denture exposed to Diode Laser beam.

Chlorhexidine Mouth Wash:

Group II patients were asked to initially wash their dentures beneath running tap water for the elimination of any probable food fragments then soak their dentures in 2% Chlorhexidine mouthwash (**Anabond Stedman (AnabondAsep-Rc); 2% Chlorhexidine Gluconate Solution, Primera Dental, Bangalore, Karnataka, India.**) for 10 min. This was escorted by their immersion in normal tap water at room temperature overnight daily for 8 hours⁽¹⁴⁾.

Assessments:

The Trueness and Precision **Pre-Disinfection** (Control) assessments were applied prior to denture delivery at the lab. However, the Retention and OHRQoLControl assessments were carried out immediately 2 hours next to denture insertion to ensure its intra-oral settlement and adaptation. On the other side, all the **Post-Disinfection** assessments in this research were carried out 60 days sequential to delivery.

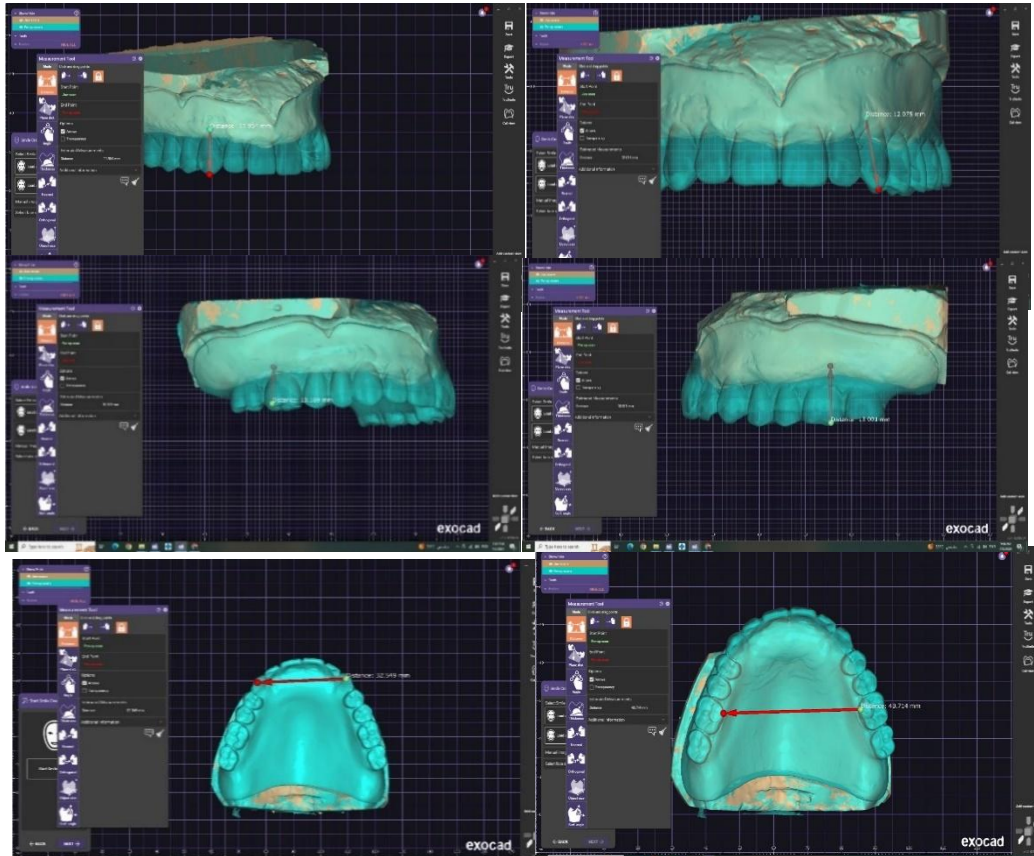
Trueness and Precision:

Digital Scanning of Maxillary Master Casts and Dentures:

Each maxillary master cast and heat-cure acrylic resin maxillary denture was scanned 3 digital scans as an average and the most accurate scans were utilized in this contemplate. Scanning was carried out with the digital scanner system; (**Dof Freedom X5 premium dental lab scanner (SMP Scanner, 100-240V(AC), 50-60 Hz, 5µm* Accuracy, #602, 77 Seongsuil-ro, Seongdong-gu, Seoul, 04790 Korea)** with Exocad Generation Dental Cad 2.4 Plovidiv software employed in the current research.

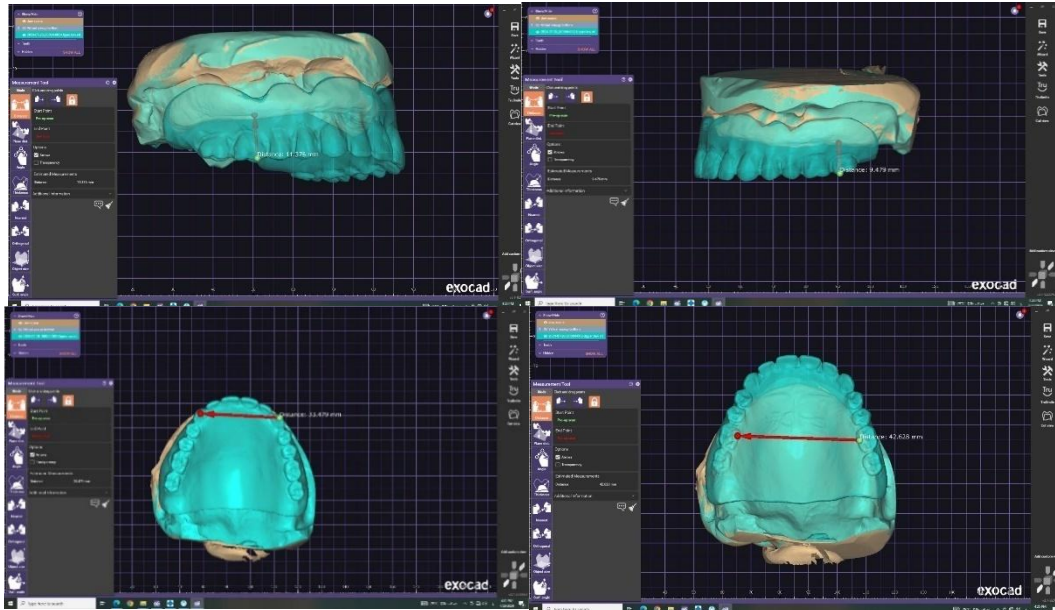
Scanning took place with uniformity of the operator and the digital scanning practice immediately before (Control) and 60 days post-delivery to check the impact of the employed antifungal disinfectants in both groups of this study. The scanner was calibrated ensuring its manufacturer's instructions; accordingly, each patient's maxillary master cast and denture were scanned by capturing occlusal images, initiating from the most distal area on the right occlusal surface to the left distal one. Successively, the buccal side was scanned distally from the left side and images were grabbed along the way till the same area was buccally approached at the right distal side and finalizing by capturing scans for the whole maxillary model's lingual side and denture as well.

Accuracy tilted Trueness and Precision was determined by the superimposition technique of the most accurately attained digitally scanned images of each patient's maxillary master cast with his maxillary denture both Pre- and Post-Disinfection procedures principally within each group and estimation in specific points and the following sequence; from the Canine tip and the Occlusal of Upper First Molar to the dentures fitting surface in both right and left sides, Mesio-Distal at Canine tip, Mesio-Distal at Occlusal of Upper First Molar, and overall; as displayed in Figures (4-27).

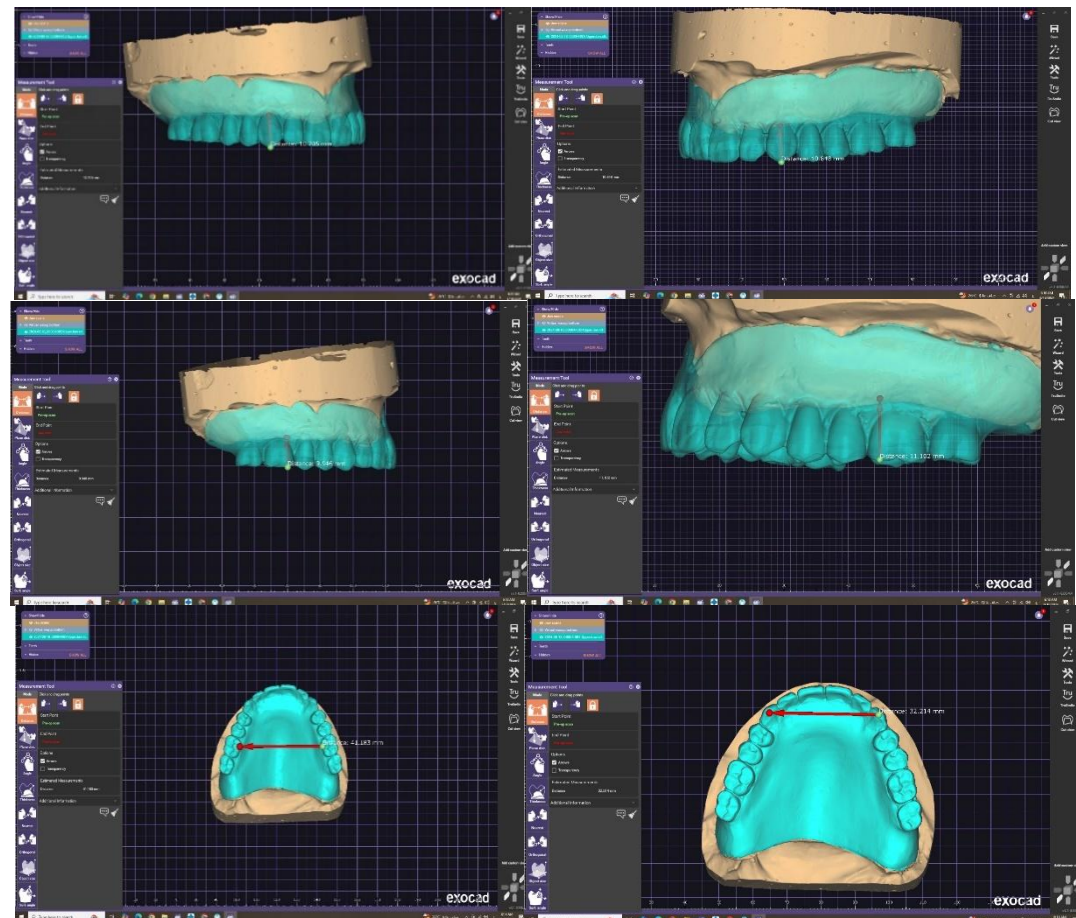


Figures (4 -9):- Superimposed digital scanned image of Group I denture Pre-Disinfection.

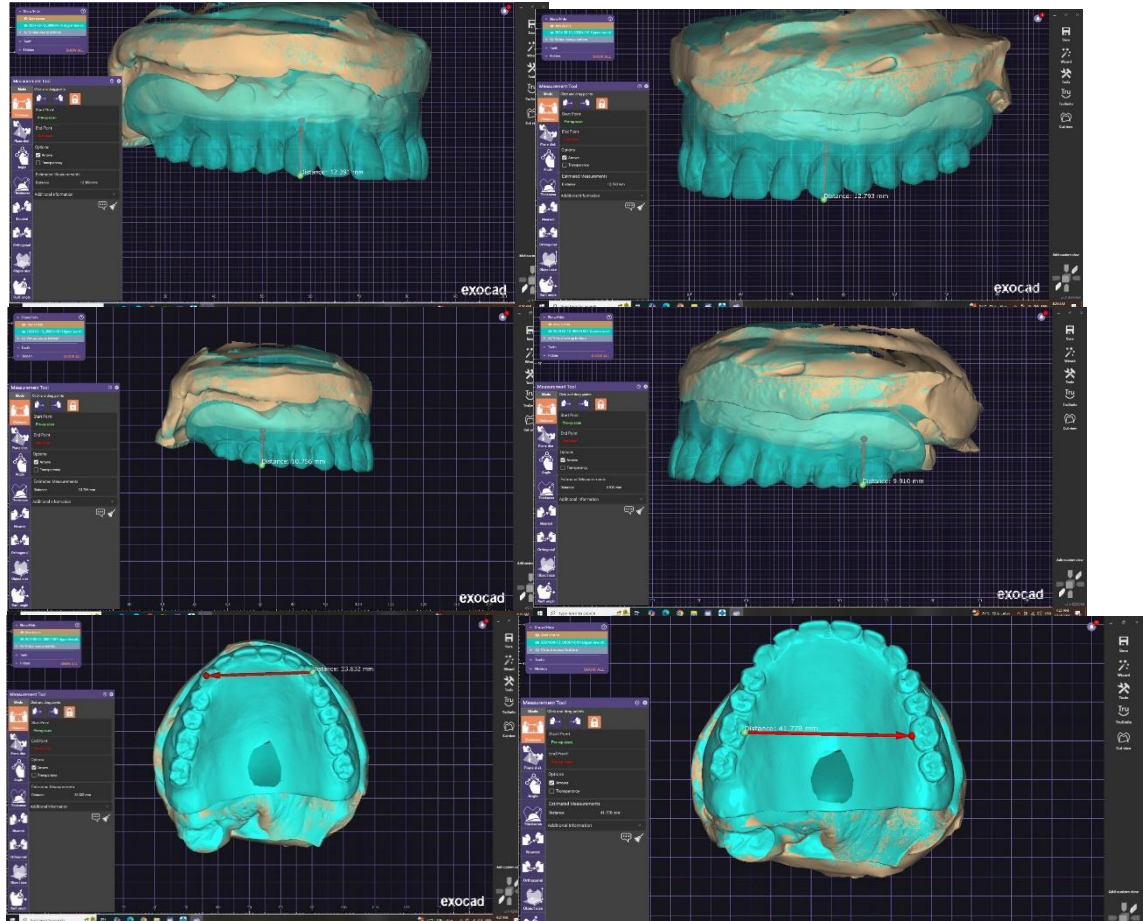




Figures (10-15):- Superimposed digital scanned image of Group II denture Pre-Disinfection.



Figures (16-21):- Superimposed digital scanned image of Group I denture Post-Disinfection.



Figures (22-27):- Superimposed digital scanned image of Group II denture Post-Disinfection.

Calculation of Trueness:

Trueness was determined by comparing all Group I patients' superimposed Post-Disinfection images with all those of Group II patients to define the impact of each denture disinfectant on the Trueness of each patient's maxillary Heat-cure denture in both groups.

Calculation of Precision:

Precision was calculated by comparing each patient's superimposed Post-Disinfection images with those of the remaining 7 patients separately in the same group and this was applied in both groups separately to determine the impact of each denture disinfectant employed on the Precision of each patient's maxillary Heat-cure denture in each group individually.

Retention (Dislodging Force):

Retention of all Group I and II patients' maxillary CD was evaluated by utilizing the digital force gauge (**HF-100 Digital Force Gauge, Jinan Hensgrand Instrumentation Co., Ltd., Jinan, China**). At each maxillary denture's palatal area center, the force gauge hook was affixed to a metal ring attached employing self-curing acrylic resin (**Acrostone Cold Cure, Acrostone Dental and Medical Supplies, Cairo, Egypt**). Each maxillary denture's dislodging force in both groups was assessed ten times by the same investigator within three-minute intervals, and through the reset button the display was accustomed to zero before every assessment. The assessment was carried out while each patient was sitting in "an upright position" with the head leaned in reverse till the stratified displacing force was nearly vertical to the denture. The displacing force was placed until denture dislodgment and all measurements were documented in Newtons (N) ⁽¹¹⁾.

The Oral Health-Related Quality of Life (OHRQoL):

The oral health-related quality of life was estimated utilizing the oral health impact profile questionnaire (OHIP-19), which embraces Nineteen numerous inquiries translated into Arabic. It comprises seven sections: physical disability and pain, handicap, functional limitation, besides, both social and psychological disability accompanying the psychological discomfort. Each inquiry has five multiple-choice replies, where each inquiry has a certain score (4 = "very often", 3 = "often", 2 = "fairly often", 1 = "seldom", 0 = "never") extending a range of 0 and 76. The whole score was valued by collecting all the answers. The lowest score implied a pleasing sense of the patient's oral situation, and hence greater satisfaction, preference, and quality of life ⁽¹⁵⁾.

Results:-

Statistical Analysis:

Statistical analysis was accomplished with SPSS 16 @ (Statistical Package for Scientific Studies), Graph pad Prism, and Windows Excel and was offered in 3 Tables and 2 Graphs. Investigation of the data attained was accomplished utilizing the Shapiro-Wilk test and Kolmogorov-Smirnov one for normality which appeared that data initiated from usual data distribution. Consequently, the Independent T-test was employed to compare between the 2 dissimilar groups. The assessment between Pre- and Post-Disinfection was achieved by the Paired T-test. Concerning the OHRQoL all comparisons were accomplished by the Chi-square test. The significance level was set at $P \leq 0.05$.

Descriptive Results:

Trueness and Precision:

Expressive results of both groups concerning Trueness and Precision were demonstrated in Table (1) and Figure (28).

In Trueness, the insignificant difference was apparent when comparing the two groups as $P=0.56, 0.93, 0.81, 0.79, 0.85$ regarding Canine tip, Occlusal of Upper First Molar, Mesio-Distal Canine tip, Mesio-Distal Occlusal of Upper First Molar, and overall, respectively. Whereas in Precision, a comparison between both groups displayed their insignificant differences as $P=0.82, 0.81, 0.72, 0.65, 0.39$ concerning Canine tip, Occlusal of Upper First Molar, Mesio-Distal Canine tip, Mesio-Distal Occlusal of Upper First Molar, and overall, correspondingly.

Table 1:- Trueness and Precision in groups I and II regarding Canine tip, Occlusal of Upper First Molar, Mesio-Distal Canine tip, Mesio-Distal Occlusal of Upper First Molar, and Overall:

| | | Group I (Diode Laser) | | | Group II (Chlorhexidine) | | | P-value |
|-----------|----------------------------|-----------------------|------|---|--------------------------|------|---|---------|
| | | M | SD | N | M | SD | N | |
| Trueness | Canine tip | 1.59 | 0.40 | 8 | 1.48 | 0.35 | 8 | 0.56 |
| | Upper 6 Occlusal | 1.11 | 0.28 | 8 | 1.10 | 0.19 | 8 | 0.93 |
| | Mesio-distal Canine tip | 0.34 | 0.08 | 8 | 0.35 | 0.09 | 8 | 0.81 |
| | Mesio-distal Occlusal of 6 | 0.47 | 0.12 | 8 | 0.49 | 0.17 | 8 | 0.79 |
| | Overall | 0.88 | 0.22 | 8 | 0.86 | 0.20 | 8 | 0.85 |
| Precision | Canine tip | 1.32 | 0.48 | 8 | 1.37 | 0.42 | 8 | 0.82 |
| | Upper 6 Occlusal | 1.25 | 0.35 | 8 | 1.21 | 0.38 | 8 | 0.81 |
| | Mesio-distal Canine tip | 0.29 | 0.05 | 8 | 0.28 | 0.07 | 8 | 0.72 |
| | Mesio-distal Occlusal of 6 | 0.38 | 0.15 | 8 | 0.35 | 0.14 | 8 | 0.65 |
| | Overall | 0.81 | 0.26 | 8 | 0.80 | 0.25 | 8 | 0.39 |

Retention:

Both groups' descriptive results concerning Retention are accessible in Table (2) and Figure (29).

Intragroup Comparison:

Comparison among Pre- and Post-Disinfection procedures in both groups revealed their insignificant decrease in retention as $P=0.71, 0.95$ regarding Groups I and II respectively.

Intergroup Comparison:

Comparison between Groups I and II demonstrated an insignificant difference between GI and GII as $P=0.92$, and 0.86 concerning Pre- and Post-Disinfection procedures.

Table 2:- Mean and Standard Deviation of Retention in Groups I and II both Pre- and Post-Disinfection:

| Groups | Retention | | | | | | P-value |
|--------------------------|------------------|------|---|-------------------|------|---|---------|
| | Pre-Disinfection | | | Post-Disinfection | | | |
| | M | SD | N | M | SD | N | |
| Group I (Diode Laser) | 1.93 | 0.41 | 8 | 1.87 | 0.32 | 8 | 0.71 |
| Group II (Chlorhexidine) | 1.91 | 0.47 | 8 | 1.9 | 0.39 | 8 | 0.95 |
| P-value | 0.92 | | | 0.86 | | | |

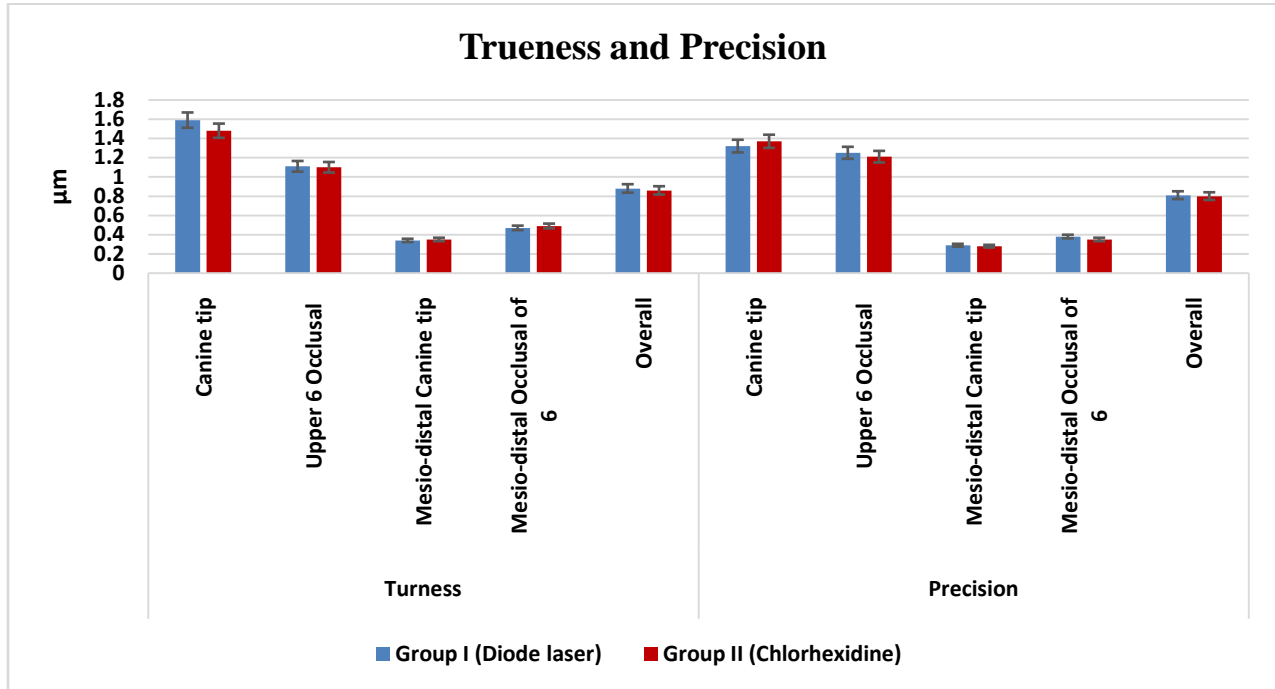


Figure (28):- Bar chart representing Trueness and Precision in Groups I and II.

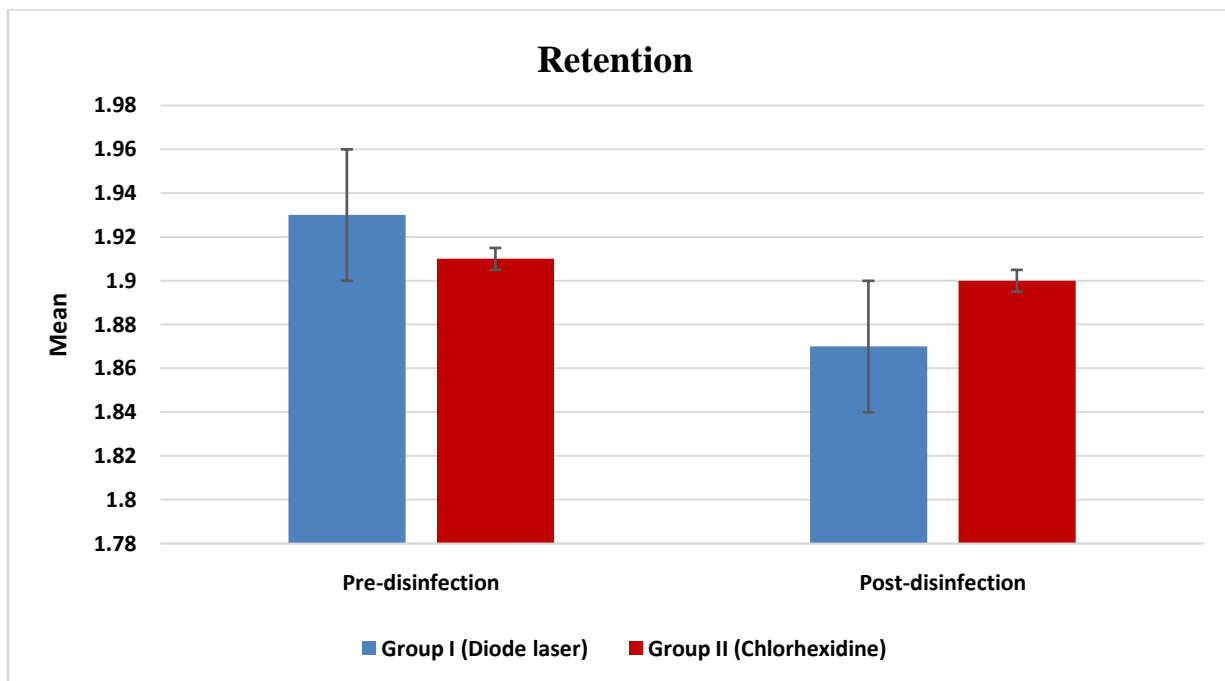


Figure (29):- Bar chart representing Group I and II Retention Pre- and Post-Disinfection procedures.

Patient’s Oral Health-Related Quality of Life (OHRQOL):

All patients revealed NO (87.5%) and YES (12.5%) concerning all questions asked Pre- and Post-Disinfection procedures in Groups I and II.

Table (3):- Patient’s Oral Health-Related Quality of Life (OHRQoL) Pre- and Post- Disinfection:

| | | | | Group I | | | | Group II | | | | P-value |
|--------------------------|---|--|---------|---------|------|------|------|----------|------|------|-------|---------|
| | | | | No | | Yes | | No | | Yes | | |
| | | | | N | % | N | % | N | % | N | % | |
| Functional Limitation | Q1 | Have you had difficulty chewing any foods? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q2 | Have you had food catching in your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q3 | Have you felt that your dentures have not been fitting properly? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| Physical Pain | Q4 | Have you had painful aching in your mouth? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q5 | Have you found it uncomfortable to eat any foods because of problems with your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q6 | Have you had sore spots in your mouth? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q7 | Have you had uncomfortable dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| Psychological Discomfort | Q8 | Have you been worried by dental problems? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q9 | Have you been self-conscious because of your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| Physical Disability | Q10 | Have you had to avoid eating some foods because of problems with your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q11 | Have you been unable to eat with your dentures because of problems with them? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| Q12 | Have you had to interrupt meals because of problems with your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- | |
| | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- | |
| | | P-value | --- | | --- | | ---- | | ---- | | | |
| Psychological Disability | Q13 | Have you been upset because of problems with your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q14 | Have you been a bit embarrassed because of problems with your | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P value | --- | | --- | | ---- | | ---- | | |

| | | | | | | | | | | | | |
|-------------------|-----|--|---------|-----|------|-----|------|------|------|------|------|-------|
| | | dentures? | | | | | | | | | | |
| Social Disability | Q15 | Have you avoided going out because of problems with your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q16 | Have you been less tolerant of your spouse or family because of problems with your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q17 | Have you been a bit irritable with other people because of problems with your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| Handicap | Q18 | Have you been a bit irritable with other people because of problems with your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |
| | Q19 | Have you felt that life, in general, was less satisfying because of problems with your dentures? | Pre | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | Post | 7 | 87.5 | 1 | 12.5 | 7 | 87.5 | 1 | 12.5 | ----- |
| | | | P-value | --- | | --- | | ---- | | ---- | | |

Discussion:-

This clinical study compared the effects of Diode Laser and Chlorhexidine mouthwash as anti-*C. albicans* disinfectants on Trueness, Precision, Retention, and Oral health-related quality of life (OHRQoL) in complete denture wearers. Variables were controlled throughout the study by uniting the prosthetic materials and the design used for both arches of completely edentulous patients. Maxillary dentures were chosen due to the high prevalence of *C. albicans* on the maxillary arch and palatal surface ⁽¹⁶⁾.

Trueness, Precision, Retention, and OHRQoL were elected for their importance in assessing denture accuracy, hygiene, functionality, and overall success. OHRQoL reflects how dental care impacts daily life, highlighting any intra-oral and prosthetic issues ^(10,17).

All patients were carefully selected based on inclusion and exclusion criteria, thoroughly examined both intra- and extra-orally, given precise post-denture instructions, and protected from factors that could cause post-operative pain or inflammation, ensuring that the study's parameters were accurately assessed and not influenced by extraneous variables.

The terminal denture impressions were made using Greenstick compound for border molding and Zn/O Eugenol impression material due to their effectiveness in creating secure border seals and their widespread use in Egyptian dental colleges. This choice ensured optimal retention, support, and stability for a comfortable denture ^(18,19).

Type IV dental stone was used for its ease of use, minimal expansion, and durability. Heat-cure acrylic resin was chosen for denture construction due to its convenience, simplicity, and patient preference ^(1,20).

Chlorhexidine mouthwash and Diode Laser were selected as antifungal disinfectants for their effectiveness in controlling *C. albicans* on denture surfaces, minimizing the need for antifungal drugs, and maintaining a sterile environment without harming denture materials ^(9,13,14).

The Dof Freedom X5 digital scanner was used for its accuracy and advanced technology in measuring Trueness and Precision. Superimposition of the digitally scanned images assessed these metrics across all areas of the maxillary

dentures before and after disinfection, evaluating the impact of the Diode Laser on denture accuracy and identifying any discrepancies^(10,21).

Patients were instructed to sit upright with their heads tilted back and remain still during the Retention assessment to ensure consistent traction. A metallic ring was precisely placed at the maxillary denture base center for accurate Retention measurements. The measuring device was calibrated before and after each session, and ten readings were recorded for each patient in Groups I and II to determine and average their Retention^(3,11).

The study revealed insignificant differences between Groups I and II in Trueness and Precision, with P-values ranging from 0.56 to 0.85 for Trueness and 0.39 to 0.82 for Precision. This suggests that neither the Diode Laser nor Chlorhexidine mouthwash had a substantial impact on measurement outcomes, consistent with other studies showing minimal effects of disinfection methods on digital scan accuracy^(22,23).

Trueness and Precision reflect the impact of each denture disinfectant on the accuracy of each patient's maxillary Heat-cure CD, where Trueness is generally compared between Groups I and II. Precision is concise on each patient's maxillary CD in each group individually. The insignificant P-values across various landmarks in the superimposed indicate the minimal impact of each antifungal denture disinfectant on the denture's accuracy, inducing minimal porosity, and non-remarkable distortion to the denture base materials^(3,24).

Utilization of the 2% Chlorhexidine mouthwash likely contributed to this minimal impact due to its broad-spectrum antifungal effects and low potential for causing inflammation or distortion. Additionally, the brief soaking time (10 min.) and overnight water immersion (37°C) had negligible effects on the acrylic dentures^(7,14).

Further studies stated that the Diode Laser with a 980 nm wavelength and 2 Watts power is an effective antifungal therapy that eliminates *C. albicans* biofilm with minimal discomfort, avoids tissue contact, and reduces denture surface porosity. Its continuous application prevents excessive heat buildup, which helps maintain denture integrity. Advances in scanning technology also contribute to the minimal impact on Trueness and Precision, as acrylic resin dentures remain stable across various disinfection methods^(9,23,25).

The present investigation found no significant changes in denture Retention Pre- and Post-Disinfection in either group, with P-values of 0.71 and 0.95 for intragroup comparisons and 0.92 and 0.86 for intergroup comparisons. These results align with other studies showing that various disinfection methods, including chemical and heat treatments, have minimal effects on prosthesis Retention. Properly applied antifungal disinfectants maintain the denture's biological, physical, and mechanical properties without affecting Retention^(7,23).

The outcomes of this study resonate with other findings which declared that the final impression procedure is crucial for denture success. Greenstick compound and Zn/O Eugenol, as commonly used materials, showed similar clinical Retention based on their accuracy. Heat-cure denture bases remain stable and retain their properties post-disinfection, contributing to the lack of significant differences in Retention across groups^(11,18).

This research revealed that 87.5% of patients experienced no change in Oral health quality, while 12.5% did, indicating minimal impact of the disinfectants on patient-reported outcomes. This reflects the disinfectants' gentle and non-disruptive nature, preserving patient comfort and oral health^(26,27). Well-constructed dentures generally provide excellent Retention, leading to high patient satisfaction and quality of life. The study's uniform procedures and effective prosthesis construction likely contributed to stable OHRQoL results, confirming that well-maintained dentures have a minimal effect on quality of life^(26,27). The existing research's findings do not support its formerly postulated hypothesis.

Conclusion:-

Based on the presented contemplate's findings, it has been concluded that neither the 980 nm Diode Laser beam with an average output power of 2 Watts nor the 2% Chlorhexidine mouthwash as antifungal denture disinfectants significantly impacted the maxillary Heat-cure acrylic resin CD's Trueness, Precision, Retention, and the OHRQoL. Hence, both are safe antifungal heat-cure CD disinfectants regarding Trueness, Precision, Retention, and the OHRQoL.

List of Abbreviations:

1. C. albicans: Candida Albicans
2. DS: Denture Stomatitis
3. OHRQoL: Oral health-related quality of life.
4. OHIP-19: Oral Health Impact Profile questionnaire
5. PMMA: Poly-Methyl Methacrylate.
6. CD: Complete Denture
7. CNC: Computer Numerical Control
8. ISO: International Organization for Standardization

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