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AN APPROACH TO ENHANCING ORAL HEALTH AND DENTAL ARCH RESTORATION IN PATIENTS WITH ACQUIRED IMMUNODEFICIENCY SYNDROME (AIDS)

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Abstract

Relevance. The clinical presentation, progression, and challenges of treatment and prevention of dental diseases in HIV-infected patients are directly related to the outcomes of managing the primary pathology. There is available data regarding the quality, biological compatibility, and physical-mechanical properties of materials used for the fabrication of removable dental prostheses (RDPs). Several studies have pointed out the lack of scientific research focused on organizing prosthodontic care for HIV-infected individuals.

Aim of the study. To justify the role and effectiveness of restoring dental arch function in HIV-infected patients using removable dental prostheses (RDPs) through a comprehensive approach in the treatment of oral tissues and structures.

Materials and methods. Clinical-dental, laboratory, histomorphological, biochemical, and functional studies were conducted at the "Republican AIDS Center" of Uzbekistan during the

period of 2022–2024. The study involved 384 HIV-infected individuals aged 18 to 56 under dispensary observation and 258 healthy individuals. The results were subjected to statistical analysis.

Results. In HIV-infected patients, periodontal tissue pathologies were characterized by severe clinical progression, atypical morphological changes, and persistently negative responses to treatment. As a result of the proposed therapeutic and preventive measures, the use of RDPs with bonded surfaces made of "Vertex ThermoSens" and "Ftorax" led to the disappearance of painful and traumatic lesions of the oral mucosa (OM), facilitated adaptation to the prostheses, and improved patients' psychological condition and quality of life indicators.

Conclusions. HIV-infected patients exhibit unusual pathological clinical features in the tissues and structures of the oral cavity: high intensity and prevalence of caries; widespread generalized periodontitis; oral mucosa conditions such as candidiasis, oropharyngeal candidiasis, angular cheilitis, herpetic stomatitis, chronic recurrent aphthous stomatitis, and chronic atypical sialoadenitis. High effectiveness in providing prosthodontic care has been scientifically and practically proven by taking into account the specifics of RDP fabrication and the unique properties of the raw materials used.

Keywords: Human Immunodeficiency Virus (HIV), dental arch defects, removable dental prostheses, oral mucosa, periodontal tissues, prosthesis fabrication stages and characteristics.

Relevance. At the end of the 20th century and the beginning of the 21st century, Acquired Immunodeficiency Syndrome (AIDS) became widespread globally and took on significant importance among overall disease incidence rates [1–3]. Human Immunodeficiency Virus (HIV) is more frequently detected in individuals aged 20 to 49, which is likely due to the higher probability of individuals in this age group seeking medical attention [4-6]. This presents a considerable threat to the health of professionals in the field—particularly dentists—and simultaneously poses numerous challenges in the diagnosis, treatment, and prevention of the disease, making it one of the pressing issues in modern medicine [7-9]. Current research focused on AIDS includes investigations into the immunopathogenetic and clinico-functional characteristics involved in the development of pathologies of the oral cavity (OC) and periodontal tissues (PT), as well as efforts to optimize treatment and preventive strategies [10-12]. These studies have highlighted the predominance of transmission mechanisms in HIV-infected individuals, the progressive damage caused by genetic factors contributing to immunodeficiency, and the rapid progression of secondary (opportunistic) infections, which often result in premature mortality [13-15].

In patients infected with HIV, the clinical presentation, course, and challenges in the treatment and prevention of dental diseases are directly related to the outcomes of managing the primary pathologies [16–18]. This includes, in particular, information regarding the quality of materials used in dental prostheses (DP), their biological compatibility, and physical-mechanical properties. However, several studies have noted a lack of scientific research dedicated to the organization of prosthodontic care for HIV-infected individuals [19–21].

Aim of the study. To substantiate the role and effectiveness of restoring the function of dental arch defects with the help of removable dentures within comprehensive treatment approaches for the oral cavity tissues and structures in HIV-infected patients.

MATERIALS AND METHOD

The present study was carried out at the Republican AIDS Prevention and Control Center over the period of 2022–2024. A total of 642 individuals aged between 18 and 56 years were examined, comprising 384 HIV-infected patients under dispensary observation (main group, MG) and 258 healthy individuals (control group, CG), as presented in Table 1. Within the framework of the proposed therapeutic and prophylactic interventions, 172 patients presenting with various dentoalveolar anomalies underwent prosthetic rehabilitation using partial and complete removable dentures. Comprehensive clinical and dental evaluations were performed, including laboratory analyses, histomorphological examinations, biochemical tests, and functional assessments. The obtained data were subjected to statistical analysis to determine the clinical efficacy and relevance of the applied treatment modalities [22-23].

Table 1.

Description of the Study Groups by Gender, Age, and Social Status.

Indicator	HIV-infected n=384	Control group n=258	χ^2 Pirson P
Gender: male female	255/66,41 129/33,59	175/67,83 83/32,17	0,65 ≥ 0,05 1,25 ≥ 0,05
age 18-24	35/9,11	19/7,36	0,65 ≥ 0,05
25-34	66/17,19	44/17,05	0,31 ≥ 0,05

35-44	191/49,74	134/51,94	0,33 ≥ 0,05
45-54	61/15,89	41/15,89	0,44 ≥ 0,05
>55	31/8,07	20/7,75	0,52 ≥ 0,05
Social status			
Worker	104/27,08	72/27,91	0,65 ≥ 0,05
Highly educated	155/40,36	103/39,92	0,71 ≥ 0,05
Secondary educated	125/32,55	83/32,17	0,45 ≥ 0,05
Unemployed	211/54,95	142/55,04	0,25 ≥ 0,05
Employed	173/45,05	116/44,96	0,41 ≥ 0,05

During the study, from the objects indicated in the table, individuals infected with HIV from the main group (M/G-1, n=68) were selected according to sex (male – 58.8%, female – 41.2%), including the comparison group (Com/G-1, n=66) (male – 63.6%, female – 36.3%) and the control group (C/G-1, n=38) (male – 57.8%, female – 42.1%). The following parameters were evaluated: Oral hygiene index (Green-Vermillion OHIS, 1969), Periodontal index (PI, Russel, 1956), Degree of alveolar bone resorption (Muhlemann, 1971; Cowell, 1975), Need for treatment in periodontal pathology (CPITN index), Assessment of tissue viability (microangioscopy and stomatoscopy), Periodontal tissue horizontal and vertical directions (H/D, V/D) pressure load (gnatodynamometric method — Bekmetov M.V. et al., patent No. 1637782), Salivary immunological parameters (J. Mancini, 1965), Dental arch defects (DMF index), Radiological evaluation (R) using “Orthophos-3” panoramic imaging (OPG), As well as histomorphological assessment of the alveolar bone and prosthetic areas in cases of prosthesis.

In orthopedic treatment, a random selection of 134 patients from group M/G who required partial removable dentures (PRDs) and complete removable dentures (CRDs) was made. These patients were divided into two groups: M/G-1 consisting of 68 patients, among whom 33 received “Vertex Thermo Sens” and 35 received “Vertex Thermo Sens” dentures sealed with “Gluma Comfort Bond.” The comparison group Com/G-1 included 66 HIV-infected patients, of whom 32 were fitted with “Ftorax” acrylic resin dentures, and 34 received “Ftorax” dentures sealed with “Gluma Comfort Bond”. The control group C/G-1 consisted of 38 HIV-negative individuals who received the aforementioned types of dentures.

In total, 168 partial and complete removable dentures were studied, including 66 made from “Ftorax” and 102 from “Vertex Thermo Sens” materials. The morphological surface analysis of these dentures was performed. Subprosthetic mucosal areas and border regions in individuals with dentures were randomly selected and examined using intravital microangiography (stomatoscopy), photodiagnoscopy, and immersion microscopy. The results were analyzed using Microsoft Excel and Statistica-6 software.

RESULTS AND ANALYSIS

Clinical observations revealed that 100% of patients in group M/G exhibited caries, with complications noted in 80% of cases. Data presented in Table 2 indicate that no healthy periodontal tissues were observed among HIV-infected patients, whereas 15.50% of cases were identified in the control group ($\chi^2 = 12.31$; $P \leq 0.05$). Conversely, the frequency of severe generalized periodontitis (SGP) inflammation was significantly higher in group M/G compared to the control group, with rates of 63.5% versus 13.18%, respectively ($\chi^2 = 21.13$; $P \leq 0.01$) (Table 2).

Table 2.
Description of Periodontal Tissue Pathology (%)

Indicator	HIV-infected n=384	HIV-negative control n =258	χ^2 Pirson, P
Healthy periodontium	0/0	40/15,50	6,25; P≤ 0,05
MiGP	57/14,8	62/24,03	11,12; P≤ 0,05
MoGP	83/21,6	122/47,29	17,32; P≤ 0,01
SGP	244/63,5	34/13,18	21,13; P≤ 0,01
Total	384/100,0	258/100	

Note: HIV-Human Immunodeficiency Virus, MiGP-Mild generalized periodontitis, MoGP-Moderate generalized periodontitis, SGP-Severe generalized periodontitis.

Additionally, in HIV-infected patients, the pathology of periodontal tissues demonstrated a severe clinical course characterized by atypical morphological changes and persistent ineffectiveness of treatment measures. Figure 1 illustrates in a patient from group M/G an ulcerative-necrotic and acute inflammatory periodontal tissue presentation, including dense swelling, brightly colored desquamative marginal gingiva, intense bleeding upon probing, and a negative CPITN index.

Figure 1. Acute inflammatory ulcerative-necrotic lesion of periodontal tissue in an HIV-infected patient.

Oral mucosal lesions in HIV-infected patients were observed as follows: candidiasis – 25% (control group – 5.04%); oropharyngeal candidiasis – 14.6% (control group – 3.9%); angular cheilitis – 18.5% (control group – 3.1%); herpetic stomatitis – 10.7% (control group – 2.3%); recurrent aphthous stomatitis – 14.3% (control group – 4.6%); chronic nonspecific sialoadenitis – 17.7% (control group – 5.8%); and leukoplakia – 3.6% (control group – 0.7%).

Gnatodynamometric examination revealed that in patients from group M/G, the resistance of periodontal tissues to vertical and horizontal pressure load decreased 2 to 4 times (Figures 2–3).

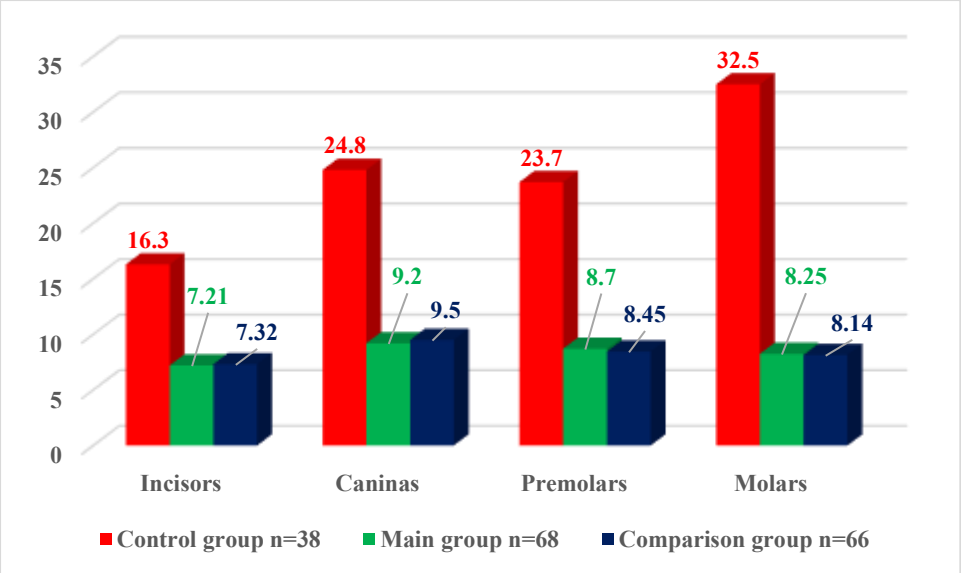

Figure 2. Vertical pressure load on periodontal tissues measured by gnatodynamometry in HIV-infected patients.

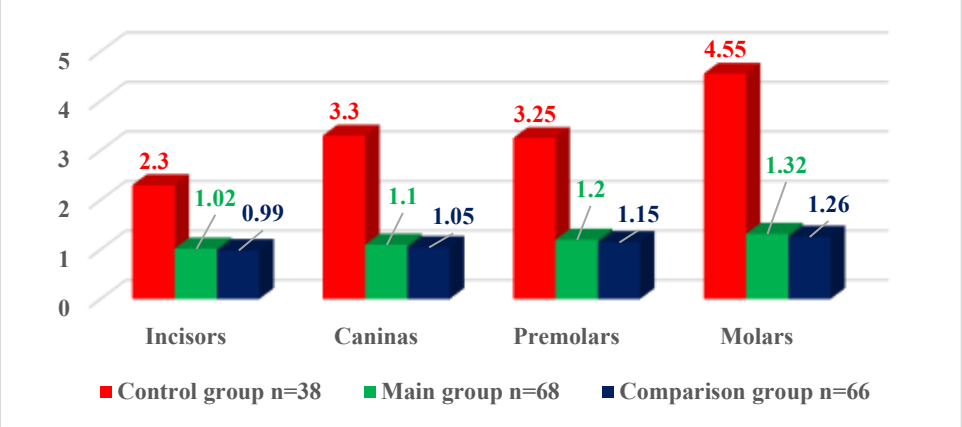

Figure 3. Horizontal pressure load on periodontal tissues measured by gnatodynamometry in HIV-infected patients.
Note: V/D – vertical direction load; H/D – horizontal direction load.
The indicators of the need for removable dentures in HIV-infected patients are presented in Table 3.
Table 3.
Prosthodontic characteristics of HIV-infected dental patients (%)

Type	Description of Removable Dentures (%)						Total patients		
	CRD		PRD		Bridge-type				
	abs	M±m, %	abs	M±m, %	abs	M±m, %	abs	M±m,%	P
User	8	16,3±0,3	13	26,5±0	28	57,16±0	49	100±0	χ^2 = 17,894;
Need	32	23,8±4,9	102	76,12±7,5	19	14,12±6,61	134	100±0	
P	χ^2 Pirson = 19,644; p = 0,007								

Note: RD – Removable Dentures; PRD - Partial Removable Denture; CRD - Complete Removable Denture.
In the study of the subprosthetic mucosal tissue and border areas beneath removable dentures made from “Ftorax” in HIV-infected patients, the thin spinous layer consisted of 4–5 rows of cells with a thinned epithelial surface. The spinous layer exhibited gradual thickening, and the gingival mucosa showed varying degrees of thickening. The poorly expressed keratohyalin and granular layers were noted, with spinous cells demonstrating karyopyknosis and acantholytic hypochromic nuclei. Furthermore, the connective tissue showed increased progression towards lymphohistiocytic infiltration (Figure 4).

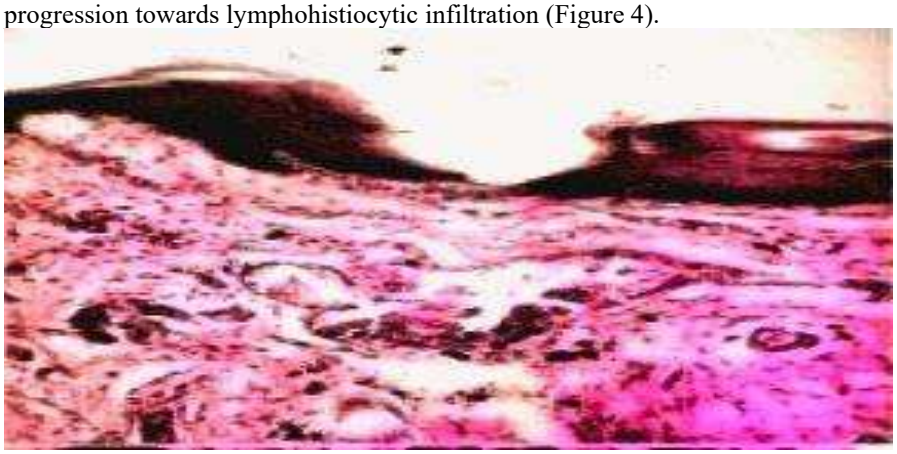

Figure 4. Subprosthetic oral mucosa beneath the removable denture made from “Ftorax.” Hematoxylin and eosin staining. Magnification ×100.
Salivary immunological parameters in the study participants were as follows: in the control group (C/G), secretory immunoglobulin (sIg) titer was 2.15 g/L and lysozyme concentration was 18.6 mg%; in the main group (M/G), sIg titer was 1.24 g/L and lysozyme concentration was 11.2 mg%; in the comparison group (Com/G), sIg titer was 1.42 g/L and lysozyme concentration was 10.6 mg%. These results indicate a decrease in local immunity in HIV-infected patients.
During the study, the surface microrelief of removable dentures made from “Ftorax” (Figures 5a and 5b) was examined using scanning electron microscopy (SEM) at 400×magnification, revealing chaotic and incompletely sealed small gaps and sharp edges. Additionally, the denture surface appeared sticky, with an unpleasant odor and unsatisfactory hygienic condition.

Figure 5a. Inner surface of the removable denture made from “Ftorax.”

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Figure 5b. Scanning electron microscopy image of the "Ftorax" denture surface at 400× magnification.

In HIV-infected patients, general treatment was conducted in parallel with antiretroviral therapy (ART). Periodontal therapy for patients in groups M/G and Com/G was carried out using conventional local methods by a dental specialist. These included improvement of hygienic conditions, elimination of necrosis, curettage procedures, correction of occlusal defects, application of ligatures with "Metrogyl Denta" ointment, and use of a combination of 0.025% chlorhexidine bigluconate and 0.3% trypsin, as well as "Sextofag" solution. Additionally, patients received systemic antifungal and antiviral therapy: Fluconazole at a dose of 100 mg for 14 days, Acyclovir locally at 400 mg three times daily, For hairy leukoplakia, a 0.1% vitamin A oil solution was applied.

A total of 134 randomly selected HIV-infected patients were provided with removable dentures (RPDs): 68 patients in group M/G-1, 66 patients in group Com/G-1, and 38 patients from the control group (C/G). In group M/G-1, 33 patients received RPDs made from "Vertex Termo Sens," while in group M/G-2, 35 patients were fitted with "Ftorax" dentures whose surfaces were treated with the adhesive "Gluma Comfort Bond." In group Com/G-1, 32 patients received RPDs made of "Ftorax" acrylic plastic; in group Com/G-2, 34 patients were provided with "Ftorax" dentures, whose surfaces were treated with "Gluma Comfort Bond" adhesive and protected with gingival suction cups.

In HIV-infected patients fitted with complete (CRD) and partial removable dentures (PRD), clinical outcomes following the use of "Ftorax" dentures were notably better compared to those made from the thermoplastic material "Vertex Termo Sens," which showed significantly negative results. In group M/G-1, the Plaque Index (PI) was 0.87, whereas in group M/G-2 it was 0.18. Similarly, after 6 months, the Green-Vermillion Hygiene Index (GI) was 0.92 in M/G-1 and 0.84 in M/G-2 ($p<0.01$; $p<0.05$). The Community Periodontal Index of Treatment Needs (CPITN) was 2.54 in M/G-1 and 1.89 in M/G-2, showing a statistically significant difference compared to baseline values (0.02; $p=0.01$; $p<0.05$). In the same patients after 6 months, the DMF index (Decayed, Missing, and Filled teeth) in M/G-1 was: Decayed (D) – 24%, Missing (M) – 44%, Filled (F) – 32%; and in M/G-2 was 26%, 46%, and 28%, respectively.

Analysis of the gnathodynamometric parameters of periodontal tissue after orthopedic prosthetic treatment is presented in Table 4.

Table 4. Gnathodynamometric Parameters of Periodontal Tissue

Groups		I	C	P	M
		Vertical Load (V/L)			
Healthy periodontium		16,3 ±0,64	24,8 ±0,76	23,7 ±0,78	32,5 ±1,33
Main group	PreT	7,32 ±0,13*	9,5 ±0,12*	8,45 ±0,13*	8,14 ±0,19*
	PostT	11,28 ±0,06*$^{x\Delta}$	12,5 ±0,08*$^{x\Delta}$	12,66 ±0,08*$^{x\Delta}$	11,59 ±0,11*$^{x\Delta}$
	After 6 month	10,08 ±0,03*$^{x\Delta}$	11,3 ±0,05*$^{x\Delta}$	10,45 ±0,04*$^{x\Delta}$	11,33 ±0,15*$^{x\Delta}$
Comparison group	PreT	7,21 ±0,2*	9,2 ±0,16*	8,7 ±0,14*	8,25 ±0,19*
	PostT	9,25 ±0,03*^{x}	11,12 ±0,32*^{x}	11,71 ±0,04*^{x}	10,05 ±0,06*^{x}
	After 6 month	8,15 ±0,03*^{x}	10,02 ±0,12*^{x}	10,41 ±0,05*^{x}	9,15 ±0,05*^{x}
	Horizontal Load (H/L)				
Healthy periodontium		2,3 ±0,12	3,3 ±0,13	3,25 ±0,12	4,55 ±0,11
Main group	PreT	0,99	1,05	1,15	1,26

		±0,04*	±0,04*	±0,04*	±0,05*
	PostT	1,53 ±0,01*xΔ	1,42 ±0,01*xΔ	1,53 ±0,05*xΔ	1,92 ±0,05*
	After 6 month	1,02 ±0,03*	1,25 ±0,03*	1,35 ±0,04*	1,46 ±0,05*
Comparison group	PreT	1,02 ±0,03*	1,1 ±0,03*	1,2 ±0,05*	1,32 ±0,05*
	PostT	1,24 ±0,03*x	1,38 ±0,03*x	1,4 ±0,05*x	1,55 ±0,06*x
	After 6 month	1,12 ±0,03*x	1,24 ±0,03*x	1,32 ±0,05*x	1,4 ±0,06*x

Note: I- incisor; C-canina; P- premolar; M-molar: -* - the differences were found to be statistically significant ($p < 0.05$) when compared to the control group of healthy individuals (*** - P<0,05; ** - P<0,01; * - P<0,001); ^{x} – the differences were statistically significant when compared with the pre-treatment results (PreT). (^{xxx} - P<0,05; ^{xx} - P<0,01; ^{x} - P<0,001); $^{\Delta}$- In Group 1, statistically significant differences were observed in comparison with the condition after HIV treatment (PostT). ($^{\Delta\Delta\Delta}$ - P<0,05; $^{\Delta\Delta}$ - P<0,01; $^{\Delta}$ - P<0,001).

As a result of the therapeutic and preventive measures carried out in the study using the “Vertex Thermo Sens” removable denture boundary, pain and traumatic lesions in the oral mucosa disappeared, and prosthetic adaptation occurred more easily. Positive changes were observed in the patients’ psychological state and quality of life indicators. A decrease in keratinization and hyperemia foci in the oral mucosa was noted, along with faster tissue regeneration, absence of xerostomia (dry mouth) and tongue coating, restoration of gingival papillae, improved venous circulation, and partial restoration of vascular patterns.

Positive changes were observed in tissue morphology as well. The basal membrane became thinner, smoother, and partially wrinkled, with signs of weak keratinization. The presence of keratohyalin granules indicated the initiation of replacement by a thickened epithelial layer with pronounced horny and granular strata, accompanied by the appearance of 2–3 layers of prickle cells.

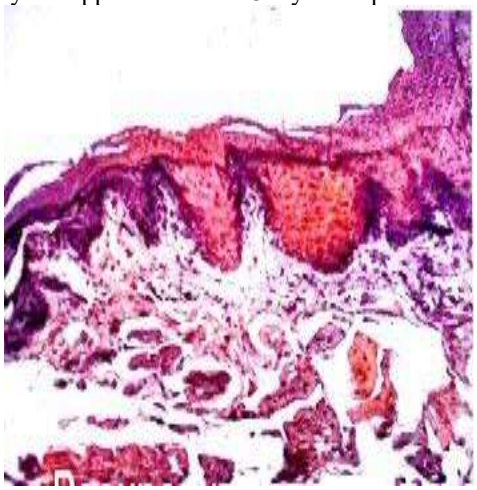

Figure 6a. Oral mucosa region under the removable denture made from “Vertex Thermo Sens”.

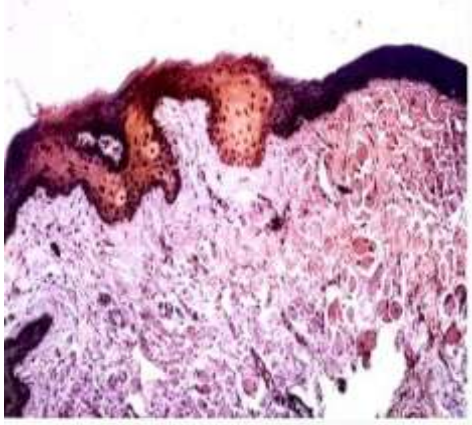

Figure 6b. Oral mucosa region under the removable denture made from “Ftorax”. Hematoxylin and eosin staining. Magnification ×100.

The histomorphology of oral mucosa tissues under the removable denture fabricated from "Ftorax" material coated with "Gluma Comfort Bond" showed a relatively widespread thinning of the epithelium with a thinner keratinized layer. Positive changes were observed in the basal membrane, stromal edema was reduced, the number of adipocytes decreased, and the number of salivary glands increased.

The removable denture made from "Vertex Thermo Sens" demonstrated favorable clinical and morphological biocompatibility. It did not cause trauma to the oral mucosa region, provided satisfactory patient comfort in terms of design, and offered protection against rapid contamination from food debris and microbial exposure. Additionally, the material lacked a microenvironment conducive to microbial accumulation.

Figure 7. Surface of the removable denture made from "Vertex Thermo Sens". SEM, magnification ×400.

At 400× magnification under Scanning Electron Microscopy (SEM), the surface of the removable denture appeared smooth, with no environment conducive to microbial infiltration into the prosthetic base. A protective barrier formed by the chemical components of the removable denture material was observed, preventing damage to the oral mucosa contact region and its boundaries (Figure 7).

Furthermore, upon re-evaluation after six months, the removable denture surface made from "Ftorax" thermoplastic material saturated with "Gluma Comfort Bond" adhesive, in combination with "Vertex Thermo Sens," remained smooth, transparent, intact, and clean. These findings indicate that the prosthesis exhibited superior biomechanical, biophysical, clinical-functional, morphological, and microbiological characteristics compared to conventionally fabricated removable dentures that were not treated with adhesive.

CONCLUSION

In HIV-infected patients, the pathological and atypical clinical characteristics of oral tissues and organs differ significantly in terms of their frequency and presentation. High caries intensity (CPE index: 23.6 ± 0.11; $p \leq 0.05$) and prevalence (100%; $p \geq 0.05$) were recorded. The prevalence of inflammatory periodontal diseases (63.5%; $\chi^2 = 21.13$; $p \leq 0.01$) and soft tissue pathologies of the oral mucosa was notably high.

Conditions such as oral candidiasis, oropharyngeal candidiasis, angular cheilitis, herpetic stomatitis, chronic recurrent aphthous stomatitis, and chronic atypical sialoadenitis were frequently observed. Moreover, there was a high demand for prosthodontic care, reflected in the significantly greater need for removable partial dentures (76.04% vs. 22.41%; n/g; $\chi^2 = 7.11$; $p \leq 0.05$) and complete removable dentures (23.95% vs. 3.87%; n/g; $\chi^2 = 8.25$; $p \leq 0.05$).

Functional studies in HIV-infected individuals revealed negative changes in the tolerance indicators of masticatory pressure. In partial dentures (PD), the moderate load tolerance thresholds for horizontal/vertical forces (H/F > 29.63 and V/F > 28.76) decreased 2–4 times compared to controls. Negative tissue morphology changes were observed on the contact surfaces of the soft tissues beneath and at the borders of the prosthesis in the oral mucosa, characterized by roughening of the continuous lines, multiple chronic lesions, formation of stagnant and varicose vessels, mild and rapid bleeding, as well as necrotic tissue foci. Local immunological parameters in the oral secretion composition showed a significant decrease in secretory IgA levels (sIgA titer down to 1.24 ± 0.03 g/L, $p \leq 0.01$), alongside an increase in lysozyme concentration (18.4 ± 0.63 mg%, $p \leq 0.01$).

The effectiveness of prosthodontic care for HIV-infected patients is confirmed by improvements in patients' quality of life, including enhanced functional status of the oral tissues and organs. This was achieved through the use of removable dentures fabricated from "Vertex ThermoSens" material and "Ftorax" removable dentures saturated with "Gluma Comfort Bond" adhesive. The protective approach of eliminating polishing and smoothing stages, and instead sealing prosthesis surface pores with monomers, contributed to improvements in the biochemical, biophysical, and functional properties of the prostheses. Additionally, the proposed removable

dentures facilitated local immune system restoration, as evidenced by increases in secretory IgA levels (42.11%; $p < 0.01$) and lysozyme (27.13%; $p < 0.05$), the elimination of pathological processes, and improvements in hygiene indices and periodontal status: periodontal index (PI) decreased by 40% ($p < 0.01$), OHI-S index improved by 53% ($p < 0.01$), bleeding on probing reduced by 36.45% ($p < 0.01$), and gnathodynamometric parameters improved by 54.4% ($p < 0.01$). These results reflect the adaptation of the histomorphological environment in oral mucosa cells.

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