CLINICALLY EVALUATED ACCURACY OF SINGLE GUIDED IMPLANTATIONS WITH TWO DIFFERENT SYSTEMS – PRELIMINARY RESULTS

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Abstract:

Introduction: Guided single implant placement ensures an optimal implant position, enables in-surgery immediate loading, and creates a predisposition for predictable treatment results.

Aim: This article aims to present the surgical and loading protocols and assess the accuracy of two guided implant systems.

Materials and methods: Ten patients missing a single molar were included. The semi-guided procedures with the two implant systems – AB Dental and Alpha Bio-Tec, were randomly assigned to each participant. The computer-assisted planning was performed with Implant Studio (3Shape, Denmark). Surgical guides and long-term, temporary, screw-retained restorations were virtually generated within the 3Shape system. Surgical appliances were printed from SG resin (Formlabs, USA), and crowns were milled from Telio CAD (Ivoclar Vivadent, Lichtenstein). Planning accuracy was evaluated based on the crown's fit and relation to the adjacent teeth and antagonists.

Results and discussion: The patients included for preliminary analysis (6 female and 4 male) were with a mean age of 33.42. The youngest was 24, and the oldest 49 years old. There were no surgical and technical complications for the period of evaluation, which ranged from 1 to 3 months. The crown's fit was excellent in 8 cases. In two cases, minor adjustments were necessary – 1 in relation to the antagonists and 1 to the adjacent teeth. In one case, a healing screw was placed for 48 hours to facilitate adequate soft-tissue space for the Ti-base.

Conclusion: The preliminary results presented in this report suggest that the clinical and laboratory protocols used for guided implantation and immediate loading are highly efficient.

Keywords: implantation, loading, planning, protocol

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Introduction

The optimal position and number of implants should be largely influenced and ideally determined by the design and type of the final prostheses, according to Deeb et al. (2017). Computer-assisted guided implant surgery facilitates prosthetically driven implant planning over superimposed surface scans and computer tomography (CT). Dolcini et al. (2016), Orentlicher et al. (2014), and Pozzi et al. (2014) discuss its advantages, among which, the ability to virtually position the implant, accounting for the availability, position, quality, and morphology of the bone and soft tissues at the edentulous site. The authors discuss the potential benefits of computer-assisted guided implant surgery, including reduced chair-time, enhanced esthetics, and reduced patient discomfort, contributing to increased quality of life and overall patient satisfaction. Several authors discuss the potential problems in guided implant surgery and determine that “deviation” between the planned and actual implant placement position is the most significant. A number of factors may contribute to these inaccuracies. Beneke A. et al. (2012) outline the possible causes for errors, including spatial resolution problems in CT, merging techniques in CT, and scan data, errors in template manufacturing, inadequate stability of the surgical template, drilling errors from the clearance between the sleeve and the drill, as well as other factors, such as soft tissue thickness, patient movement, and the types of software used. Therefore Pyo SW et al. (2019) conclude that clinical evaluation of the accuracy is essential to determine whether the inaccuracies of guided surgery are clinically acceptable.

Mora et al. (2014) review software applications for guided implant planning and surgical guide fabrication, which have been developed in recent years. The latter range from proprietary closed tools used for a specific implant system (IS) to open systems including several implant libraries and enabling

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clinicians to plan cases with multiple IS. Due to rapid development in guided implant placement, multiple ISs are being included in programs for planning and guide fabrication without established optimal clinical and laboratory protocols and established/evaluated accuracy.

This article aims to present the surgical and loading protocols and assess the accuracy of single guided implantation with two different implant systems.

Materials and methods

The study was approved by the ethical committee at Medical University – Plovdiv (protocol number 5793/18.07.2019). Ten patients (6 female and 4 male) missing a single molar were included for analysis. Two implant systems – Alpha Bio Tec (Fig. 1) and AB-Dental (Fig. 2) were used in this study. They were randomly assigned to the participants with five patients ($n=5$) for each system. All patients 18 years or older with a single missing molar and presence of adjacent teeth and antagonists, adequate quantity and quality of bone to facilitate implant placement, without general contraindications for a surgical procedure, were considered eligible for the study.

After initial screening and inclusion in the study, informed consent were obtained. An intraoral scanning procedure with Trios (3Shape, Denmark) was performed, and patients were referred for a CT scan with ProMax 3D (Planmeca, Sweden). All planning and laboratory procedures were done in the 3Shape software system. The computer-assisted planning and surgical guide generation were performed with Implant Studio (3Shape, Denmark) (Fig. 3 and 4). The long-term, temporary, screw-retained restorations were designed with DentalDesigner (3Shape, Denmark). Surgical appliances were printed from SG resin (Formlabs, USA). The long-term temporary crowns were milled from Telio CAD (Ivoclar Vivadent, Lichtenstein), and the Ti-based were cemented extra orally to the crowns with Multilink Hybrid Abutment Ivoclar Vivadent, Lichtenstein.

Before implant placement, the static guides were visually and manually checked to assess their fit. Patients were given a 2% chlorhexidine solution and rinsed for 2 minutes. The surgical field was disinfected with iodine solution following an application of terminal anesthesia with Septanest 1:100 000, Septodont, France. Punch tissue drills were used at the beginning, followed by crystal drill (for Alpha Bio Tec System) (Fig. 5). The next drills were used according to the manufacturer's instructions and with sizes optimal for the individual size of the implant. Special keys from the kit were used for every size of the drill with AB-Dental System (Fig. 6).

Figure 1: Alpha-Bio Tec Guided Surgery Tool Kit, Israel.

Source: Authors

The initial stability of the implants was checked with Osstell, W&H, Sweden. In cases when values indicated sufficient stability, the prefabricated crowns were screwed in place. When the values were 70 and higher in vestibular-lingual and in mesial-distal direction, immediate loading was performed (Fig. 7). Control appointments were scheduled on 1., 3., 7. day and on 1 and 3/4 month depending on which jaw is the placement lower/upper. An antibiotic, Ospamox was prescribed, and instructions for homecare were given to all patients.

Planning accuracy was evaluated based on the constructions' fit and its relation to the adjacent teeth and antagonists. The former was checked with a post-surgical parallel radiograph used to assess any discrepancies between the Ti-base and the implant platform. A metal matrix – MEBA Nr 3 (Interdent, Slovenia) insertion in the interdental spaces with moderate resistance, indicated correct relationship with the adjacent teeth. All crowns were designed with precise distance from the antagonists determined with the distance-map and cross-section functions in the software. The latter was checked post-surgically with a second intraoral scan at the first control appointment.

Figure 2: AB-Dental Guided Surgery Tool Kit, Israel.

Source: Authors

Figure 3: Digital design of surgical guide for Alpha Bio Tec implantation.

Source: Authors

Figure 4: Digital design of surgical guide for AB-Dental implantation.

Source: Authors

Figure 5: Fully guided Alpha Bio Tec implantation.

Source: Authors

Figure 6: Fully guided AB-Dental implantation.

Source: Authors

Figure 7: Immediate loading after the Alpha-Bio Tec implantation.

Source: Authors

Figure 8: Radiograph after immediate loading with the PMMA crown that is not radiocontrast.

Source: Authors

Results and discussion

The patients included for preliminary analysis (6 females and 4 males) were with a mean age of 33.42. The youngest was 24, and the oldest 49 years old. There were no surgical and technical complications for the evaluation period, which ranged from 1 to 3/4 months. All implants showed sufficient primary stability, which permitted immediate loading.

The evaluation of the included cases demonstrated excellent clinical results in eight out of the ten patients. One of the crowns in the Alpha-Bio group required approximal adjustments. One case required occlusal correction in the AB group because of its supra-position and presence of contacts with the antagonists. Due to a thick gingival biotype, one of the patients required a healing screw for 48 hours to facilitate adequate soft tissue space for the crown. The confirmation of the clinical observations analyzing the obtained parallel radiographs revealed an excellent fit between the Ti-base and the implant platforms in all cases (Fig. 8).

The preliminary results reported in this article support the findings of studies published by Lanis et al. (2015), Pozzi et al. (2016), and Vlahova et al. (2017 and 2018) in that, a combination of digital surface scanners and CT's facilitates the predictability of the results in guided implant surgery.

The main purpose of this article is to share the early findings, methodology, and study protocols; hence there are some inherent limitations. Due to the insufficient number of cases included (n=10), no statistical analysis of the results was performed and reported. However, the study is prospective in nature, with 30 more patients already in the preoperative stage. The advantages of clinically evaluating the accuracy of the guided procedures include less harmful X-ray exposure, reduced time, and costs for the patient. A miscalculation is a choice of material for the long-term temporary crown, that lacks radiopacity (Fig. 8), but still permits evaluation of the Ti-base to implant platform fit after the construction is fully seated. Completing the project will enable quantification and accurate analysis of the results.

Conclusion

The preliminary results presented in this report suggest that the clinical and laboratory protocols used for guided implantation and immediate loading are highly efficient. Computer-assisted guided surgery, and prosthodontic restoration enables clinicians to perform a non-invasive, predictable, patient-centered treatment.

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