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A case of maxillary anterior implant prosthesis secured with proper treatment plan and prosthetic design

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With the development of digital dentistry and computer-aided-design/computer-aided-manufacturing (CAD/CAM), implant placement became possible by analyzing the final prosthetic design and the anatomical structure of the alveolar bone. Before the development of guide stents using CAD/CAM, fixed bridges or cantilever bridges were used to repair missing teeth in places where implant placement was difficult due to poor alveolar bone shape. In the cantilever bridge, stress is applied to the pontic to remove the prosthesis, or the load is concentrated on the abutment and the prognosis of the abutment is poor. The patient in this case had implants placed only in the maxillary right central incisor (#11), and the prosthesis was restored with a cantilever zirconia porcelain bridge using the left central incisor (#21) as a pontic. Afterwards, she visited our hospital due to frequent prosthetic fallout and mobility. During intraoral examination, retention of the prosthesis was insufficient due to the short abutment length in #11. As a result of CBCT imaging and analysis, it was determined that implant placement in the #21 pontic was possible if a surgical guide was used. Therefore, we report that the patient's discomfort was resolved through the restoration of the new prosthesis, and satisfactory results were obtained for both the patient and operator. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2022;14(1):18-24)**

Key words: Surgical guide, Cantilever bridge, Dental implant diagnosis, Customized abutment

INTRODUCTION

When determining the number of implants in a partially edentulous area, it is decided by considering not only the number of missing teeth, but also the spacing between adjacent teeth and the spacing between adjacent implant fixtures[1,2]. If the distance between the two implants is too close, the resorption of the alveolar bone is caused, and the loss of the interdental papilla and non-esthetics are caused[3]. In the case of loss of both maxillary central incisors, since the acetabular canal is located between the two central incisors, even if the mesiodistal distance between the bilateral lateral incisors is sufficient for the placement of two implants, it may not be possible to secure two implant fixtures to avoid the nasopalatine canal[4]. In addition, from an aesthetic point of view, it is easier to obtain symmetry of the prosthesis by pontic processing the other side according to the shape of the implant prosthesis on one side rather than the connection of two adjacent implant fixtures. And there is no need to worry about alveolar bone resorption due to the proximity of the two implants. Nimwegen[3] reported that, through a systematic literature review, a 2-unit cantilever prosthesis fixed to a single implant was recommended as an alternative treatment in esthetic areas due to its excellent short-term success rate and excellent patient satisfaction.

However, after placing one implant fixture in the two central incisors, one side has the shape of a cantilever during prosthesis, so careful consideration of occlusion and retention of the prosthesis is necessary. If excessive forward stress is applied to the cantilever, the prosthesis on the other side is removed or a torsional stress is applied to the fixture[5]. When considering the retention force in cement-retained prostheses, the type of cement and the shape of the abutment influence the improvement of the retention force[6]. Also, the prosthetic dislodgement is the result of unbearable excessive stress. When excessive stress is applied to the implant prosthesis, loosening of the screw, fracture of the screw[7], fracture of the abutment, and detachment of the prosthesis[8] occur.

The diagnosis of implant position using CAD/CAM and the use of a surgical guide system increase the predictability of the diagnosis and treatment process of implant prosthetics. Since the

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model-based implant guide was a model-based planning system, the implant placement position could be determined according to the proper prosthesis position, but the anatomical structure of the lower alveolar bone could not be considered. Therefore, implant placement planning was limited when there were important anatomical structures nearby or when the width was narrow[9].

In this case, the number of implant fixtures was insufficient due to the esthetic purpose and inaccurate diagnostic process, and the retention form of the abutment was insufficient, so the removal of the prosthesis was continued. We report that an implant prosthesis with stability can be completed by additionally placing an implant through diagnosis using a surgical guide and connecting an abutment changed to an appropriate length.

CASE REPORT

A 35-year-old woman came to the hospital with the complaint that the implant prosthesis continued to fall off from the anterior part for some time. She had no special systemic medical history, and she had a prosthesis for her maxillary central incisor that was implanted 5 years ago (Figure 1). The implant was placed on the right central incisor of the maxilla (#11), and the abutment on the upper part had a short length and did not consider the relationship with the opposing tooth at all. The maxillary left central incisor (#21) was a ridge rap type cantilever pontic connected to the right abutment (Figure 2). The prosthesis completely lost its rentention ability without cement, but when it was placed by hand, the fit between the abutment and the prosthesis and the labial esthetics were excellent First, for evaluation, the prosthesis was cemented as before and the progress was observed. It was adjusted so that occlusal force was not applied to the pontic side. However, the prosthesis fell off again at the time of visiting 2 weeks later, and an additional implant was planned with the patient's consent.

Upon intraoral examination of site #21, it had mesiodistal broad and pale pink gingiva. When evaluated by CBCT, the thickness of the alveolar bone on the labial surface of the #11 implant fixture was insufficient, and the nasopalatine canal was expected to have a sufficient distance when the implant fixture was positioned at the #21 position (Figure 3). After obtaining a model through intraoral scan impression taking and matching this model with CBCT, the precise location of the implant was diagnosed simultaneously with the design of the implant surgical guide (Oneguide, Osstem, Korea) on Implant Studio planning software (3Shape) (Figure 4 and 5). Since the implant fixture at #11 is labial and insufficient to secure the thickness of the alveolar bone, the #21 implant fixture with 3.5 mm wide and 10 mm length (Osstem TSIII, Osstem, Pusan, South Korea) should be positioned slightly more lingually than #11. Instead, the fixture was placed deeper into the alveolar bone to control the cervical shape of the prosthesis.

After the additional implant was placed, the inner surface of the existing upper prosthesis was adjusted and temporarily cemented. The upper part of the implant healing abutment of #21 was positioned at the same height as the gingiva and a prosthesis was temporarily installed there. Cementation was maintained for a longer period of time than in previous cantilever prostheses (Figure 6).

After confirming the osseointegration, impressions were taken with an intraoral scanner (i700, Medit, Seoul, Korea). Information was delivered to the laboratory by taking impressions of the temporary crown in use, subgingival contour, scan body, and lips (Figure 7). The 2-unit implant prosthesis of #11 21 was designed by opening the stl file obtained by scan on the CAD software pro-

Figure 1. Cantilever bridge prosthesis using one implant fixture as an abutment in the right upper central incisor.

Figure 2. Symmetry of the gingival margin is esthetic, but a dark reflection of the fixture inside the gingiva (A). Upper central incisor implant prosthesis with short abutment and upper cantilever prosthesis removed (B). Zirconia bridge outside the oral cavity (C).

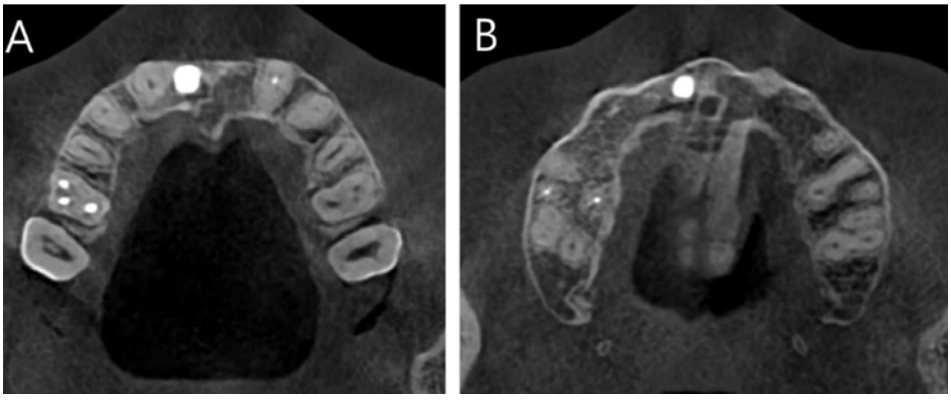

Figure 3. Insufficient labial alveolar bone mass in #11 (A). Considering the location of the nasopalatine canal, the mesiodistal space for #21 appears to be sufficient (B).

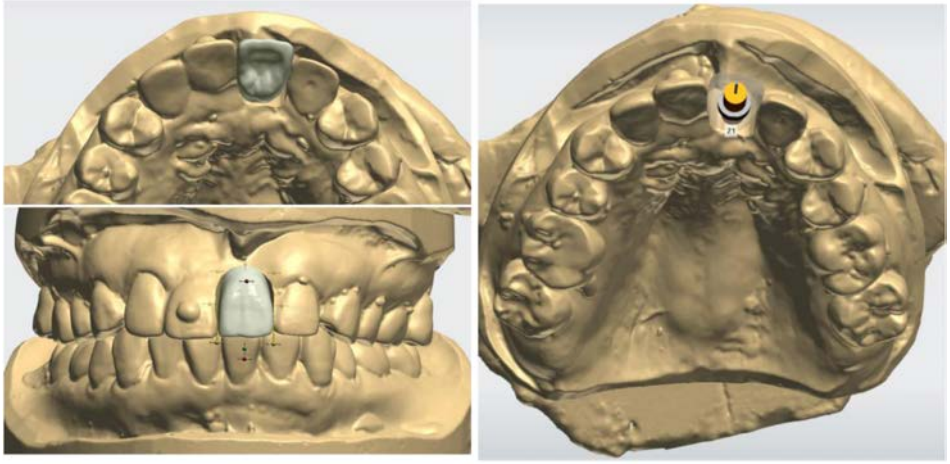

Figure 4. Virtual wax-up with reference to the position of the existing upper prosthesis.

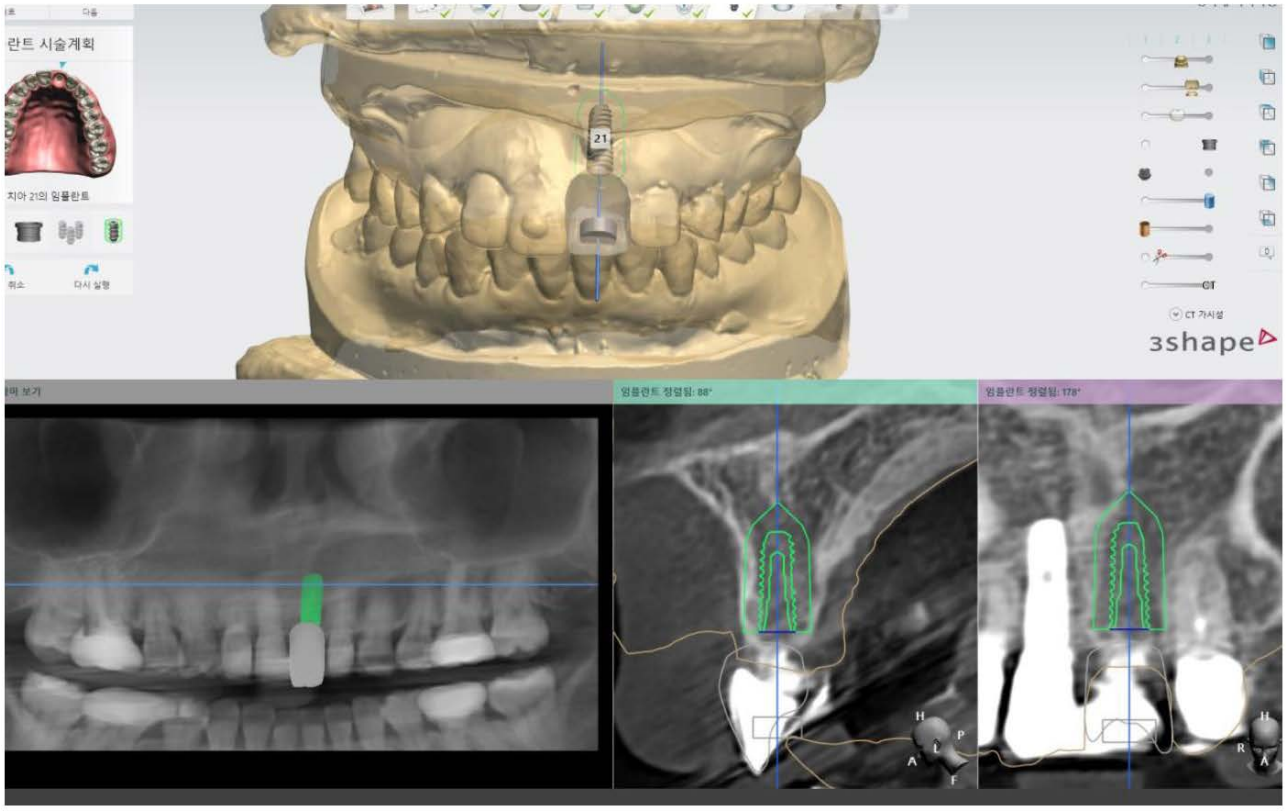

Figure 5. The position of the fixture relative to the position of the virtual wax–up. The position of the fixture relative to the position of the virtual wax–up. Buccal and mesiodistal spacing of the implant fixture is secured.

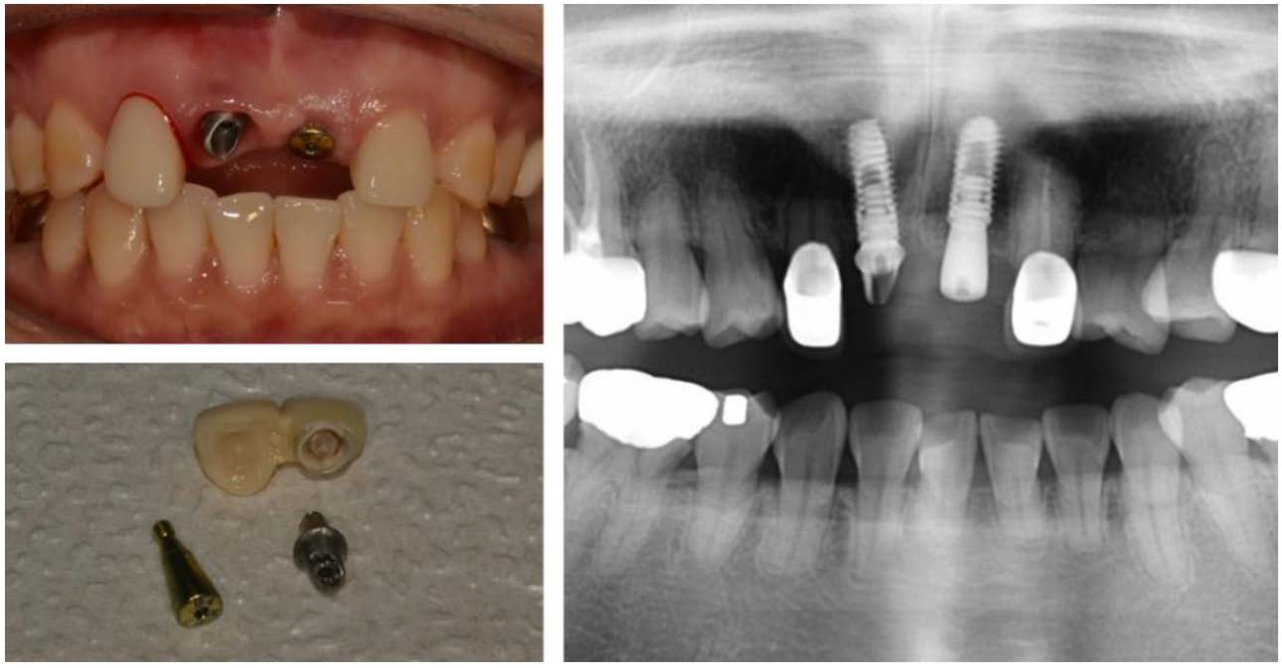

Figure 6. Period of waiting for osseointegration of fixture with healing abutment installed after additional implant placement.

gram (exocad DentalCAD; exocad GmbH). After designing the final prosthesis, the inner customized abutment was designed using the cut-back method (Figure 8).

The final prosthesis was placed in the oral cavity. The gingiva of #11 was thinner than #21, so the color of the fixture was transmitted through, but the morphological aspects such as left-right sym-

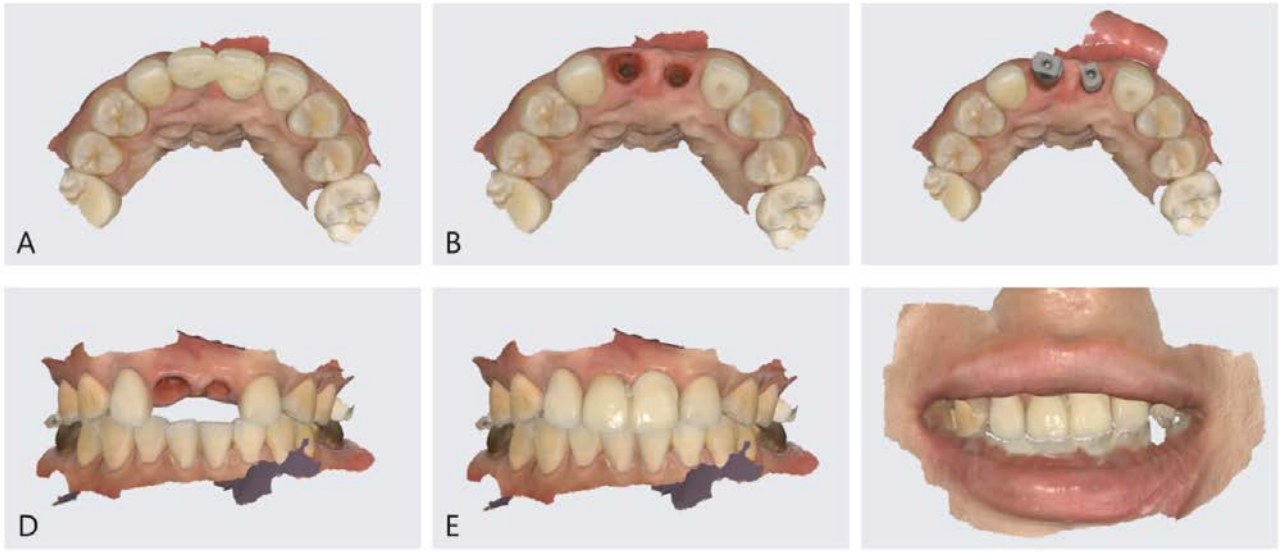

Figure 7. Impression taking. Occlusal view provisional restoration (A). Subgingival contour scan (B). Scan bodies (C). Labial view of gintival contour without prosthesis (D). Frontal view of provisional prosthesis (E). Lip scan image for estimation of teeth exposure (F).

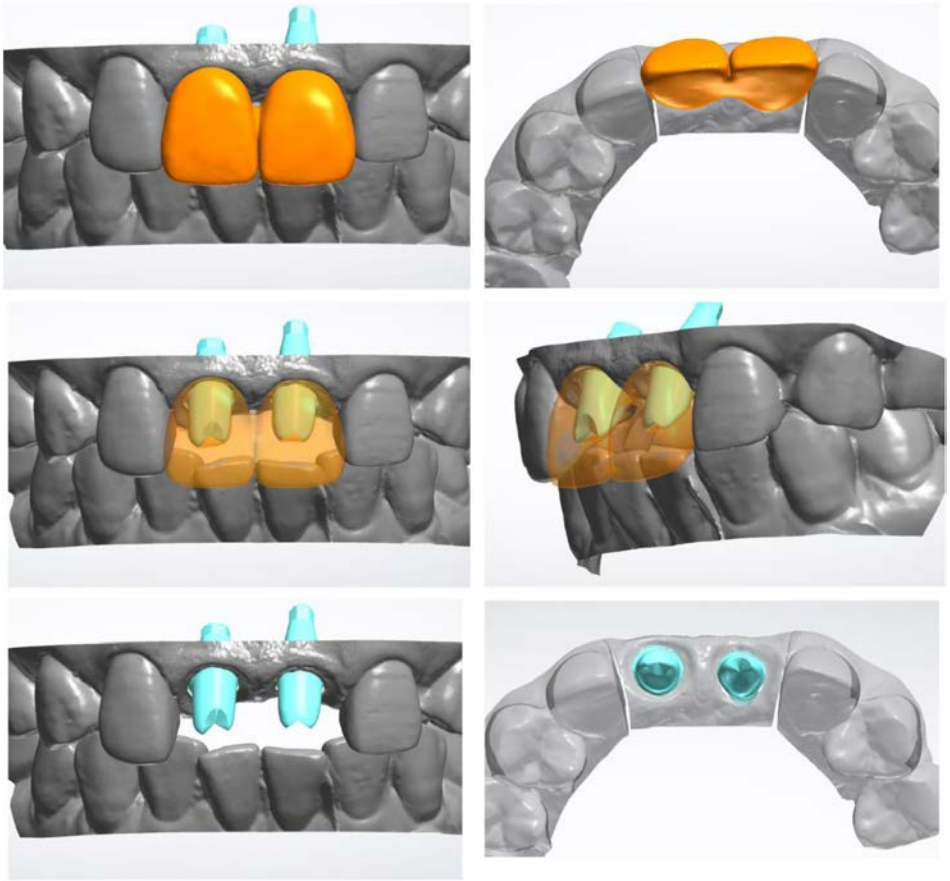

Figure 8. On the Cad software. Prosthesis design Customized abutment design tailored to the relationship with the opposing tooth and the shape of the final prosthesis.

Figure 9. Customized abutments and definite prosthesis.

metry were not bad. However, the difference in the gingival margin was more pronounced than when it was in the pontic form. At the beginning of installation, the interdental papilla between the central incisors was also in a tense state, but it was expected that the shape of the interdental papilla would change naturally during regular orthodontic visits (Figure 9). Structural retention of the prosthesis itself was exhibited, and dislodge of the prosthesis did not occur during the elapsed period after final cementation, and the patient was very satisfied esthetically and functionally.

DISCUSSION

Aesthetic implant prosthetic treatment in the maxillary anterior region is a challenging part. In the anterior maxilla, the shape and size of the alveolar bone is limited, so the placement of the implant fixture is difficult and aesthetic consideration should be given priority because it is a location that is seen outside the oral cavity.

When two implants are placed close together in a narrow area, the inter-implant nipple height is reduced and a black triangle can occur, which can reduce esthetic results. To avoid black triangle, the contact points of adjacent implant crowns are often located more apically to disguise these defects. This compensation is often used when the interdental papilla is low, but it also interferes with the creation of an esthetic and anatomically shaped implant crown[10]. In addition, the asymmetric shape of the alveolar bone and the different placement positions of the implants affect the shape of the upper gingiva, making it impossible to guarantee the symmetry of both prostheses.

Implant survival rate itself is no longer currently accepted as an outcome assessment for the clinical efficacy of implant prosthetic rehabilitation. Accurate implant positioning has obvious advantages such as good esthetic and prosthetic results, long-term stability of hard and soft tissues around the implant as a result of easier oral hygiene, and the potential to ensure optimal occlusal contact and implant loading[11].

Obtaining three-dimensional data of anatomy from CBCT and adding images generated by intraoral scanning devices to it can contribute to the digital data collected for treatment planning[12]. The accuracy of a guided implant surgical system is defined as the deviation between the planned and deployed position of the implant[13]. Errors from multiple sources can lead to inaccuracies in the accuracy of guided implant surgery. Accurate three-dimensional merging of CBCT and intraoral scan file images is a prerequisite for planning implant placement[14]. If the number of remaining teeth is insufficient or there are no teeth, the accuracy of the image superposition will be greatly reduced. Also, the choice of impression material, impression technique, casting materials and techniques, choice of computed tomography machine, and computed tomography scanning methodology are subject to error[15]. However, the digitization of implant surgery not only enables optimal planning of implant placement, but also the ability to transfer this planning to the surgical field. Accurate three-dimensional positioning of the implant allows optimal design of the final prosthesis.

In this case, only one implant was placed in the area of loss of both maxillary central incisors for aesthetic, anatomical, and technical reasons, and a cantilever prosthesis was installed and used for a long time. But, due to the loss of function of the cement and the poor shape of the lower abutment, it was unable to obtain any

more holding power. Digital technology was used to secure the basis for additional implant placement, and convenience was promoted by installing an abutment with an appropriate design considering the relationship between the shape of the upper prosthesis and the opposing tooth. The position of the two implants was not the same due to the difference in placement time and anatomical limitations, which resulted in inferior esthetics compared to the previous prosthesis. However, considering the long-term prognosis, it was possible to complete prosthetic treatment with retention and a certain degree of esthetics.

CONCLUSION

In this case, with the development of digital technology, a safe implant placement position was secured and the prosthesis was remanufactured to relieve the patient's discomfort by making a guide stent and selecting a customized abutment appropriately.

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