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Manufacturing Method For Overlaid Prosthesis Structured By Teeth

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Abstract: The rehabilitation of patients with severely worn or partially edentulous dentition requires restorative solutions that balance structural integrity with aesthetic requirements.1 Overlaid prostheses (overlay dentures) offer a conservative alternative to traditional extractions or high-risk implants, yet their success depends heavily on the precision of the manufacturing process.

Objective: This study describes an advanced manufacturing method for overlaid prosthesis structures, focusing on the integration of digital workflows and material science to enhance the fit, durability, and functional occlusion of the final restoration.

Methods: The manufacturing protocol involves a multi-stage approach:

Utilizing intraoral scanning to create a high-resolution 3D topographical map of the existing teeth and alveolar ridges.2

Designing the framework with specific attention to the "overlaid" zones, ensuring uniform stress distribution across the supporting natural teeth.

A comparative analysis between Computer-Aided Manufacturing (CAM) milling of cobalt-chrome or high-performance polymers (PEEK) and Additive Manufacturing (3D Printing) for the framework.

The application of aesthetic composite or ceramic layers to replicate natural dental morphology.

Results: The implemented digital manufacturing method demonstrated a significantly higher degree of marginal fit (within $50-100 \mu m$) compared to traditional lost-wax casting techniques. The use of high-performance polymers in the framework reduced the "heavy" sensation for the patient while maintaining sufficient flexural strength to withstand masticatory forces.

Conclusion: Transitioning from analog to digital manufacturing methods for overlaid prostheses

significantly minimizes human error and material shrinkage. This approach provides a predictable, repeatable, and bio-compatible solution for complex pediatric or adult dental reconstructions.

Keywords: Overlaid Prosthesis, CAD/CAM, Digital Dentistry, Pediatric Prosthodontics, Additive Manufacturing, Overlay Denture.

Introduction: One common condition affecting the dentoalveolar system is dental defects. Within the prosthetic care spectrum, there is a substantial need for detachable prostheses, with a range of 33% to 68% [4-6]. The alveolar process of the maxilla and the alveolar segment of the mandible experience atrophy after tooth loss. Because the bone cannot support the masticatory force, the atrophy process with a detachable denture is irreversible [13–17]. The transitional fold's location changes in tandem with bone shrinkage. The fold's arch flattens and aligns with the denture base on the vestibular side, while the frenulum and muscle attachment sites move closer to the center of the alveolar ridge. This has a negative effect on denture retention by drastically reducing the denture field's area [2, 18, 19]. Preventing the patient from losing all of their teeth as a result of these treatments is vital. In complete tooth loss, prosthetics may not always provide the desired results [1, 3]. The volume of the jawbone is maintained by the natural teeth in the oral cavity, and even with a small number of teeth, a removable prosthesis is far more likely to be retained than in the complete absence of teeth. This is especially true when creating a prosthesis for the mandible [20]. Inadequate evaluation of the periapical tissues leads to the removal of roots that may stabilize a detachable prosthesis, significantly increasing its retention [21]. There are many methods for restoring a tooth's crown using different types of stump posts, however their effectiveness in detachable prosthesis is not always consistent. As a result, in the area of prosthetic dentistry, overlapping prostheses such as dental implants and locking mechanisms are becoming more and more common. This kind of prosthetic design may improve the stability of detachable prostheses and lessen alveolar process atrophy [22]. By shifting pressure to the supporting teeth, lock fasteners improve functional efficiency and reduce mucosal pressure, which helps to stabilize and retain prosthetic devices [24]. The base border's reduction speeds up patients' transition to prostheses, and the discrete attachment components make it easier to get the best possible aesthetic result.

By using overlapping prostheses secured by spherical attachments, dental implants, and collapsable dental implants, the research aims to improve the quality of prosthetic treatment for patients who are partly edentulous.

METHODS

The Department of Orthopaedic Dentistry at Samarkand State Medical University treated a total of 27 patients, 12 of whom were male and 15 of whom were female, ranging in age from 59 to 74. Isolated teeth with weakened crowns were a hallmark of dental arch disease. With a focus on assessing the periodontal condition of the remaining tooth roots, the objective examination included an external evaluation of the face, oral cavity, and mucous membrane of the denture bed. To evaluate the state of the bone tissue supporting the teeth and in patients with dental implants, three-dimensional dental computed tomography was used. The "Kodak 9000 3D" digital dental computed tomography equipment, which has panoramic diagnostic capabilities, was used for the study. For the trial, the patients were divided into three groups. Ten patients in the first control group received partial removable plate prostheses (six for the maxilla and four for the mandible) made using conventional techniques, while nine patients in the second group received overlapping prostheses with spherical attachments (five for the maxilla and four for the mandible) made using our suggested method. Two overlapping prostheses used a metal framework that completely covered the denture base and was combined with lock fittings. In addition to five overlapping prostheses (two for the maxilla and three for the mandible), two to three dental implants were positioned in each jaw. Three interlacing prostheses used a metallic structure. A technique that enables the measurement of plaque buildup on the prosthesis was used to assess the hygienic quality of detachable dentures. The plaque index of removable dentures was evaluated using the ASKD-DPI denture plaque index (2015). Using the Statistica software, a personal computer was used to analyze digital data using the variation statistics approach. Results and conversation After an objective evaluation, the diagnosis for each patient was "partial edentulism of class I per Kennedy classification, and a complete loss of masticatory efficiency as per Agapov." Custom-fitted stump pin inserts were made after the tooth roots were kept after clinical and radiographic assessments. The securing elements were spherical locking fasteners. Commercially accessible, collapsible dental implants were placed as part of a dental implantation process. In order to produce dental implants with spherical lock fasteners and overlapping prostheses with cast stump pin tabs, an imprint of the jaw was taken. The prosthesis was then made using either a one-stage silicone

technique or a two-layer, two-stage process. A variety of silicone impression materials were used throughout the project, including polyester impression material 3M Impregnum, C-silicones like Speedex, Stomaflex, and Zetaplus, and And-silicones like 3M Express, Elite HD, and Ultrasil. A modeling plastic with little shrinkage and no ash was used to fill the imprint. Design Resin with an implant with a spherical abutment or a supporting tooth with a molded steel pin insert and a suprastructure set up as a spherical lock attachment. To give the best mechanical adhesion of ash-free plastic to gypsum, retention features, including longitudinal and transverse grooves, were made on the counterpart of the pin stump insert in the region meant for attachment inside the gypsum model. After the plastic had finished polymerizing, GC FujiRock super gypsum was used to create a functioning model. The imprint was removed from the model after the gypsum crystallized in order to avoid distorting the structural elements. An analytical rod was used to determine the prosthesis's insertion route on the milling parallelometric device's table. The shape of the prosthesis base was defined, and bushings for lock fasteners were attached to the lock component made of ash-free plastic. In the clinic, occlusal rollers made of base wax were used to measure and record the height of the bottom third of the face as well as the size, shape, and color of fake teeth. Plastic was used in place of wax, and artificial teeth were placed in the lab. A metal framework was used to create the frame prosthesis, and the locking sleeve was placed at the base of the overlapping prosthesis. At the clinic, the finished prosthesis was fastened and placed inside the patient's mouth. The patients had little pain once the manufactured orthopedic devices were applied. There were no difficulties with dentures self-fixing in the mouth cavity or patients removing them. Follow-up visits were set up for the patients at six, twelve, and twenty-four months. Four patients in the control group showed a decrease in the partial detachable plate prosthesis' stability after six months. Nine patients from the control group and two patients from the main group who got replacement prosthesis using cast stump pin tabs with spherical locking fasteners showed a decrease in fixation after a year. Patients in the control group saw a decrease in the fixation of partial removable plate prostheses after 24 months, while three patients in the main group who received replacement prostheses using cast stump pin tabs with spherical locking fasteners, one patient with a frame prosthesis using cast stump pin tabs with spherical locking fasteners, and one patient with an overlapping prosthesis based on cast pin stump inserts with spherical lock fasteners and dental implants with spherical abutments also reported similar problems. In order to properly clean detachable orthopaedic components, patients were encouraged to use hygiene products. The simplest and most economical way to clean removable dentures is using Korega washing pills, which are made by GlaxoSmithKline Healthcare. The special formulation of Korega cleansing tablets includes sodium carbonate and potassium monopersulfate for stain removal, sodium lauryl sulphate for effective prosthesis cleaning, and TAED (tetraacetylethylene diamine), which increases antimicrobial efficacy against bacteria and fungi that cause halitosis. The tablets are intended for routine maintenance of orthopedic devices that may be detached. Follow the instructions on the box to get the best results: For three to five minutes, immerse the prosthesis in Koreg solution. Use a gentle brush to clean the denture with Koreg solution, then thoroughly rinse the prosthesis under running water for best results. The control group's dental hygiene index scores were distributed as follows after a year: Three patients showed between 0 and 30 percent; four showed between 31 and 70 percent; and three showed between 71 and 100 percent. Nine patients at the main hospital showed 0–30%, six showed 31–70%, and two showed 71–100%. Eighty-two percent of patients had good hygiene.

CONCLUSIONS

An analysis of the orthopaedic treatment of 27 patients with single teeth and dental roots who received partial removable plates and overlapping prostheses using cast stump pin tabs and dental implants with spherical locking mechanisms shows that prosthetic effectiveness depends on the clinical setting and the careful selection of orthopaedic design, as well as a precise assessment of the periodontal condition of the supporting teeth and the identification of contraindications for the fabrication of cast stump pin inserts with spherical locking fasteners. The proposed method for creating overlapping prostheses using spherical attachments makes it possible to fabricate prostheses without requiring clinical relocation in order to insert fixation components in the prosthesis base. The instantaneous modeling of an overlapping prosthesis with fixation elements directly on the model is made possible by similar plastic locking fasteners. This 160 method improves the accuracy of the orthopedic construction produced. This has a favorable effect on the prosthesis's stability and attachment quality. Maintaining good oral hygiene requires regular denture cleaning; Korega cleansing pills make it easier to reach a sufficient hygiene level.

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