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CASE REPORT

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A Digital and Conventional Approach to the Rehabilitation of Complete Edentulous Patient with a Toronto Infrastructure Design Hybrid Prosthesis: A Case Report

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Abstract

This case describes the prosthetic treatment of a completely edentulous patient treated with the "Toronto Bridge" technique, an implant-supported (all-on-four/all-on-five) hybrid prosthesis.

A 42-year-old male patient applied to our clinic for aesthetic and functional problems. After clinical and radiographic examination, the all-on-five treatment concept for the edentulous maxilla and an all-on-four treatment concept for the edentulous mandible were planned. In the maxilla, two distal implants were placed at 30-45° angles, and three straight implants were placed in the anterior region. In the mandible, two distal implants were positioned at the anterior to mental foramina at an angle of 30-45°and two straight implants were placed in the anterior region. The digital impressions were taken, and the infrastructures and veneers were designed according to the "Toronto Bridge" protocol. The infrastructures and veneers were fabricated by milling zirconium blocks and cemented. The occlusion was rechecked for any interferences.

This case report showed successful results for the all-on-four/five treatment concept "Toronto Bridge" prostheses at a six-month follow-up, and no complications were observed. This case report suggests that the implant-supported prosthetic treatment of a completely edentulous patient treated with the "Toronto Bridge" treatment technique provides esthetics, phonetics, oral hygiene, and oral comfort, which may be an alternative to an acrylic resin or porcelain fused metal fixed restorations.

Keywords: Edentulous, Implant-Supported Dental Prosthesis, Dental Esthetics, Zirconium

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INTRODUCTION

Severe atrophy of the alveolar ridge after the loss of teeth usually occurs in the edentulous jaw, increasing over time. Complete dentures and implant-supported removable partial or fixed dentures are among the treatment options for this type of edentulism. Removable prostheses used in the solution of complete or partial edentulism are among the prosthesis's patients have the most difficulty using. With the spread of implant applications, dental implants have shown stabilization and retention-enhancing effects in fixed restorations and removable prostheses (1).

The main purpose of implant treatment, which is used in many cases from simple to complex, is to avoid using complete dentures by applying implant-supported fixed dentures or to increase the retention and stability of complete dentures. The treatment option may vary depending on the anatomical limitations, the patient's preference, and surgical interventions to restore the patient's soft tissue and bone (2). Treatment of edentulous jaws with atrophic alveolar ridges with implants; is often complicated by problems such as poor bone quality in the posterior region, insufficient bone quantity due to long-term edentulism, and anatomical limitations of the alveolar bone income. Several implant rehabilitations can be performed depending on the quality and quantity of residual bone, the level of atrophy, and nerve positions (3). Grafting may be an appropriate treatment option to obtain the bone required for implant placement. However, this treatment often requires meticulous surgical procedures, complications can develop, and therefore it requires more time, and the cost of treatment can be high. Therefore, it is a treatment option with low acceptance by the patient (4). To avoid grafting procedures and to make the most effective use of the pre-existing bone, the alternative of placing the implants at an angle has been recommended (5). The name of this technique is the All-on-four technique, and in 2003 Malo et al. started to be used it for the first time as a modern technique in implant prosthesis rehabilitation and appeared in atrophic full arch mandibula and maxilla in 2005 (6). The two anterior implants are placed axially. The two posterior implants are angled distally to reduce the cantilever length and allow the prosthesis to be applied to up to 12 teeth. Anterior implants are placed perpendicular to the lateral incisor region in the mandible and maxilla; posterior implants are placed distally inclined just in front of the mental foramen in the mandible and parallel to the anterior wall of the maxillary sinus in the upper jaw. Anterior implants are placed perpendicular to the occlusal plane, and posterior implants are inclined approximately 30-45° distally (7). In patients with higher risk factors regarding the quality and quantity of residual bone, treatment concepts such as all-on-5 or all-on-6 can be considered with the

placement of additional implants without changing the number of angled distal implants.

Different connection systems between prosthetic infrastructures and implant fixtures in screw-retained rehabilitation are available today. Particularly in full-arch implant-supported rehabilitations, the Multi-Unit Abutment systems are widely used to achieve a passive prosthetic fit in the case of implants with various sizes and angled parallelisms (8). Patients are not only concerned about functional chewing but also about esthetics lost due to increased life expectancy and tooth loss. The patients' expectations have increased with the development of implantology, CAD/CAM, and other digital systems. Today, edentulous patients consider the implant-mounted fixed prosthesis first with this expectation. It is essential to fix by screwing in extremely atrophic jaws to provide aesthetics and phonation and to remove it from the mouth in case of any fracture or repair in the prosthesis, especially in full arc implant-supported prostheses in the lower and upper jaws. There are two options for the construction of implant-supported fixed prostheses. The first of these options is fixed prostheses that can be cemented with transmucosal abutments or metal-ceramic implant-supported fixed prostheses used with screw abutments for prosthetic retention (9). One of the types of fixed prosthesis on the implant is implant-supported hybrid prosthesis (1). Hybrid prostheses in dentistry are fixed prostheses consisting of screwed artificial teeth arranged on a rigid (metal or titanium) infrastructure and consisting of at least 4 implants with implant diameters that should be as wide as possible and an acrylic resin prosthesis base (10). However, these prostheses can be made on a variable number of implants, but ideally, the largest possible number of implants should be placed (9).

The inert structure of porcelain is minimally affected by staining and abrasions, providing permanent aesthetics. It can also be prepared by making metal-supported porcelain crowns on metal infrastructures formed as cut teeth to gain a more natural and aesthetic gingival appearance. Infrastructures can be produced from chromium-cobalt (Cr-Co) with the lost wax technique or from titanium and zirconium in addition to Cr-Co by the CAD/CAM milling technique. Factors such as the shape and dimensions of the infrastructure of hybrid prostheses, passive compatibility with the implant platform, the number and distribution of implants, aesthetics, and oral hygiene affect the success of these prostheses (11). The first criterion to be taken as a basis when deciding on the construction of this type of prosthesis is the inter arch distance. However, lip support, a high smile line in the upper jaw, and a low lip line in the lower jaw during speech are other aesthetic parameters to be considered. It is reported that the inter arch distance should be 12-15 mm to ensure the passive fit of implant-

supported fixed prostheses in the mandibular arch. Because the high temperature used during the firing of the porcelain can cause an expansion in the metal infrastructure during firing and shrinkage during cooling, thus preventing the passive seating of the restoration (1). Therefore, providing passive compatibility between the metal infrastructure and the implants in implant-supported hybrid prostheses becomes an important factor (12). It has been reported that better aesthetic results can be obtained in cases where the interarch distance is sufficient (13). In the treatment of patients using hybrid prostheses, it has been observed that these prostheses provide more chewing function and psychological satisfaction than traditional prostheses. Occlusal forces have increased significantly following implant-supported prostheses (14). Mandibular implant-supported hybrid prostheses are also used successfully in edentulous patients who cannot adapt to the long-term use of conventional complete dentures (15).

CASE REPORT

A 42-year-old edentulous male patient was applied to the Department of Prosthodontics, Ordu University, due to aesthetic and functional problems. The patient had no relevant medical history. After clinical and radiographic examination and according to the patient's request, the all-on-five treatment concept for the edentulous maxilla was planned. An all-on-four treatment concept is for the edentulous mandible with a fixed prosthesis. Surgery was performed under local anaesthesia under aseptic conditions in an outpatient environment. In the maxilla, two distal implants were placed at an angle of 30-45°. Three straight implants were placed in the anterior region of the maxilla. In the mandible, two distal implants were positioned at the anterior to mental foramina at an angle of 30-45°. Two straight implants were placed in the anterior region of the mandible (Implance, BL 4.3; A.G.S. Medical, Trabzon, Turkey). After waiting 3 months for osteointegration of dental implants, gingival formers were taken. Two weeks later, conventional impressions were taken using the open tray technique. After, cast models were poured with Type III dental stone (Whip Mix Dental Stone; Whip Mix Corp, Louisville, Kentucky, U.S.A.) (Fig 1.)

Fig. 1. Conventional cast models obtained after open tray impression.

Base plaques were produced, and the vertical dimension of the jaws was determined with a base plaque using closing wax. Scanbodies were taken onto the cast models for digital impression. Digitally impressions of models were made with an extra-oral scanner (E4; 3Shape, Copenhagen, Denmark) (Fig. 2).

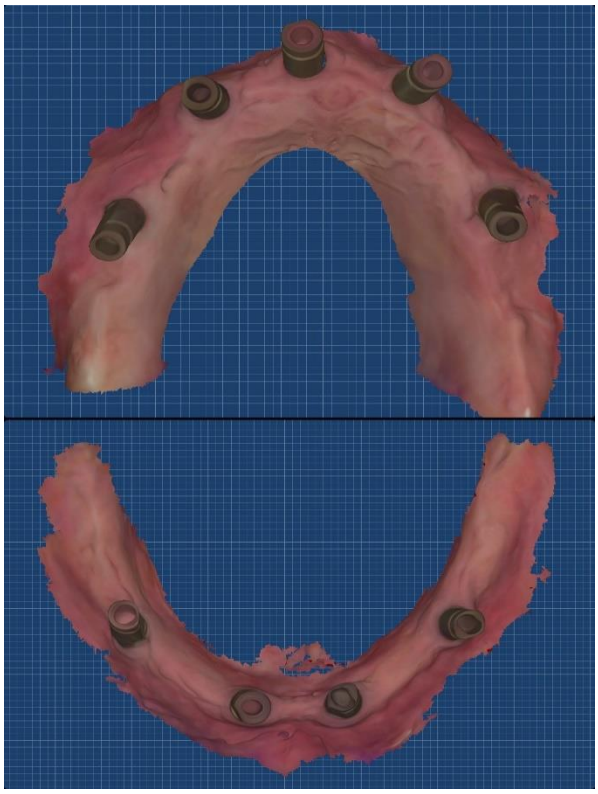

Fig. 2. Digital models obtained after extra-oral scanning.

The vertical records of models were taken the same way. The infrastructures and veneers were designed according to the "Toronto Bridge" protocol by using the Exocad software program (Exocad DentalCAD; Exocad GmbH, Germany) (Fig. 3).

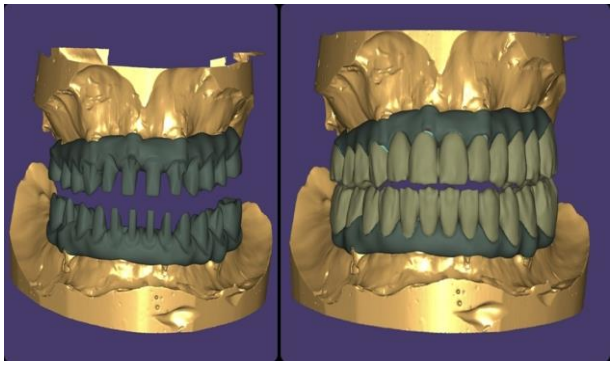

Fig. 3. Digital design of infrastructures and cut-back veneers.

The diagnostic dentures (try-in) were fabricated for the control of interocclussion, vertical dimension, gingival appearance and passive fitting of infrastructures by using the resin-based polymer liquid (NextDent Try-In; 3D Systems Co, Rock Hill, SC) and 3D dental printer (NextDent 5100; 3D Systems Co, Rock Hill, SC) (Fig 4.).

Fig. 4. Intra-oral photographs of 3D-printed try-in infrastructures and cut-back veneers.

After control and the patient's consent, the final infrastructures were fabricated by milling zirconium blocks (Ceramill Zi; Amann Girrbach AG, Koblach, Austria) with a milling machine (Motion 2; Amann Girrbach AG, Koblach, Austria) (Fig. 5). After the passive infrastructure fitting was controlled according to the Sheffield Passivity Test (Single Screw Test). When the infrastructure compatibility was checked, the gingival porcelain and

gingival shaping for pink aesthetics were done and checked in the mouth (Fig. 6).

Fig. 5. Intra-oral photographs of zirconia infrastructures.

Fig. 6. Intra-oral photographs of gingival porcelain applied zirconia infrastructures.

Triple, double, and single crowns were fabricated by milling monolithic zirconia blocks (Ceramill Zolid fx; Amann Girrbach AG, Koblach, Austria). The buccal surface of crowns was veneered with feldspathic ceramic (G.C. Initial; G.C. America Inc, Alsip, IL, U.S.A.). The veneered restorations were glazed. Titanium caps that were comfortable for the multi-unit abutments were cemented in the zirconium infrastructure with the help of dual-cure resin cement (RelyX U200; 3M Espe, Seefeld, Germany) after applying to the primer agent (Z Prime Plus; Bisco Inc, Schaumburg, U.S.A.). Screw-retained Toronto infrastructure was placed onto the multi-unit abutments and screwed with 20 Newtons torque according to the manufacturer's instructions. Screw holes were closed with teflon and composite resin (Filtek Z250; 3M ESPE, St. Paul, MN, U.S.A.). The primer agent was applied to the crowns' inner surface and the zirconia infrastructure's corresponding surface and cemented with dual-cured resin cement. The excess cement was cleaned from the edges. Lateral and protrusive movements of the mandibula were rechecked (Fig. 7).

Fig. 7. Intra-oral photographs of the final prosthesis.

Hygiene techniques were explained and demonstrated, and a mouth guard was delivered

to the patient. The patient was called for control and care after 6 months. As a result of panoramic film examination and intraoral examination, no problems were encountered regarding function and aesthetics in prostheses and implants (Fig. 8). The patient was satisfied with the prosthesis, and the patient's quality of life increased. There was no problem in the care of the prosthesis.

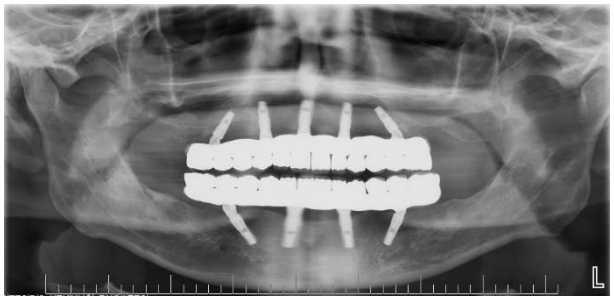

Fig. 8. Panoramic radiograph of the patient after treatment.

DISCUSSION

Nowadays, tilted posterior implants are commonly placed in each jaw without bone grafts and extra surgery appointments. With four and more than four implants placed, there is always the possibility of proceeding with sufficient support without replacing an implant (16). Thus, time and the economy can be saved.

Implant-supported fixed restorations are among the most appropriate treatment options in edentulous patients if sufficient residual bone quantity and quality, appropriate skeletal relationship and interarch distance, and economy are available. Many combinations of materials have been used for this type of restoration, such as metal alloy-acrylic, metal alloy-composite, and metal alloy-ceramic. The use of zirconia for infrastructures is an option that has been proposed. The zirconia infrastructure is an alternative material for these dentures. Although metal-ceramic restorations provide superior mechanical properties, previous studies have shown that zirconium restorations have excellent physical, mechanical, biological, and chemical properties (17). The infrastructures were fabricated using zirconia stabilized with 3 mol % of yttria (3Y-SZ) blocks to obtain high mechanical properties. However, the crowns were fabricated using high translucency 5 mol % Y-SZ blocks to obtain high aesthetics. On the other hand, the crowns were fabricated with cut-back facial and veneered feldspathic ceramic to increase the optical properties.

Although the digital workflow provides many advantages, such as storing-transmitting data, shortening the production process, and minimizing laboratory-related errors, it is stated that the decreased accuracy and precision, especially in full-arch implant-supported restorations impressions obtained with intraoral scanners (18,19). According to previous studies, the open tray technique was used for the impressions. The cast models were scanned using an extra-oral scanner, and impressions were digitized. So, other processes were performed digitally. Thus, a more comfortable infrastructure design was aimed at combining conventional and digital impressions.

CONCLUSION

This case report showed successful results for the all-on-four/five treatment concept "Toronto Bridge" prostheses at a six-month follow-up, and no complications were observed. This case report suggests that the implant-supported prosthetic treatment of a completely edentulous patient treated with the "Toronto Bridge" treatment technique provides esthetics, phonetics, oral hygiene, and oral comfort, which may be an alternative to an acrylic resin or porcelain fused metal fixed restorations.

Ethics Committee Approval: The consent form was filled out by the participant.

Author Contributions: Concept: ASK, EÇ Design: ASK, EÇ Literature search: ASK, EÇ Data Collection and Processing: EÇ Analysis or Interpretation: ASK Writing: EÇ ASK.

Conflict of Interest: No conflict of interest was declared by the authors.

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