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Assessment Of Orthodontic Intervention Utilizing Removable Dental Prostheses

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Abstract: This study is dedicated to evaluating the clinical effectiveness of utilizing removable orthodontic structures in the treatment of patients with dentofacial anomalies and defects. In modern dentistry, removable prostheses serve as vital tools not only for restoring aesthetic and masticatory functions but also for guiding jaw growth and correcting tooth positioning. The research involves a comprehensive analysis of various designs—including plate appliances and functional-guiding devices—focusing on clinical outcomes, patient adaptation periods, and the long-term stability of the treatment.

The findings indicate that the timely application of removable appliances, particularly during the mixed dentition stage in pediatric patients, demonstrates high efficiency in preventing jaw deformities and malocclusions. However, the study highlights that clinical success is heavily dependent on patient compliance and the maintenance of rigorous oral hygiene. The conclusions of this research contribute to the refinement of clinical protocols for orthodontic intervention using removable prosthetic devices.

Keywords: Dentistry, removable orthodontic structures, atrophy, diabetes.

Introduction: Orthodontic treatment of chronic

generalized periodontitis with dental abnormalities in diabetic individuals has long presented a challenging multifactorial problem. Diabetic complications significantly impact several organs and systems, with the oral cavity serving as a key signal, marked by vascular, neuropathic, metabolic, and structural diseases affecting the hard tissues of the teeth, periodontal tissues, and oral mucosa [5]. It is often a modification of an inflammatory and biological character, accompanied by halitosis, mucosal dysesthesia, and dysgeusia. Furthermore, there exists widespread stomatitis (catarrhal, aphthous, ulcerative), candidiasis, and lichen planus of the oral mucosa, along with periodontitis characterized by various degrees of tooth mobility, alveolar bone resorption, and periodontal pocket depth. The pathogenesis of the aforementioned oral pathogenic alterations is associated with hormonal imbalances and significant metabolic abnormalities. Researchers assert that genetic predisposition and traumatic factors significantly contribute to the genesis of the oral inflammatory response at both the tissue and organ levels. Type I and type II diabetes mellitus induce deficiencies in blood flow, hypoxia, and energy supply within periodontal tissues, resulting in impaired plastic and regenerative processes, diminished stability and resistance of the periodontal complex to mechanical and infectious agents, as well as other detrimental factors. The latter include inadequate dental care, orthodontic procedures, multiple tooth extractions, bruxism, dental anomalies, and classifications C, B, A, E, etc., which are of significant importance. The adaptive ability of periodontal tissues is surpassed, leading to hemodynamic disturbances and the onset of resorption processes in both periodontal tissues and prosthetic beds [3, 5]. Atherosclerosis diminishes the protective characteristics of the oral mucosa owing to compromised blood flow and lipid imbalance. Histological analysis of the oral mucosa demonstrates papillomatosis characterized by papules, parakeratosis, both localized and widespread atrophic changes in the epithelial layer, elevated glycogen levels in the gingival epithelium, and the presence of mast cells and plasma cells within the inflammatory infiltrate. Literature and clinical findings confirm the generic characteristics and diverse alterations in the oral cavity associated with type 2 diabetes [4, 5]. Heightened osteoclast activity results in the resorption and demineralization of the bone matrix, intensifying inflammatory and destructive alterations within a complicated adverse immunological response. A significant accomplishment in domestic dentistry within periodontics is the meticulous and intricate use of medicinal, physiotherapeutic, surgical, and orthopedic techniques based on specific indications. The treatment of widespread periodontitis with dental abnormalities is further complicated by underlying endocrine illness that directly impacts oral health. Upon identifying the primary connections between etiological factors and pathological mechanisms, the specialist must select therapeutically and pathologically appropriate interventions and formulate a personalized management plan for the patient, considering the advancing inflammatory-dystrophic process in diabetes, for instance [6, 9]. Researchers investigating the origin of periodontal tissue disease have attributed significant importance to diabetes. Clinical observations and experimental investigations suggest that dentists often concentrate on diagnosing "diabetes" in patients with periodontal tissue disease, with many of these individuals being identified in the early stages of the condition. In individuals with chronic generalized periodontitis, orthodontic interventions may be used to rehabilitate tissue-function connections and enhance adaptability and compensation in cases of dental insufficiency. During surgery, "prosthetic plaque" develops on the surface of the orthodontic structure of the denture, and numerous microorganisms influence the microbiological composition of the oral cavity, while accompanying local or systemic pathology exacerbates these processes, such as inflammation and destruction. The resultant chronic imbalance negatively impacts immunological reactivity, the body's sensitivity, and incites an inflammatory reaction in the mouth cavity (toxic chemicals/prosthetic stomatitis). The physicochemical properties of denture polymers significantly affect microbial adherence and colonization on detachable surfaces, prompting contemporary dental materials research to require that these structural materials possess specified characteristics [7, 8]. National and international researchers have indicated that the superior characteristics of dental thermoplastics have broadened the applications for orthodontists in fabricating various orthodontic structures and devices for the prosthesis of dental defects complicated by alveolar bone deformities and periodontal tissue disorders. In treating patients with systemic periodontal disease associated with diabetes, the application of bone stimulants can yield effective outcomes, halting the progressive loss of bone tissue in the maxillary alveolar process and the mandibular alveolar portion, while also promoting restorative regeneration. The research by Kalivradzhiyan E.S. et al. established the efficacy of medicated biofilms with adhesive properties, which positively influenced the adaption length of patients to removable dentures and aided in the prevention and treatment of potential issues affecting the oral mucosa [3]. Consequently, to enhance the efficacy of prosthetic treatment for patients with dental

defects resulting from periodontal tissue pathology in a diabetic context, it is both appropriate and beneficial to undertake a series of therapeutic interventions focused on adjusting and restoring masticatory function while alleviating inflammatory dystrophic reactions [4, 5]. This idea is of paramount importance. Patients with deteriorating dental and endocrine histories often report pain, difficulty in mastication, persistent discomfort, and prolonged adaptation challenges to the prosthetic structures after their placement. Consequently, the aforementioned substantiates the legitimacy of the study objective aimed at enhancing orthodontic therapy for periodontally compromised individuals with diabetes using removable dentures.

Materials and Methodology

X-ray techniques have consistently been significant in dentistry. Contemporary dental practice and scientific research favor advanced radiographic techniques, such as computed tomography. This approach enables the assessment of bone disease at a particular location, the clinical presentation, the alterations occurring in the process, the precision of the diagnosis, treatment strategy, and diagnostic procedures with a high degree of reliability. A three-dimensional computerized dental tomography system (Veraviewepocs 3D, manufactured in Korea) was used in the dental clinic of Voronezh State Medical University, named after N.N. Burdenko, to accomplish this purpose. This multi-projection Rh+ study approach allows the acquisition of a coherent planar and volumetric reconstruction of the subject while evaluating the anatomical configuration and density of the alveolar bone structures. The examination of the acquired digital data was conducted as part of scientific research by the personnel of the Department of Prosthodontics at Voronezh State Medical University, under the supervision of N.N. Burdenko, an expert in radiographic diagnosis, utilizing a personal computer in the clinic to visualize the cortical plate of the maxillary sinus floor across three planes. The three-dimensional picture may be manipulated and seen from any perspective. The clinic does not need a specialized software for 3D reconstruction of tomographic pictures, provided that the acquired data is documented [5]. The primary characteristic of dental CT is the acquisition of three-dimensional images of specific regions of the teeth and jawbone. The whole alveolar arch is scanned, yielding an image volume of 12 x 7 cm, and the 3D computer-generated picture is shown on the monitor in accordance with the "orthopantomography - panoramic zonography" format of AP. Participants in the orthopedic therapy trial were categorized into four groups of 20 patients each based on the selected strategy. The first cohort of patients used the acrylic plastic "Ftorax" as the foundational polymer for the manufactured detachable lamellar dentures. The second cohort of patients received prosthetic devices including a clasp construction (clasp-fixed, splinted arch denture). Structural materials include cobalt-chromium alloy (CCS) and acrylic polymer "Ftorax". In the third cohort of patients, detachable dentures were constructed using thermoplastic polymer. The fourth cohort of patients received prostheses with detachable orthodontic components constructed from thermoplastics, followed by composite therapy using a calcium-containing mineral-vitamin complex and an adhesive anti-inflammatory bioabsorbable film applied to the prosthetic base.BAP is a self-absorbing film composed of bilayer hydrophilic and hydrophobic natural polysaccharides, exhibiting antibacterial, anti-inflammatory, regenerative, and wound-healing characteristics. Concerning the financial aspect of the research design, five patients from each group were chosen for 3D imaging. The research assessed the degree of atrophy in alveolar bone tissue /h and n/h in patients over a one-year period with the use of different orthopedic constructions. Findings and Analysis The severity of bone tissue atrophy, indicated by the decrease in the height of the alveolar process and the alveolar segments of the upper and lower jaws, was examined in relation to different types of removable denture bases. This study aimed to evaluate the impact of a comprehensive approach in orthodontic treatment on its efficacy and the reduction of complications associated with the prosthetic floor tissue. Measurements were recorded prior to the implantation of the selected orthodontic apparatus and after one year of using the detachable denture. The studies indicated that patients with systemic periodontal disease, exacerbated by secondary periodontal disease in the context of non-insulin-dependent diabetes mellitus, experienced a reduction in the number of orthodontic visits for dentures, a decrease in adaptation duration, and an enhancement in dental health and quality of life throughout the entire duration of orthodontic appliance usage. This research demonstrates that the appropriate selection of structural substrates and effective composite treatment may enhance dental health by mitigating issues such as bone tissue atrophy, which impacts both the dentition and the overall maxillofacial area. The study's findings reaffirmed the superior characteristics of dental thermoplastics, including exceptional aesthetics, lightweight composition, elasticity, flexibility, stability, enough strength, absence of monomer residues, and bioinertness. Secondly, during the adaptation phase following the placement of thermoplastic removable

structures, the adhesive anti-inflammatory biodegradable film and calcium-containing mineral-vitamin complex (MVC) positively influenced the resilience of the oral mucosa, the progression of inflammatory processes in the prosthetic floor tissue, and the volume of bone tissue. Conclusions The management of patients with partial dental defects utilizing removable prostheses presents distinct advantages over fixed prostheses, including therapeutic and preventive benefits: the avoidance of hard tissue preparation of the supporting teeth, the adaptability to various sizes and topographies of dental defects, and the design principle that enhances hygienic maintenance. The primary disadvantage, however, is the specific pressure transfer to the underlying OM resulting from its limited adjustability to masticatory pressure and bone tissue sensitivity. Removable prosthetic foundations are sometimes difficult to identify and may induce adverse effects and pain because to significant foreign body intrusion into the oral cavity. Consequently, the primary issue for prosthodontics is to meticulously plan the design attributes of removable dentures, optimize the floor space, and choose appropriate structural materials.

Conclusion

This study demonstrates that utilizing thermoplastic polymers as the foundational material for dental prosthetics in type II diabetic patients is a more rational approach; adhesive anti-inflammatory biofilms for the application and consumption of Ca-containing MVA present a viable alternative to the complexities associated with orthopedic treatment in this patient demographic. The integration of this element into the algorithm has shown its use and efficacy in diminishing the dynamics of inflammatory process zones in the tissue underneath the prosthetic foundation, as well as in lowering the severity of atrophic processes and the loss of bone tissue in the prosthetic floor tissue. The adaption period for patients after the installation of orthopedic structures was reduced in the fourth group of prostheses, and the frequency of corrective visits was also decreased.

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