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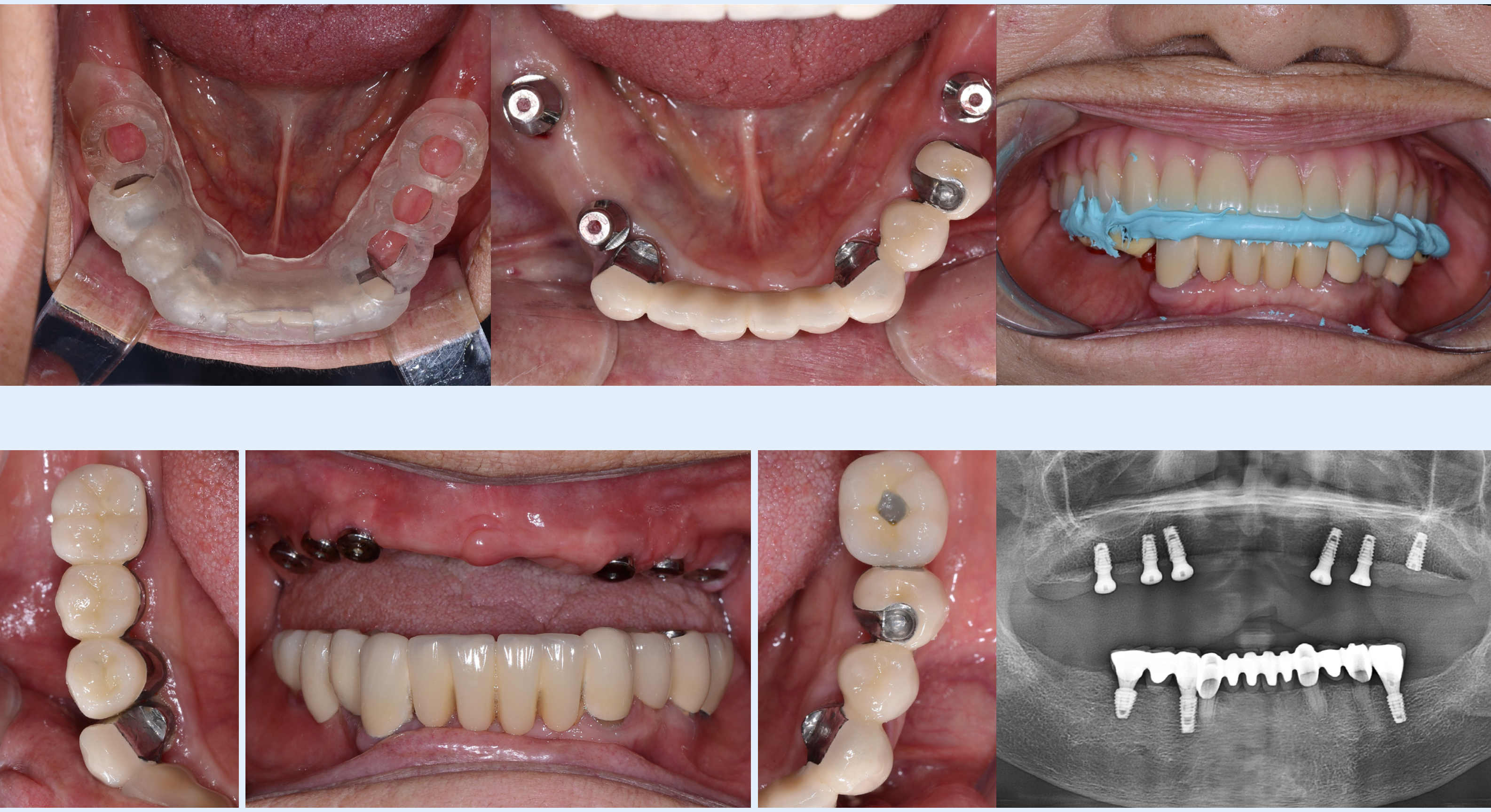
JCDD

Journal of Clinical & Digital Dentistry



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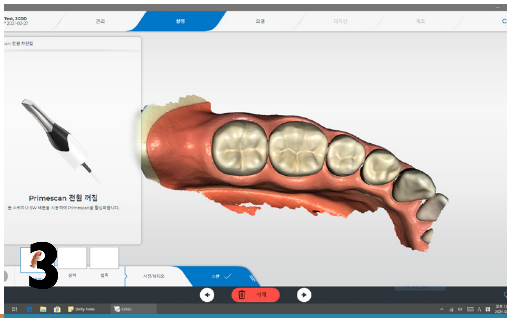

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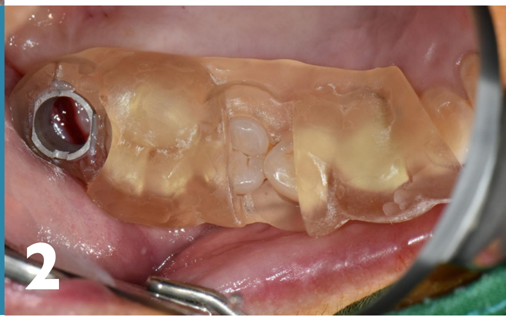

JCDD
Journal of Clinical & Digital Dentistry

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About the Journal

The Journal of Clinical and Digital Dentistry are published four times (March, June, September, and December) annually since May 2019. The abbreviated title is "J Clin Digit Dent". In the journal, articles concerning any kind of clinical dentistry such as prosthodontics, orthodontics, periodontics, implant dentistry and digital dentistry are discussed and presented.

Aims and scope

This journal aims to convey scientific and clinical progress in the field of any kind of clinical and digital dentistry.

This journal publishes

· Original research data and high scientific merit in the field of clinical and digital dentistry.
· Review articles.
· Case reports in implant dentistry including GBR, digital dentistry, 3D printing, and prosthodontics.
· Short communications if they provide or document new technique and clinical tips.

About the Journal

Editorial Board

Editorial

Continuous LEARN is absolutely necessary for continuous RUN

Individuals who enjoy watching videos of famous gourmet restaurants on YouTube or other social media platforms often desire to dine at such restaurants. When you visit a restaurant, most of the restaurants have unique characteristics. First, they do not have fancy signboards. Second, the restaurant owners do not invest significant efforts in receiving many customers. Third, from a diner's perspective, diners often find it difficult to discern the attraction that draws them toward a restaurant. Finally, they have their specialties and constantly strive to develop and maintain them.

The running capacity of sportspersons determines their training plan. Even weightlifters run as part of their basic physical training. This is because running is the most crucial exercise for becoming a good player.

Every dentist should possess the characteristics of gourmet restaurateurs and excellent sportspersons. While there are ordinary restaurants and average sports persons, dentists should reflect the characteristics of gourmet restaurateurs and excellent sportspersons. This is because it is crucial for dentists to provide the best treatment to every patient.

Like owners of old restaurants who strive for decades to ensure that the restaurant provides delicious food and like sportspersons who continuously train to improve themselves, all dentists should learn continuously to lead a successful practice.

Wongun Chang, DDS MS PhD

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The maxillary implant-supported bar overdenture as an alternative to the complete denture in a patient with severe alveolar bone resorption and combination syndrome: A case report

Giwon Na, DDS

Introduction

The restoration of oral function and esthetics in edentulous patients is often a daunting challenge for dentists. In the past, removable complete dentures were the only treatment option for edentulous patients, and treatment success was mainly dependent on the condition of the remaining alveolar bone. The pioneering work of Branemark, who initially inserted implants in an edentulous patient over 60 years ago, generated a paradigm shift in oral rehabilitation. A plethora of studies conducted since then have demonstrated that implants are a predictable and successful means for replacing missing teeth. Fixed and removable prostheses utilizing implants have considerable advantages over conventional removable complete dentures in terms of patient satisfaction; nevertheless, no significant differences have been reported between implantsupported fixed and removable prostheses.1 However, fixed prostheses require more stringent conditions, in terms of the anatomy of the residual alveolar bone, as well as biomechanical and esthetic factors. Since maxillary residual ridge resorption after tooth loss is more prominent on the labial and buccal aspects, compared to the palatal aspect, a Class III intermaxillary relation tends to develop over time.

Figures 1 and 2 show a patient with severe labial bone resorption in the maxillary anterior region. While it appears that there is sufficient residual bone for implant placement, the provision of a fixed prosthesis in this region would require considerable labioversion, due to the Class III intermaxillary relation. The treatment outcome would not only be mechanically undesirable, but also unesthetic, as the lost lip support is not restored. Indeed, severe labial or buccal alveolar bone resorption typically requires a removable prosthesis with a flange to support the lip and restore esthetics. In these situations, an implant overdenture would be an adequate treatment option for edentulous patients, and provide a higher degree of patient satisfaction compared to fixed prostheses and conventional removable complete dentures. Mericske-Stern et al. reported the factors that must be considered when determining the number and distribution of implants required in edentulous patients.2 An implant-supported overdenture typically requires the placement of four to six implants in the maxillary region, and the use of a design that lacks palatal coverage can considerably increase patient satisfaction.

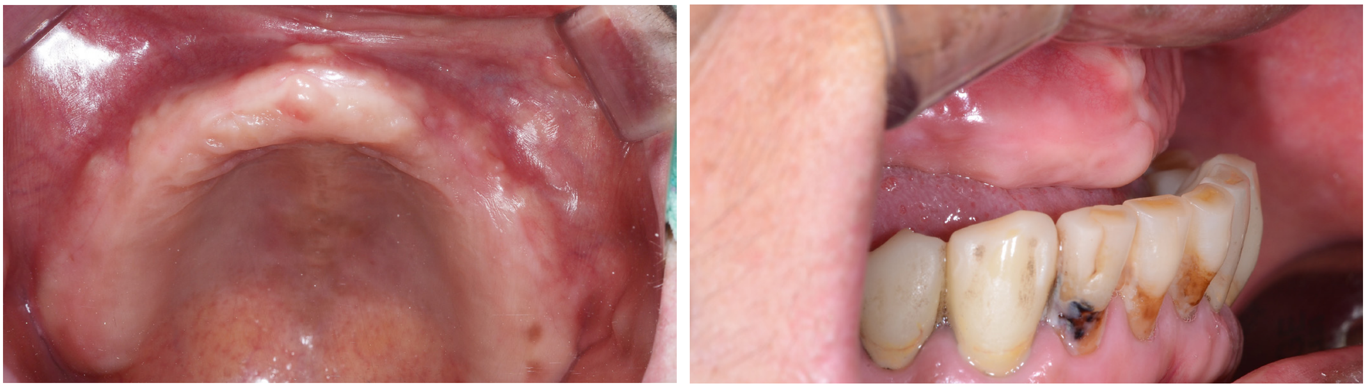

Fig 1-2. A patient with a Class III intermaxillary relation due to severe labial bone resorption in the maxillary anterior region.

Giwon Na

Director of Yeonsu Seoul Dental Clinic & Dentis implant course director
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Case Report

A 75-year-old patient presented with an existing mandibular removable partial denture and maxillary complete denture, which he had used for many years. Combination syndrome was evident, due to the presence of lower mandibular teeth and an edentulous maxillary arch. The patient's chief complaint was that he could no longer use either denture. While the missing mandibular teeth could be replaced with fixed implant-supported prostheses, a Class III intermaxillary relation was observed, with severe bone resorption in the anterior region of the maxillary arch.

Therefore, the provision of fixed prostheses was not feasible in the maxillary arch, due to their inability to restore the lip support and facial profile (Figures 3 and 4). Therefore, a removable prosthesis was planned for the maxillary arch; this comprised an overdenture with an open-palate design, supported by six implants in the anterior and posterior regions. Overdenture retention would be provided by the attachment to three clips on a milled bar, which would splint the six implants.

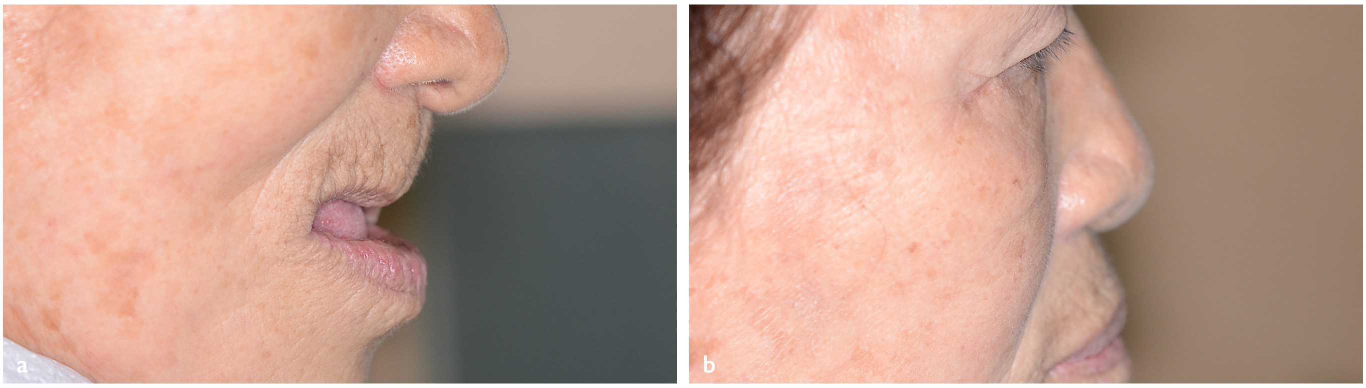

Fig 3a-b. (a) Facial profile without CD (b) Facial profile with CD

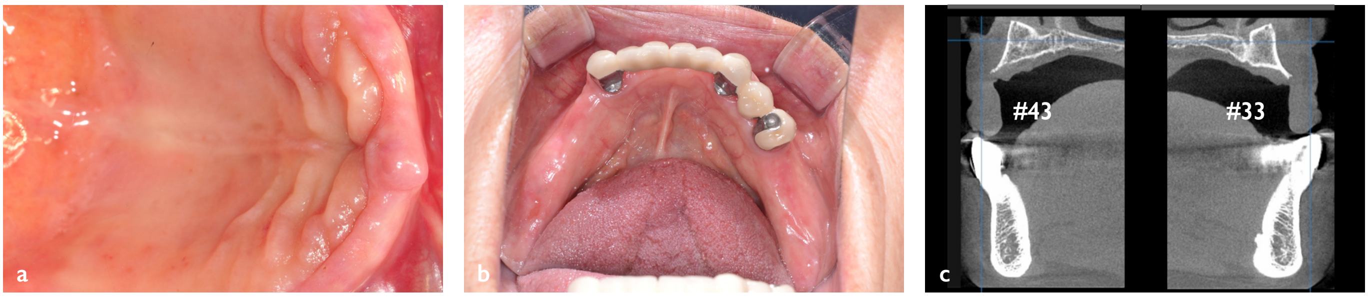

Fig 4a-c. (a), (b) Initial oral state (c) CT View of #33, 43 – Class III intermaxillary relation

Six implants were surgically placed, according to the treatment plan (Figure 5). However, a posterior implant in the upper left quadrant failed due to mobility, 3 months after placement; this was despite sufficient primary stability. The failure may have been caused by the improper replacement of the temporary denture soft liner and excessive stress from the healing abutment.

A new implant was placed in another site, which was posterior to the original socket (Figure 6). Osseointegration was achieved in all implants, with no major adverse events.

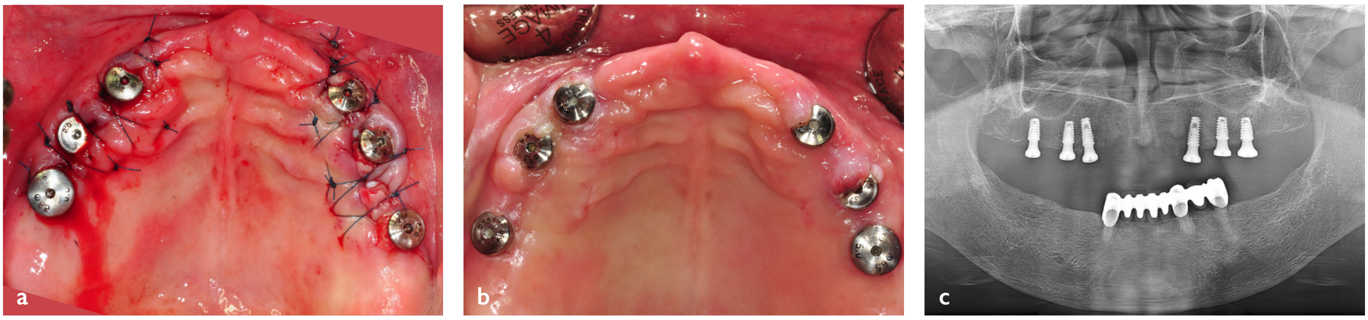

Fig 5a-c. (a) Implant placement
(b) POD 3 weeks
(c) Panorama after OP

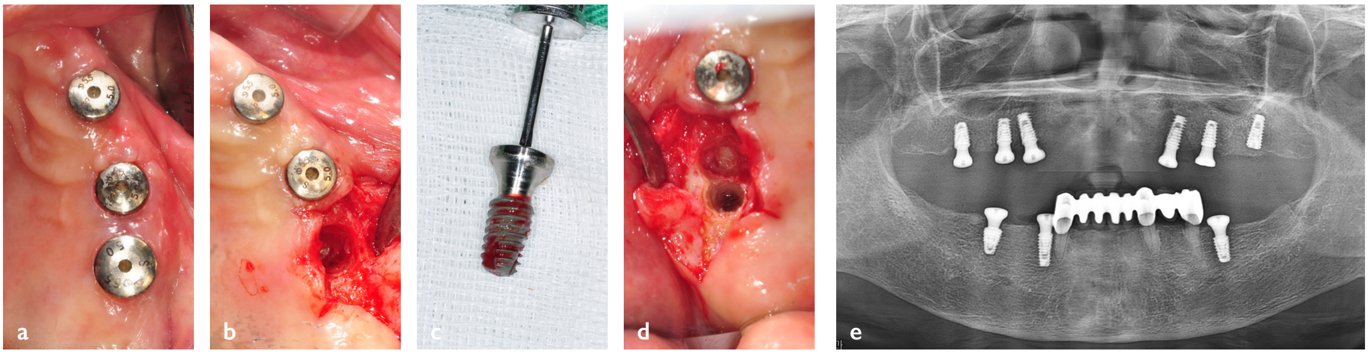

Fig 6a-e. (a) POD 3 months (b)-(d) Implant Failure (e) Implant re-placement

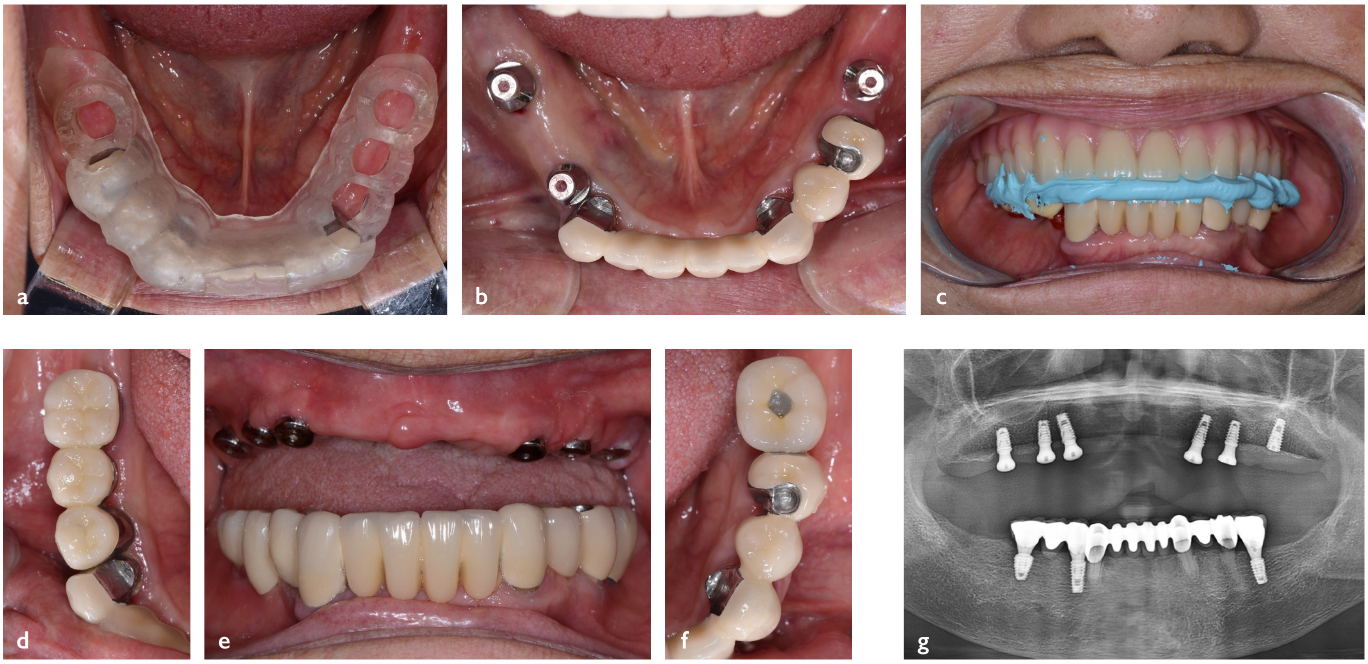

Fig 7a-g. Mandibular implants were placed via guided surgery, and prostheses were fabricated using conventional methods 2 months later.

Passivity of fit is critical for the prognosis of a one-unit prosthesis, such as a milled bar, when it is connected to widely distributed implants in the anterior and posterior regions.3 This requires an impression that is as accurate as possible. Splinting pick-up impression copings may greatly facilitate the simultaneous impression of multiple implants.4 In this case, a transfer impression was taken as a preliminary impression, which was used to produce an open tray for the pick-up impression.

The pick-up impression copings were splinted with pattern resin (Pattern resin LS, GC America Inc., Alsip, USA) on the model, and an open tray was fabricated; copings were separated by a cutting disk. Each pick-up impression coping was attached to an implant body in the oral cavity, and re-splinted with adjacent copings using pattern resin. An impression was then obtained with the open tray. Subsequently, the vertical height was determined using a wax rim (Figure 8).

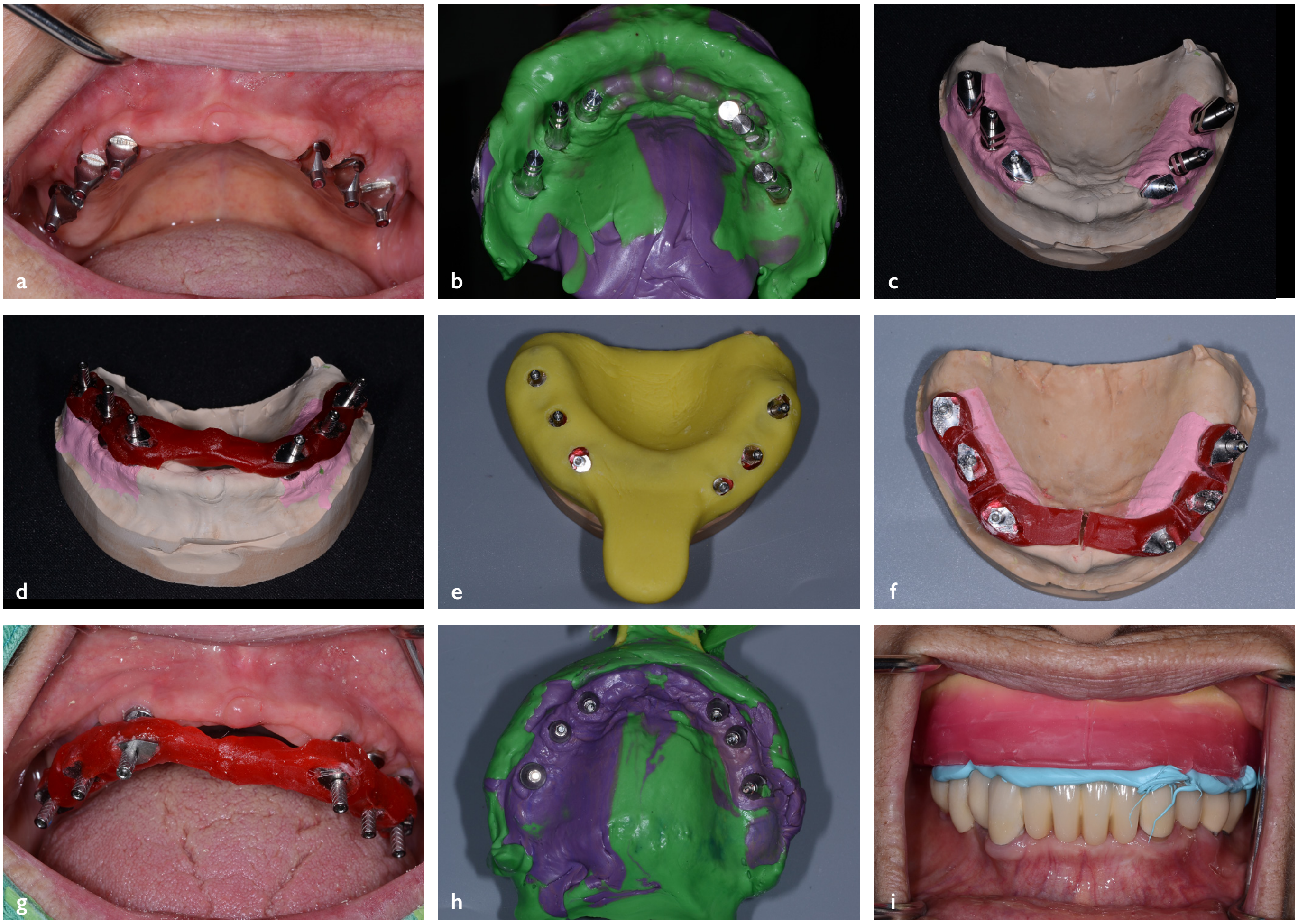

Fig 8a-g. (a), (b) 1st tranfer impression
(c)-(f) Splinting of pick-up impression copings, Open tray fabrication, Disking of copings
(g), (h) Pick-up impression taking
(i) VD check

A milled bar can be produced by waxing-up abutments, such as the University of California at Los Angeles (UCLA) abutments, in the desired bar shape and subsequent casting. However, milled bars fabricated in this way require screw retention, which has disadvantages in passivity and biomechanical performance compared to cement-retained superstructures.5 This is particularly the case for implants that are widely distributed in the anterior and posterior regions, as it is difficult to achieve a parallel path of insertion.

In the present case, a cement-retained bar structure was fabricated for a ready-made abutment to compensate for the nonparallel path of insertion. The retention of the milled bar was compromised, due to the short abutments. A screw-retained design with a castable abutment (CCM abutment) was used for the most anterior implant in the upper left quadrant, in order to enhance retention, while still ensuring passivity. A cement-retained design in this region would have been unable to provide sufficient retention (Figure 9).

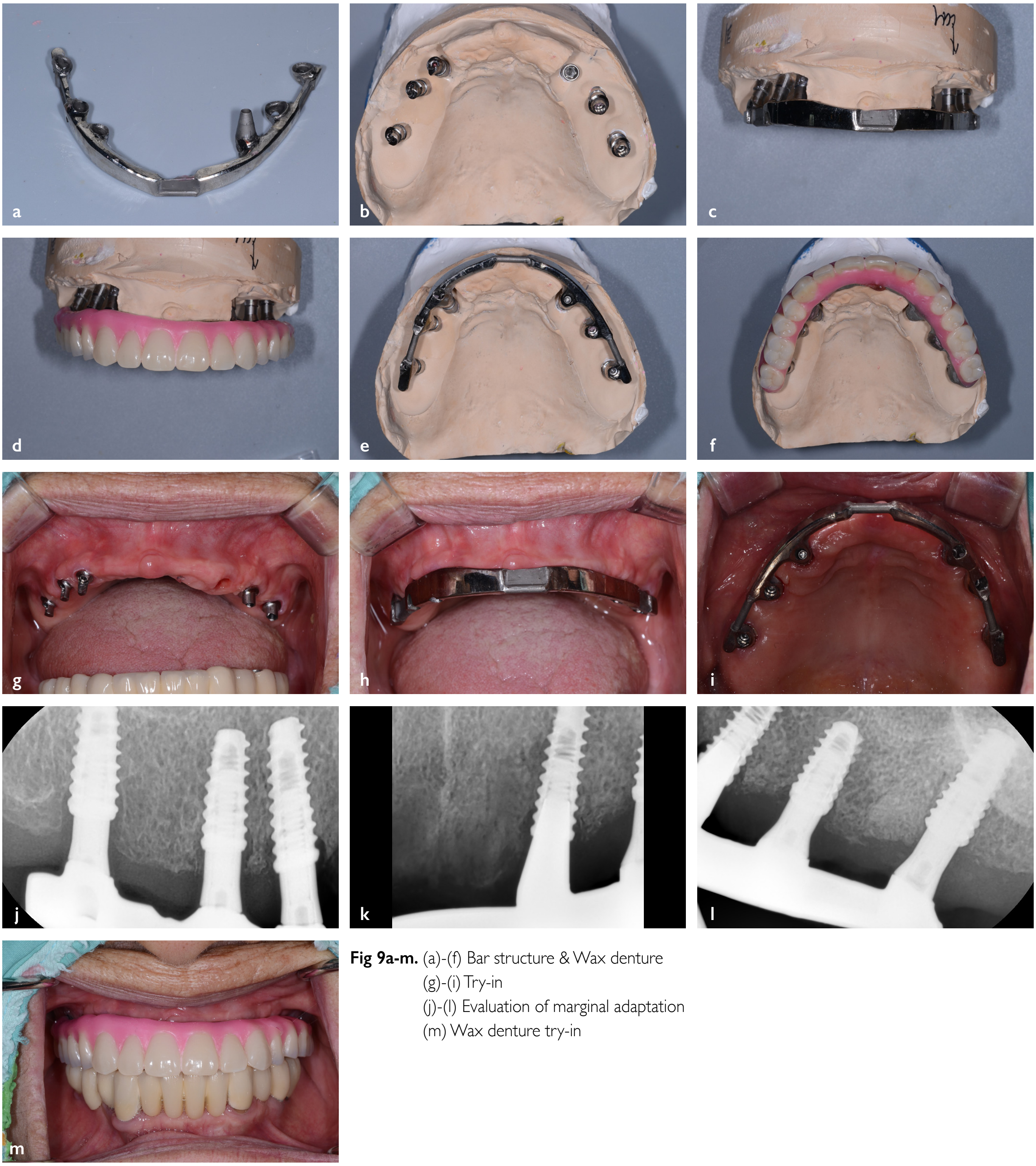

Fig 9a-m. (a)-(f) Bar structure & Wax denture
(g)-(i) Try-in
(j)-(l) Evaluation of marginal adaptation
(m) Wax denture try-in

Fig 10a-j. Final overdenture Delivery

While the anterior flange may appear somewhat excessive in the completed denture, it restored the original facial profile of the patient. The use of a maxillary fixed prosthesis in this case would not have been able to provide a satisfactory esthetic appearance, due to the lack of lip support. The continued exacerbation of the combination syndrome was avoided by supporting the overdenture with six implants.

The open-palate design also alleviated discomfort associated with the patient's previous conventional maxillary complete denture. Three clips were used, as the frictional retention between the milled bar and denture metal housing was expected to decrease over time. However, in order to facilitate the patient's initial adaptation to the denture, only two clips were connected to the posterior region at the time of delivery; the remaining clip was connected 6 months later (Figure 10).

Discussion

Implant-supported overdentures are superior to conventional complete dentures, in terms of retention, support, stability, and patient satisfaction. Compared to fixed prostheses, implant-supported overdentures allow greater flexibility in the selection of implant sites, and are less affected by anatomical limitations; they are also less costly. However, the main disadvantage of implant-supported overdentures is their increased requirement for maintenance and repair. Goodacre et al. reported that overdentures were associated with the highest incidence of mechanical complications, including loss of retention, attachment fracture, and overdenture fracture.6 In addition, one of the main patient complaints is that the attachment, especially the bar attachment, is visible in the oral cavity when the denture is removed. Despite these shortcomings, implant-supported overdentures are an optimal treatment option when a removable prosthesis is required to restore the patient's facial profile. When planning and designing an implant overdenture, it is necessary to first consider the functional load-bearing requirements,7,8 and how sufficient retention, support, and stability for the prosthesis can be achieved. Retentive forces for implantsupported overdentures only act along the path of denture displacement, which is in direct opposition to the path of insertion. The use of only two implants in the mandibular region (e.g., with a locator, magnet, or ball and socket attachment) requires that the overdenture be dependent on soft tissue support, mainly from the alveolar ridge. In this case, the role of the implants is to provide retention, and the clinical and laboratory procedures are relatively simple. However, to obtain adequate support and stability from the residual ridge, the overdenture must be made based on the principles of conventional complete denture fabrication. The overdenture must be sufficiently extended to cover support areas such as the buccal shelf and the retromolar pad, while achieving bilateral balanced occlusion.2 These prerequisites may not be attained where the residual ridge is severely resorbed, thus resulting in implant failure. In such cases, support may be obtained via a tissue-implant supporting system, in which the number of implants is increased to four or more; alternatively, an implant-supporting system may be used, in which overdenture support is provided solely by the implants. The use of an implant-supporting system for a maxillary overdenture requires the placement of four to six implants in the anterior and posterior regions, as well as the splinting of the implants with a bar attachment.9 Since support is provided primarily by the implants, it is possible to fabricate a horse-shoe-shaped denture that does not cover the palate; this greatly improves patient satisfaction. However, for bar attachments, the vertical dimension from the gingiva at the site of prosthetic placement to the opposing occlusal surface needs to be at least 14 mm. Therefore, it is necessary to ensure that there is sufficient vertical space for this prosthesis design. The use of a bar with an inadequate vertical dimension may result in frequent fractures and dislodgement, due to a relatively thin denture or short artificial tooth. Regular check-ups are essential for overdentures and fixed prostheses. Periodic relining is required, as denture fit tends to decline over time; this is especially important for implant-supported overdentures, as a poor fitting surface leads to excessive stress on the implant and subsequent failure.

Conclusion

The presence of a Class III intermaxillary relationship with lost lip support due to severe residual ridge resorption requires the restoration of an optimal occlusion and esthetic facial profile with a removable prosthesis. When the treatment outcomes achieved with a conventional complete denture are expected to be unsatisfactory, an implant-supported overdenture can be a good alternative. The use of six implants with a maxillary implant-supported overdenture can provide sufficient retention and support, and allow the palate to be left uncovered, which greatly improves patient comfort and satisfaction..

1. G Heydecke, P Boudrias, MA Awad, et al. Within-subject comparisons of maxillary fixed and removable implant prostheses: Patient satisfaction and choice of prosthesis. Clin Oral Implants Res 2003;14(1):125–30.

2. RD Mericske-Stern, TD Taylor, U Belser. Management of the edentulous patient. Clin Oral Implants Res 2000;11(Suppl 1):108–25.

3. J Paiva, DA Givan, JC Broome, et al. Comparison of the passivity between cast alloy and laser welded titanium overdenture bars. J Prosthodont 2009;18(8):656– 62.

4. HG Filho, JVQ Mazaro, E Vedovatto, et al. Accuracy of impression techniques for implants. Part 2 – comparison of splinting techniques. J Prosthodont 2009;18(2):172–6.

5. GC Silva, TM Cornacchia, CS de Magalhaes, et al. Biomechanical evaluation of screw- and cement-retained implant-supported prostheses: A nonlinear finite element analysis. J Prosthet Dent 2014;112(6):1479–88.

6. CJ Goodacre, G Bernal, K Rungcharassaeng, et al. Clinical complications with implants and implant prostheses. J Prosthet Dent 2003;90(2):121–32.

7. J Liu, S Pan, J Dong et al. Influence of implant number on the biomechanics behavior of mandibular implant-retained/supported over dentures: A threedimensional finite element analysis. J Dent 2013;41(3):241–9.

8. SA Bilhan, C Baykasoglu, H Bilhan, et al. Effect of attachment types and number of implants supporting mandibular overdentures on stress distribution: A computed tomography-based 3D finite element analysis. J Biomech 2015;48(1):130–7.

9. GM Raghoebar, HJ Meijer, W Slot, et al. A systematic review of implant-supported over dentures in the edentulous maxilla, compared to the mandible: How many implants? Eur J Oral Implatol 2014;7(7 Suppl 2):S191–201.

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Accuracy analysis and consideration of overcoming errors in computer-guided dental implant surgery

Taegu Chung, DDS

Introduction

The main advantage of computer-guided preoperative dental implant surgery is ensuring a prosthodontically-driven surgery. Other advantages include the possibility of performing a predictive flapless and minimally invasive surgery, enabling safe implant surgery in elderly patients with chronic systemic diseases. Compared to conventional freehand implant surgery, studies have shown that computer-guided implant surgeries yield similar or better results in terms of marginal bone loss, mechanical and biological complications, and implant survival rates, which further highlight the advantages of computer-guided surgery. Guided implant surgery can be classified into dynamic and static navigation types. Static navigation surgery can be further divided into fully guided or semi-(or half)-guided surgery according to the drilling technique and implant placement guidance.

On the other hand, dynamic navigation surgery is performed without using guidance templates by tracking bone drilling and three-dimensional (3D) real-time implant placement using special instruments and software. The advantage of this approach is that it enables the modification of the planned surgical approach during surgery, which leads to accurate implant placement. However, these methods are disadvantageous because of high cost and extensive training required to accurately adopt this technique. There is also a limitation in the number of cases where this method could be used. Static navigation involves bone drilling and implant placement using static surgical templates. The fully guided method involves performing the entire process from bone drilling to implant placement using a guided stent. The greatest advantage of fully guided implant surgery is that it is accurate and has been widely reported. Moreover, it has several advantages, such as providing the highest predictability for flapless surgery and shorter chair-time, in addition to causing minimal postoperative discomfort, pain, swelling, and analgesic requirement. The disadvantage is that it is difficult to correct errors during pre-surgical planning or guided surgery, and therefore requires extensive surgical experience. It is also expensive as compared to conventional freehand implant surgery. The half-guided method is also called a partial-guided or semi-guided method. The drilling sequence is performed using a surgical stent. Implant placement refers to the process of implantation without using a stent. Its advantages are similar to those of the fully guided method during drilling; however, as the implant is placed without a stent, more errors can occur in vertically and horizontally placed implants as compared to those with the fully guided method. Based on several reports, computer-guided implant surgery has been shown to give implant placement results accurately than conventional freehand implant surgery, which, on the other hand, gives better desirable prosthodontic restoration results.

Case Report

The process of computer-guided implant surgery is as follows: First, data are obtained through intraoral scan or model cast scan and cone-beam computed tomography (CBCT). This is followed by the planning and designing stage, using implant position planning software. The guided stent is produced through 3D printing or milling. This is installed and fixed in the same position according to the plan in the oral cavity for drilling and implant placement.

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He Performs dental treatment using digital technologies every day with joy because it provides comfortable, accurate, and prompt treatment solutions to patient.

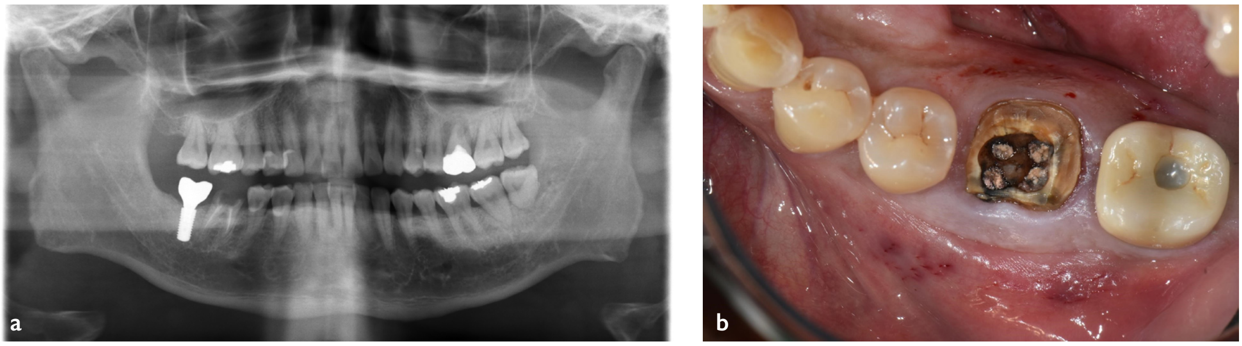

Fig 1a-b. Extraction and immediate implantation with a preoperative planned guide
(a), (b) Preoperative panoramic view and intraoral photo (tooth #46)

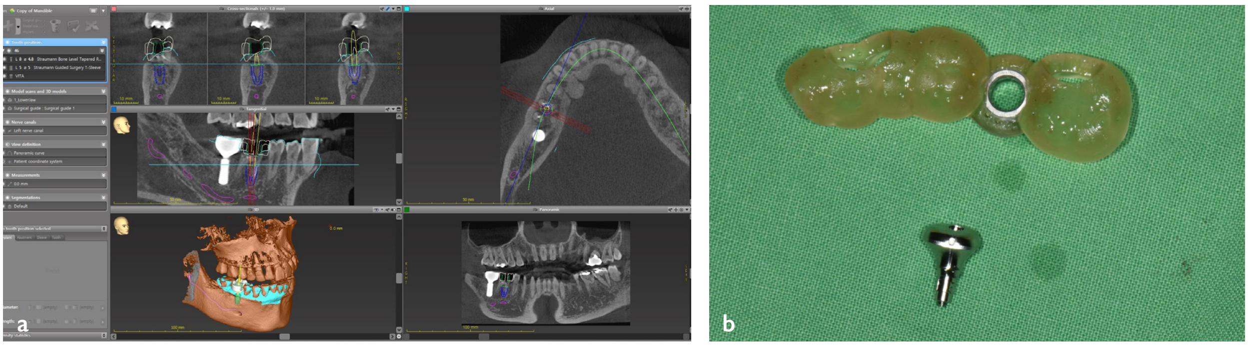

Fig 2a-b. (a), (b) Preoperative planning (CoDiagnostix, Dental Wing, Canada), manufacturing guide stent P30+ (Rapid Shape, Germany), and customized healing abutment

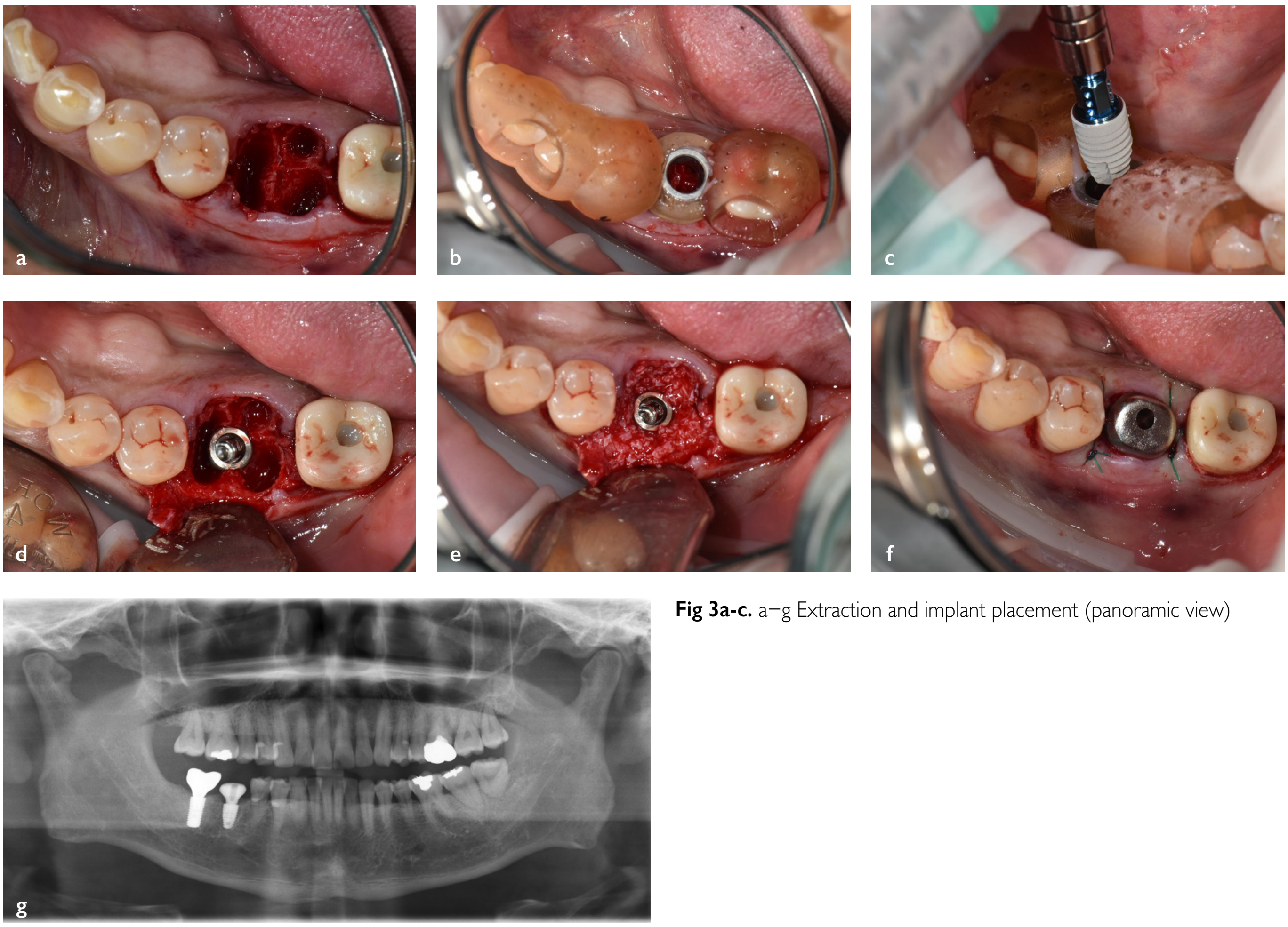

Fig 3a-c. a–g Extraction and implant placement (panoramic view)

Fig 4a-c. a–c Gingival healing mask and final restoration (panoramic view)

In this process, the main causes of errors in computer-guided implant surgery are as follows: i) errors in intraoral scan and CBCT imaging, which are used to acquire data, ii) errors in the planning and designing process, or the guide production process; iii) errors during oral installation or fixation; and iv) errors during drilling and implant placement. I used the following methods to quantitatively determine the errors between the actual and planned positions of the implant: i. The designed guide and intraoral scan STL file were loaded from exocad® DentalCAD. The guide sleeve was used as a scanbody to register the scanbody library. Next, the intraoral scan file and the library fixture STL were merged and saved (for reference, virtual planning export is possible by selecting a scanbody from many implant guide planning software). ii. After performing guided implant surgery, the scanbody was preloaded to perform intraoral scanning and aligned to the scanbody library by loading it on exocad® DentalCAD. The intraoral scan file and the library fixture STL were merged and saved as described above. iii. The above two STL files were loaded from GOM Inspect or exocad® DentalCAD, overlapped, and compared for the apical onethird position.

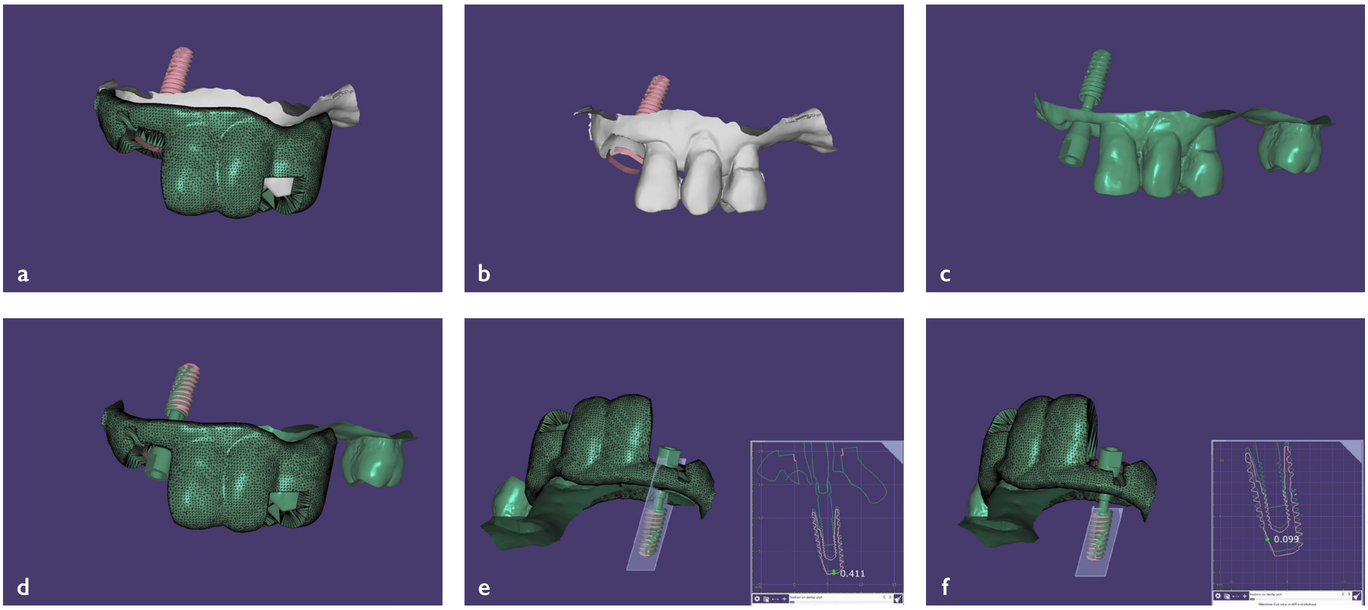

Fig 5a-f. Methods of accuracy analysis of the computer-guided implant surgery

(a), (b) Combining with library fixture STL by using the guide sleeve as a scanbody

(c) The scanbody within the oral cavity is preloaded with the intraoral scan STL file

(d)-(f) Superimposition and analysis of the file on exocad® DentalCAD (exocad®, Germany)

The above method can quantitatively determine the difference between planned and actual positions without comparing the preoperative and postoperative CBCT images. Moreover, it is not affected by metal artifacts of CBCT as it uses a library STL file. Therefore, it is advantageous for a more accurate quantitative comparison.

Conclusion

I analyzed 72 cases that were performed by me using computer-guided implant surgery using the above method. Most of the tooth-supported guide cases did not reveal any major differences. The differences were in the range of 600–800 μm horizontally and vertically.

Large differences were observed when there was a severely inclined bone defect, such as the extraction socket of the implant placement when the posterior

edentulous area was long or in the second molar tooth with a small opening that was difficult to access, and in a half-guided implant surgery case.

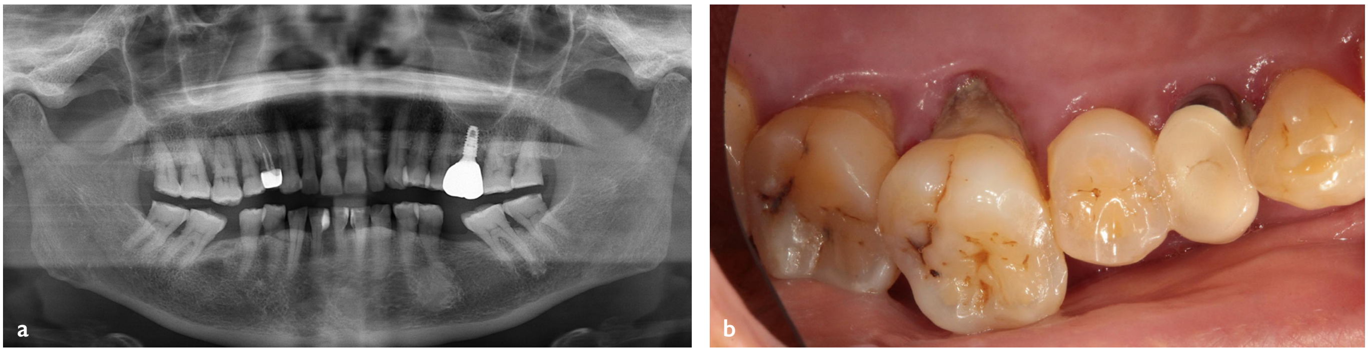

Fig 6a-b. A case of an inclined bone. Extraction and immediate implantation with a preoperative planned guide are shown Preoperative panoramic view and intraoral photo (tooth #16)

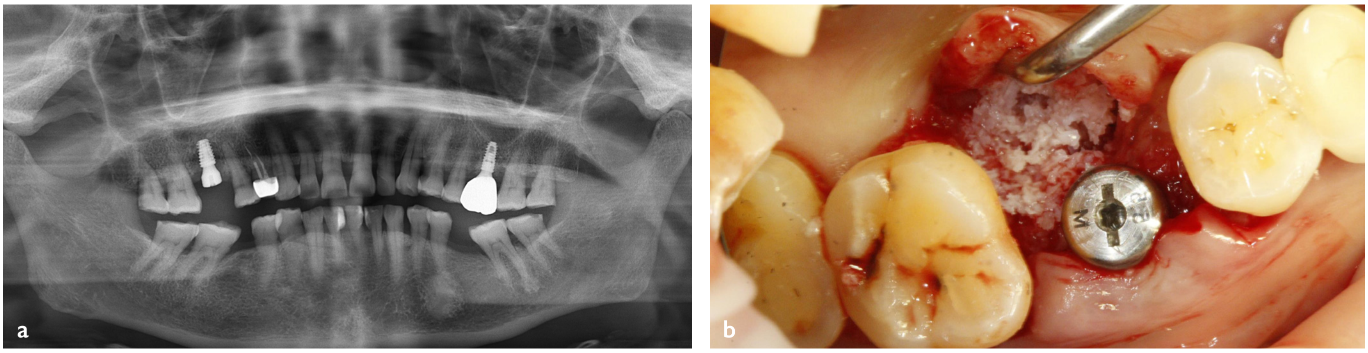

Fig 7a-b. Postoperative panoramic view and intraoral photo, palatal inclined bone defect

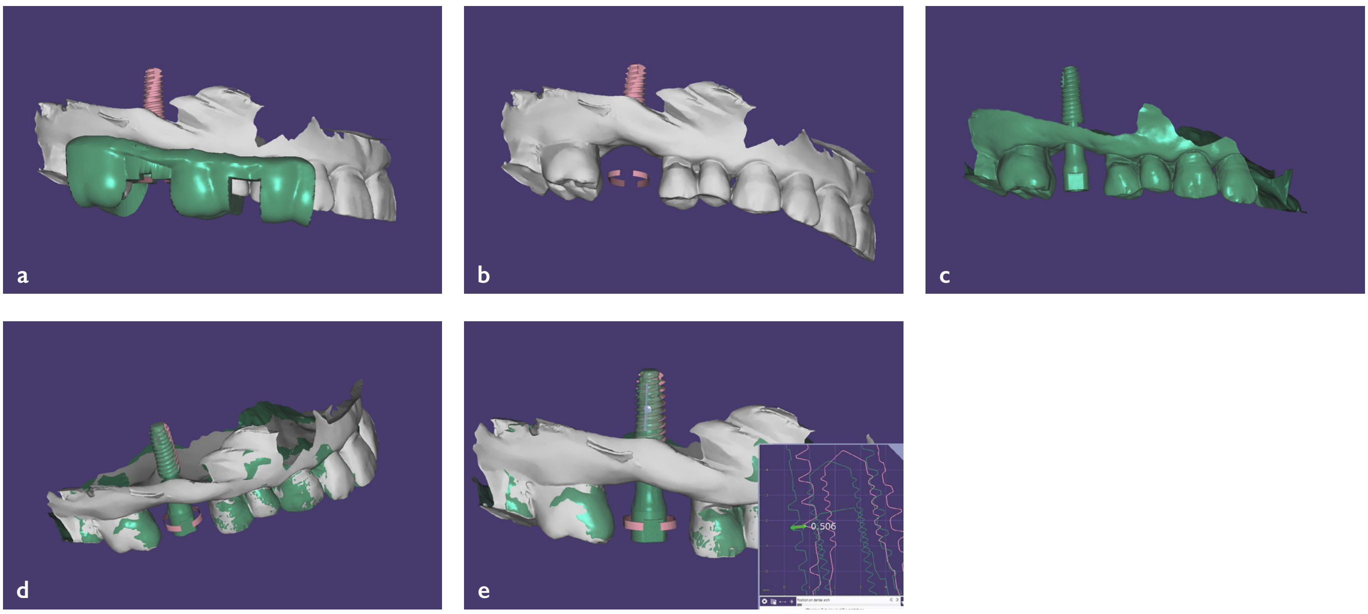

Fig 8a-e. Analysis of the planning position and actual position in exocad® DentalCAD (exocad®, Germany) (horizontal error: 506 μm at the apical one-third position)

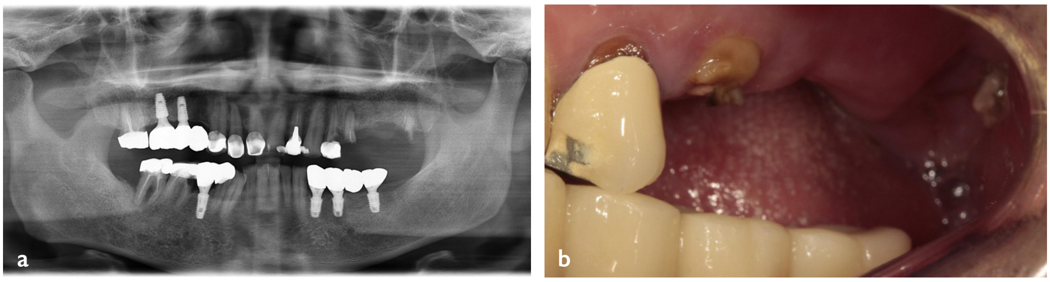

Fig 9a-b. Long free-end case. Extraction and immediate implantation with a preoperative planned guide are shown Preoperative panoramic view and intraoral photo (tooth #24,25,27)

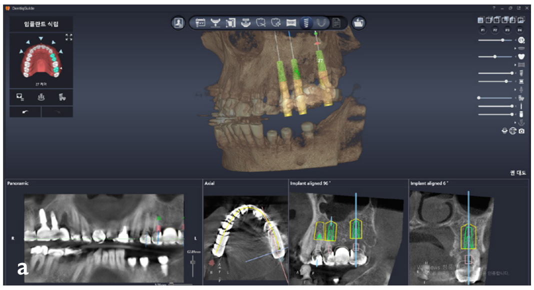

Fig 10. Implant position planning with DentiqGuide (3DII, Korea)

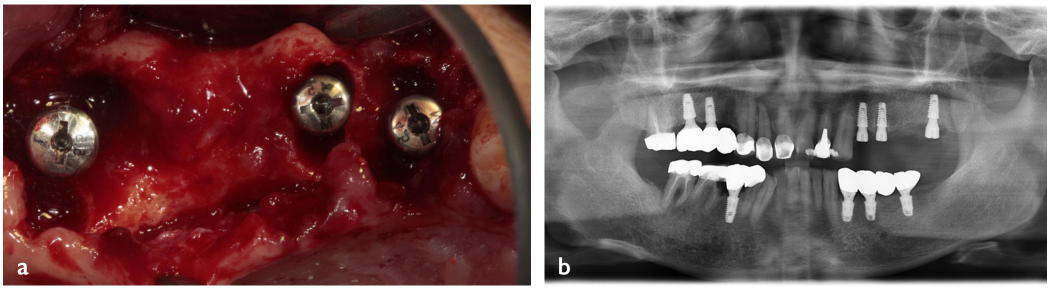

Fig 11a-b. Extraction and immediate implantation with a surgical guide and postoperative panoramic view

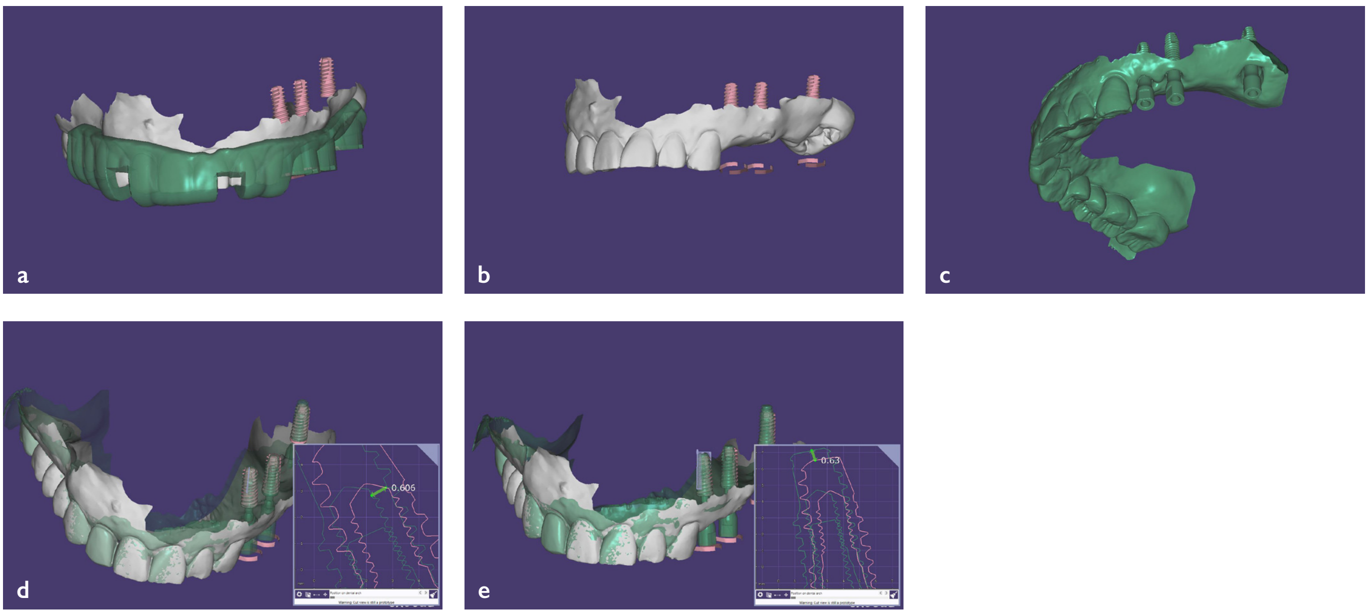

Fig 12a-e. Analysis of the planning position and actual position in exocad® DentalCAD (exocad®, Germany) (horizontal error in #24: 606 μm at the apical one-third position)

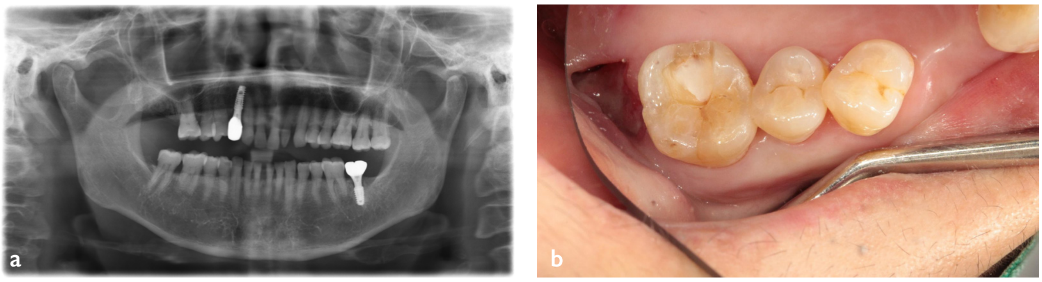

Fig 13a-b. Half-guided surgery case due to limited mouth opening. Preoperative panoramic view and intraoperative view (tooth #17)

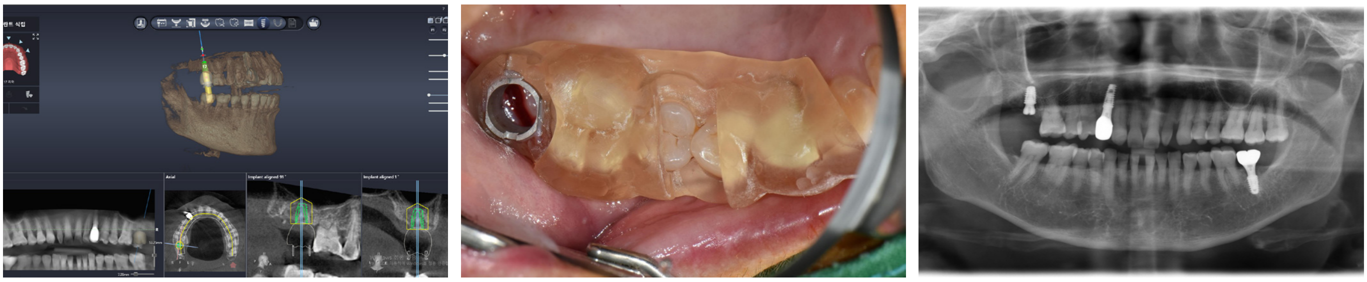

Fig 14a-c. Implant position planning with DentiqGuide (3DII, Korea), manufacturing guide stent with Zenith L (Dentis, Korea), and postoperative panoramic view

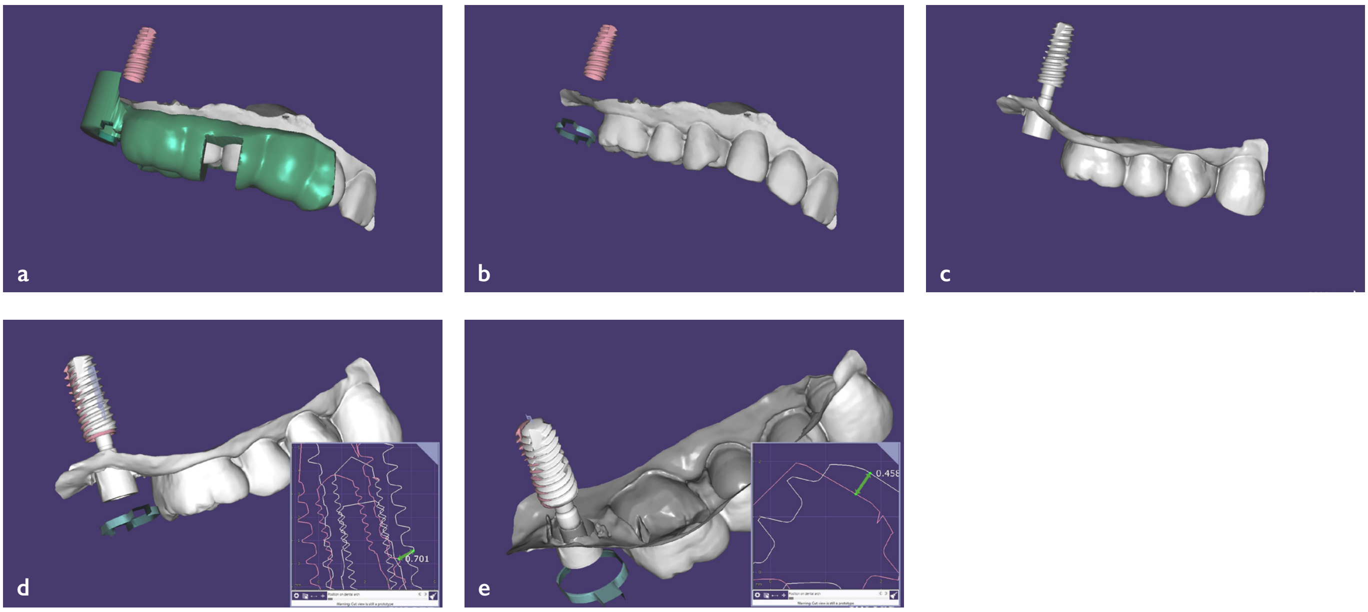

Fig 15a-c. Analysis of the planning position and the actual position in exocad® DentalCAD (exocad®, Germany) (horizontal error in #17: 701 μm, vertical error in #17: 458 μm at the apical one-third position)

When large differences were noted in soft tissue-supported cases, such as in the edentulous case, there was 1.2−1.8 mm of horizontal difference. The reason for such a large difference in the edentulous case was due to various errors that occurred during the fixation of the guide stent during removal of the inflamed granulation tissue after surgical procedures, such as tooth extraction or flap opening, or due to irregular alveolar bone shaping.

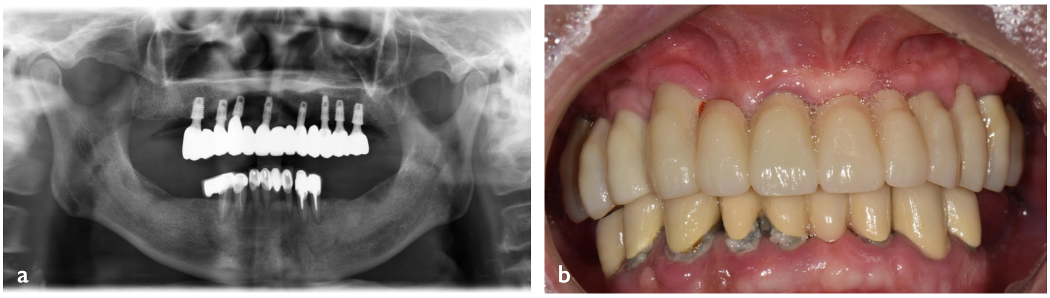

Fig 16a-b. An edentulous case: extraction of all teeth from the mandible and surgical debridement before the guide stent fixation Preoperative panoramic view and intraoral photo

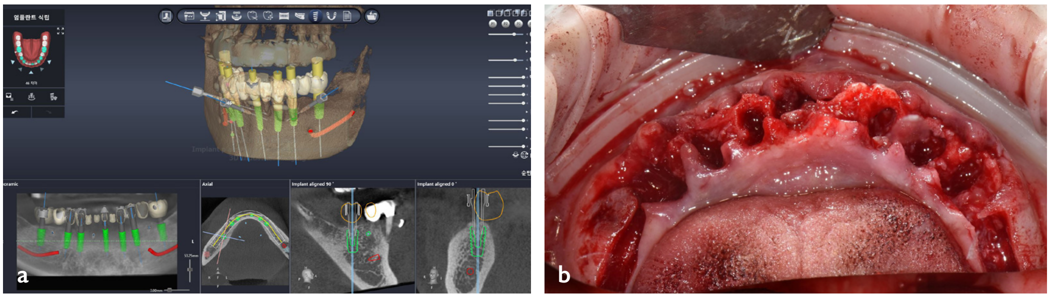

Fig 17a-b. (a) Guide planning with DentiqGuide (3DII, Korea) and manufacturing guide stent with Zenith L (Dentis, Korea) (b) Extraction of all teeth from the mandible and surgical debridement before guide stent fixation

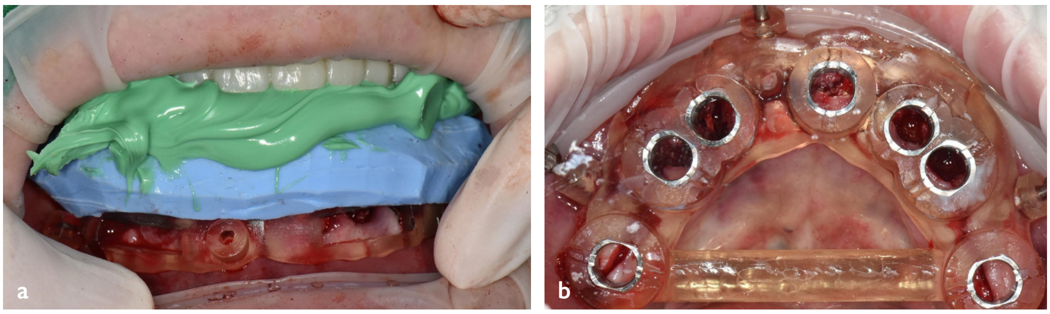

Fig 18a-b. Guide stent position with bite jig and screw fixation

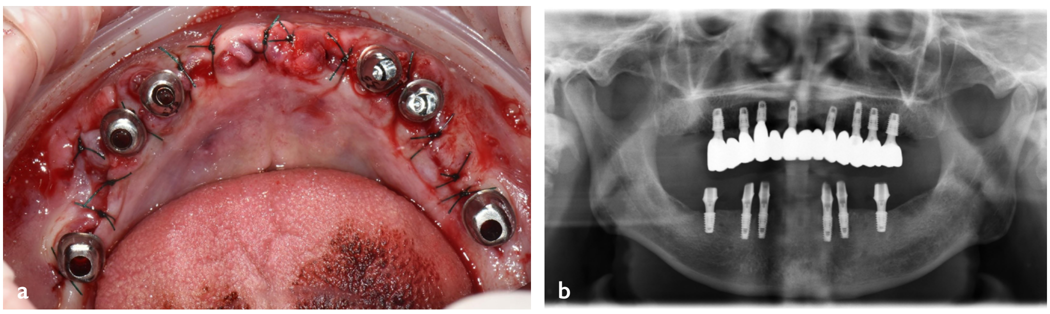

Fig 19a-b. Implant placement and preoperative fabricated non-hex customized abutments and postoperative panoramic view

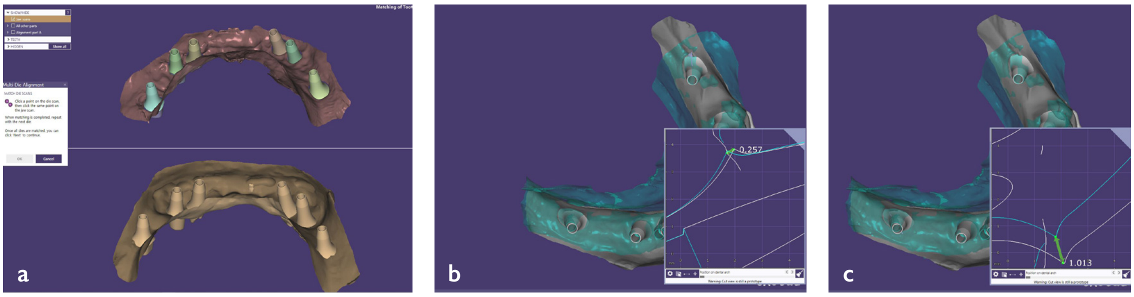

Fig 20a-c. Analysis of the planning position and actual position in exocad® DentalCAD (exocad®, Germany) (horizontal error: 1.01 mm)

Differences in the vertical and horizontal accuracies were observed according to the types of support (soft tissue-supported vs. toothsupported) for the guide stent, the shape of the alveolar bone in the implant placement site, drilling, and the degree of guidance in implant placement (fully guided vs. half-guided).

Discussion

Evident differences between planned and actual positions of the implant after computer-guided implant surgery were examined. Errors in data acquisition (intraoral or model scan, CBCT taking), CAD design and planning, and manufacturing could be improved by performing the analysis using a phantom or scanning the produced guide stent with a high-precision scanner, comparing it with the guide design file, improving the skill of handling the equipment, adjusting the CAD offset, and calibrating the equipment. Besides, as hardware and software are constantly being improved, there could be more errors in the fixation and drilling of the guide stent in clinical practice than hardware or software errors. In tooth-supported guide cases, a stable installation and fixation can be obtained, and the differences between the actual position of the implant and the planning position are small. However, as discussed above, if the edentulous area is large or if the residual tooth fluctuation is severe, large differences may occur due to several reasons, such as inclined alveolar bone defects. In such cases, it is necessary to secure stabilization of the guide by expanding its coverage (cross-arch stabilization). Besides, the entire process of drilling and implant placement should be performed as a fully guided surgery using guide

Evident differences between planned and actual positions of the implant after computer-guided implant surgery were examined. Errors in data acquisition (intraoral or model scan, CBCT taking), CAD design and planning, and manufacturing could be improved by performing the analysis using a phantom or scanning the produced guide stent with a high-precision scanner, comparing it with the guide design file, improving the skill of handling the equipment, adjusting the CAD offset, and calibrating the equipment. Besides, as hardware and software are constantly being improved, there could be more errors in the fixation and drilling of the guide stent in clinical practice than hardware or software errors. In tooth-supported guide cases, a stable installation and fixation can be obtained, and the differences between the actual position of the implant and the planning position are small. However, as discussed above, if the edentulous area is large or if the residual tooth fluctuation is severe, large differences may occur due to several reasons, such as inclined alveolar bone defects. In such cases, it is necessary to secure stabilization of the guide by expanding its coverage (cross-arch stabilization). Besides, the entire process of drilling and implant placement should be performed as a fully guided surgery using guide

Conclusion

Differences between the planned position and the actual position of the implant clearly exist depending on the case, even with computer-guided surgeries. However, computer-guided surgery is much more effective and accurate in ensuring proper implantation than conventional freehand surgery. If several errors occur, appropriate methods are used to overcome this situation, which could ensure a satisfactory implant placement surgery.

1. Digital technologies for dental implant treatment planning and guided surgery, Greenberg AM. Oral Maxillofac Surg Clin North Am 2015 May;27(2):319-340
2. Current state of the art of computer-guided implant surgery, D'haese J, Ackhurst J, Wismeijer D, De Bruyn H Tahmaseb. Periodontol 2000. 2017 Feb;73(1):121-133
3. Dynamic navigation for dental implant surgery, Panchal N, Mahmood L, Retana A, Emery R 3rd. Oral Maxillofac Surg Clin North Am 2019 Nov;31(4):539-547
4. New innovative method relating guided surgery to dental implant placement, Fauroux MA, De Boutray M, Malthiéry E, Torres JH. J Stomatol Oral Maxillofac Surg 2018 Jun;119(3):249-253
5. Guided implant surgery in the edentulous maxilla: A systematic review, Laleman I, Bernard L,Vercruyssen M, Jacobs R, Bornstein MM, Quirynen M. Int J Oral Maxillofac Implants 2016;31;Suppl:s103-s117
6. Accuracy of implant placement with computer-guided surgery: A systematic review and meta-analysis comparing cadaver, clinical, and in vitro studies, Bover-Ramos F, Viña-Almunia J, CerveraBallester J, Peñarrocha-Diago M, García-Mira B. Int J Oral Maxillofac Implants 2018 Jan/Feb;33(1):101–115
7. Different techniques of static/dynamic guided implant surgery: Modalities and indications, Vercruyssen M, Fortin T, Widmann G, Jacobs R, Quirynen M. Periodontol 2000 2014 Oct;66(1):214-227
8. Advantages and disadvantages of implant navigation surgery. A systematic review, Gargallo-Albiol J, Barootchi S, Salomó-Coll O, Wang HL. Ann Anat 2019 Sep;225:1-10
9. The accuracy of single-tooth implants placed using fully digitalguided surgery and freehand implant surgery, Smitkarn P, Subbalekha K, Mattheos N, Pimkhaokham AJ. Clin Periodontol 2019 Sep;46(9):949-957
10. Magnetic resonance imaging based computer-guided dental implant surgery-A clinical pilot study, Probst FA, Schweiger J, Stumbaum MJ, Karampinos D, Burian E, Probst M. Clin Implant Dent Relat Res 2020 Oct;22(5):612-621
11. Accuracy comparison of guided surgery for dental implants according to the tissue of support: A systematic review and metaanalysis, Raico Gallardo YN, da Silva-Olivio IRT, Mukai E, Morimoto S, Sesma N, Cordaro L. Clin Oral Implants Res 2017 May;28(5):602-612
12. Clinical factors affecting the accuracy of guided implant surgery-A systematic review and meta-analysis, Zhou W, Liu Z, Song L, Kuo CL, Shafer DM. J Evid Based Dent Pract 2018 Mar;18(1):28-40
13. Robotics in dental implantology, Wu Y, Wang F, Fan S, Chow JK. Oral Maxillofac Surg Clin North Am 2019 Aug;31(3):513-518
14. Comparison between computer-guided and freehand dental implant placement surgery: A systematic review and meta-analysis, Yogui FC, Verri FR, de Luna Gomes JM, Lemos CAA, Cruz RS, Pellizzer EP. Int J Oral Maxillofac Surg 2021 Feb;50(2):242-250
15. Accuracy of guided implant surgery: An experimental set-up, Ruoppoli A, Beltrame C, Tonoli G, Amaroli A, De Angelis N. Minerva Stomatol 2019 Apr;68(2):61-66
16. The accuracy of static computer-aided implant surgery: A systematic review and meta-analysis, Tahmaseb A, Wu V, Wismeijer D, Coucke W, Evans C. Clin Oral Implants Res 2018 Oct;29;Suppl 16:416-435

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Computer-assisted Occlusal Adjustment of Direct Composite Restoration: An Experimental Approach

Changhoon Lee, DDS, MS

Introduction

Dental CAD software was first developed for chair side porcelain restoration, and the range of applications has been extended from zirconia restoration to PMMA and titanium milling. Digital dentistry is being continuously applied and developed in various areas of restoration. Unfortunately, such use has been limited to indirect restorations. There seem to be no cases of direct restorations with the help of advanced computer technology.

Digital dentistry is advantageous for indirect restoration. If scanning is precise, and the milling machine is well calibrated, then only a few or none of the occlusal adjustments are required after insertion into the oral cavity. Digital dentistry may save a considerable amount of chair time.

However, when teeth are restored directly with composite resin, digital dentistry cannot be applied. Dentists must use the conventional filling techniques without any digital guide, meaning that the volume of the restorative material should be decided by the dentist's experience and intuition. The shaping of the restoration should also follow the dentist's knowledge of occlusal anatomy and the imaginary occlusal plane. Furthermore, some degree of overfilling is essential for finishing and polishing. Therefore, dentists must determine the correct amount of overfilling before moving to the finishing/polishing step.

In the following finishing/polishing step, occlusal adjustment must be performed without digital assistance,too. Instructing the patient to occlude and checking the marking points on the occlusal surface must be done to confirm proper occlusion.

There are cases where a T-Scan device is used to represent this as a numerical value and to use the digital assisted method, but it does not make the procedure much easier compared to the traditional adjustment method with the marking paper.

In some cases, it is challenging to obtain the patients' cooperation during this occlusal adjustment procedure. For example, patients with anxiety or severe gag reflex usually have difficulties receiving general dental treatment. Moreover, patients with mental conditions may not cooperate with the dentist's instructions. In these cases, moderate to deep sedation may be required; but when the patients are in a sedation state, they may not recognize the verbal instructions of the dentist. For this reason, the idea of using CAD software for occlusal adjustment in direct restoration cases has been developed. If CAD software can help practitioners to fill cavities and occlusal adjustments, we can save time and eliminate the need to ask for the cooperation of the patient.
Currently, preparation training software using CAD software (i.e., prepCheck – SironaDentsply, E4d Compare) has been used in dental education, which has a function that displays the degree of taper and determines whether the required amount of preparation is satisfied from the scan data. If this method is applied in reverse, it might provide information on the amount to be adjusted and mark overfilled areas by comparing preoperative data and postoperative scans. The present study aimed to investigate the possibility of a new occlusal adjustment method using the existing CAD software.

Changhoon Lee

Dr. Changhoon Lee received his DDS degree from Seoul National University in 2005 and received his Master of Science in Dentistry at SNU. He is a Board Member of the Korean Academy of Esthethic Dentistry and the Korean Academy of Adhesive Dentistry. He has lectured nationally on restorative dentistry in many dental meetings, study clubs, and live webinars. He has been in private practice in Yongsan, Seoul, since 2013.

Case Report

Material and method

Unmodified dentiform (Nisin, Zefen) was prepared and scanned into a bio-copy column using CAD software (CEREC 5.1.2, DentsplySirona, Germany).

A Class II cavity was prepared on the distal side of the mandibular left first molar and was filled with composite resin. It was intentionally overfilled. After digitally acquiring it with CAD software, a new scan was correlated with a previous preoperative scan (Figures 1 to 4).

Fig 1.

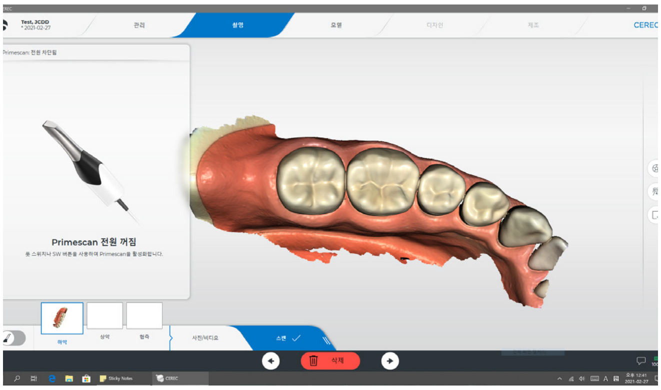

Fig 2.

Fig 3.

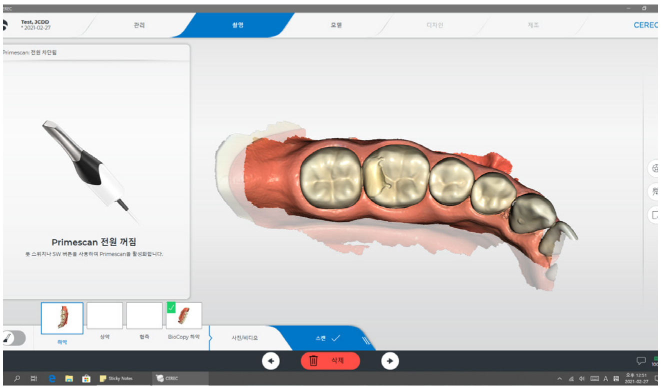

Fig 4.

Fig 5a-c. While viewing from various angles, the volume difference seen on the screen of the two overlaid objects, the initial model, and the filled model, was corrected using a handpiece.

A comparison with the same bio-copy as in the previous step was performed.

Then, the restoration was partially cut with CAD software and rescanned.

The area that was still overfilled was readjusted. Adjustment was completed when there was no difference in the volume during the comparison.
[Figures 6a–d]

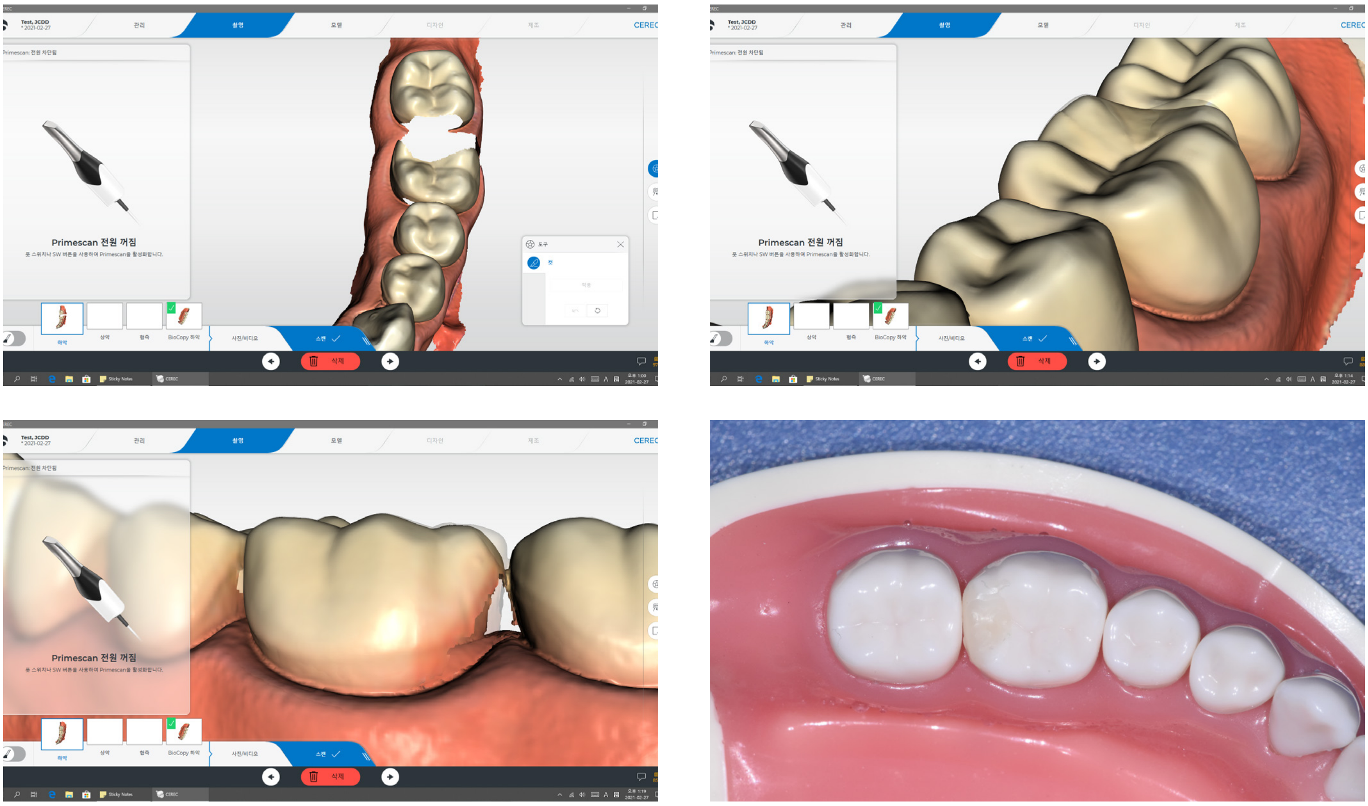

Fig 6a-d. While viewing from various angles, the volume difference seen on the screen of the two overlaid objects, the initial model, and the filled model, was corrected using a handpiece.

Clinical case

A 21-year-old male patient complained of food sticking between his teeth with mild and intermittent pain. Dental caries were observed on the bitewing radiograph, and direct composite resin restoration was planned due to the small size of the caries.

After local anesthesia, a quadrant rubber dam was placed.

Fig 7a-d. The area was scanned using CEREC CAD software.

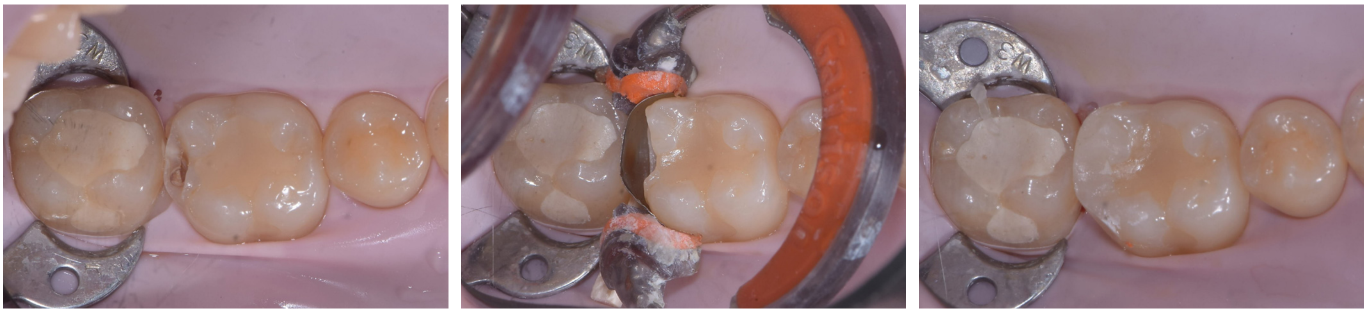

Fig 8a-c. Caries was removed by Class II cavity preparation while a rubber dam was on. The Composi-Tight sectional matrix system of Garrison was used and composite resin was overfilled.

Fig 9a-d. Second intraoral scanning was done and correlated with previous pre-op scan. Finishing was performed by comparing the second scan with the initial scan while changing the viewing angle and opacity. By repeating this procedure and confirming that the difference was minimized, the rubber dam was removed after polishing.

Discussion

Considering the reproducibility of the current oral scanner, precision is not a problem in occlusal adjustment using CAD software. However, the existing CAD software does not have easy comparison features. In this study, we used a feature that was not intended for this use. This is a big limitation on practical use, as it is difficult to make an adjustment based on accurate observations. This processing is also cumbersome, as it requires a step to cut out the affected area using the "CUT" function of the software every time a new adjustment is made and rescanned. If the functions for digital occlusion comparison and adjustment are implemented in software in the future, it would be convenient to designate a specific area in advance and make it possible to scan only that area repeatedly without having to touch another screen.

However, such occlusal adjustment is limited and utilized only to follow the outline of the preoperative state without being able to identify the actual dynamic occlusion. A severely damaged tooth may require the creation of a new shape, but the method described above does not provide adequate restoration for said cases. In those cases, the use of the articulator function built into the CAD software to virtually occlude the opposing arch should be considered. If these functions were implemented in the software, all adjustments could be performed without removing the rubber dam or waking up patients under sedation. The addition of related functions to the software is anticipated, and it would open up new possibilities for treatments under particular circumstances.

Reference

1. Callan, R. S., Haywood, V. B., Cooper, J. R., Furness, A. R., & Looney, S. W. (2015). The validity of using E4D Compare's "% comparison" to assess crown preparations in preclinical dental education. Journal of Dental Education, 79(12), 1445-1451.

2. Kerstein, R. B. (2004). Combining technologies: a computerized occlusal analysis system synchronized with a computerized electromyography system. Cranio®, 22(2), 96-109.

3. Lee, C. (2018). Easy, Efficient Class II composite resin restoration technique. Korean Journal of Aesthetic Dentistry, 27(2), 66-74

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