Complications of Computer-Aided-Design/ Computer-Aided-Machining-Guided (NobelGuide™) Surgical Implant Placement: An Evaluation of Early Clinical Results

Loong Tee Yong, BDS, MDS (Oral and Maxillofacial Surgery), FRACDS;* Peter K. Moy, DMD†

ABSTRACT

Purpose: The aim of this study was to evaluate early clinical results of computer-aided design (CAD)/computer-aided machining (CAM)-guided surgical implant placement (NobelGuide™, Nobel Biocare, Yorba Linda, CA, USA) with focus on surgical and/or prosthetic complications, management, and prevention.

Materials and Methods: Thirteen patients rehabilitated between March 2003 and October 2006 with CAD/CAM-guided dental implants and immediate loading (NobelGuide, Nobel Biocare) were evaluated. The treatment planning and procedures were carried out in accordance to the system protocol. The complications encountered in this case series were classified and assessed according to early (planning and procedural – surgical; prosthetic) and late complications (surgical; prosthetic).

Results: The prosthetic complications outnumbered surgical complications both in the early and late treatment phases. The main early surgical complication was bony interference that prevented complete seating of the prostheses. Most of the late surgical complications were implant failures with an overall failure rate of 9%. Fracture of the carbon fiber framework prosthesis was the main late prosthetic complication.

Conclusions: The NobelGuide system is a reliable treatment modality, but not without its complications. Strict adherence to the system protocol is the key prevention of complications.

KEY WORDS: immediate loading, guided surgery, complications

There are two main objectives of computer-aided design (CAD)/computer-aided machining (CAM)-guided dental implant placement and restoration. The first is to permit precise planning of implant positions on computed tomography scans, and the second is to generate an accurate surgical guide that permits the surgeon to place implants precisely into planned positions so that a prosthesis may be delivered immediately.

CAD/CAM-guided implant procedures have been shown to be accurate and predictable in terms of treatment planning and its execution.[1,2] The main advantages of this treatment modality are flapless, minimally invasive surgery, resulting in less postoperative morbidity,[3] shorter surgery duration, as well as delivery of a prosthesis for immediate function.[4]

This study evaluates early clinical results of CAD/CAM-guided surgical implant placement (NobelGuide™, Nobel Biocare, Yorba Linda, CA, USA) with a focus on surgical and/or prosthetic complications, management, and prevention.

MATERIALS AND METHODS

Between March 2003 and October 2006, 13 patients were rehabilitated with CAD/CAM-guided surgical placement of implants which were immediately loaded with a fixed prosthesis (NobelGuide, Nobel Biocare).

The cases were managed by a single team comprised of an oral and maxillofacial surgeon and a

*UCLA surgical implant fellow; †professor, OMFS & director of Implant Dentistry at UCLA

Reprint requests: Loong Tee Yong, Nobel Biocare Research, Education and Surgical Training, BO-129 CHS, Box 951668, Los Angeles, CA 90095-1668, USA; e-mail: yongloongtee@yahoo.com.sg

DOI 10.1111/j.1708-8208.2007.00082.x

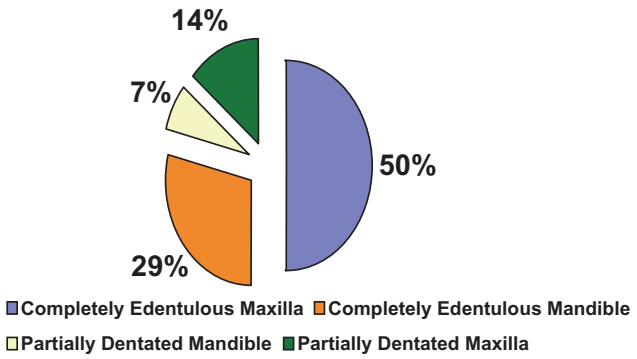

Figure 1 Distribution of treated dental arches.

prosthodontist. The mean age of the patients was 67.5 years, with sex distribution of six men (46.2%) and seven women (53.8%). The treatment planning and procedures were carried out according to the system protocol (NobelGuide, Nobel Biocare). This technique utilized a computer-assisted surgical design, CAD/CAM-fabricated surgical template, flapless surgical procedure, and prefabricated final or provisional prosthesis for immediate loading. The prostheses delivered included carbon fiber frameworks with acrylic teeth, porcelain fused to metal bridges, and acrylic denture teeth on a milled titanium frame (Procera® Implant Bridge). The mean follow-up period was 26.6 months.

Complications encountered in this case series were classified and assessed accordingly:

1. Early complications: (i) planning; (ii) procedural (surgical, prosthetic)
2. Late complications: (i) surgical; (ii) prosthetic failures

RESULTS

In this population of 13 patients, there were 14 dental arches restored with this protocol. There were seven (50%) completely edentulous maxillary arches and four (29%) completely edentulous mandibular arches. Two (14%) partially dentated maxillary arches and 1 (7%) partially dentated mandibular arch were treated (Figure 1).

Planning

There were no complications encountered with the planning procedure using the software system (Procera).

Early Surgical Complications

There were three early surgical complications encountered (see Figure 1), including two incomplete seating

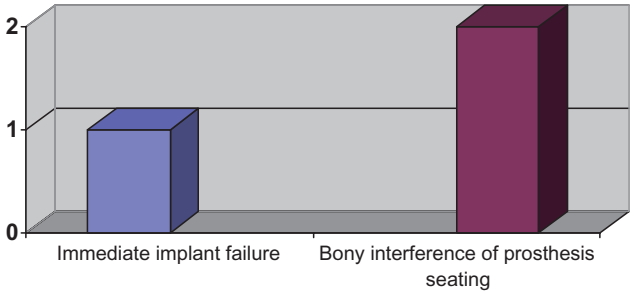

Figure 2 Early surgical complications.

of the prosthesis because of bony interference (Figure 2).

One involved an implant that was incompletely placed to depth and would have prevented the seating of the prosthesis (Figure 3). The implant was removed immediately (immediate failure) and the site was left empty to heal.

Early Prosthetic Complications

Early prosthetic complications encountered included prosthesis loosening, speech problems, and bilateral cheek biting (Figure 4).

Late Surgical Complications

There were nine late surgical complications recorded (Figure 5). One patient had persistent pain and one implant had a residual buccal soft tissue defect. The rest were late implant failures.

In this case series, altogether 78 implants were placed with eight failures. This included the implant which was removed at time of placement (immediate failure). The overall implant failure rate was therefore 9%.

The dimensions of the failed implants are shown in Figure 6. Five out of the seven (71.4%) late implant

Figure 3 The implant that was incompletely seated at time of surgical placement.

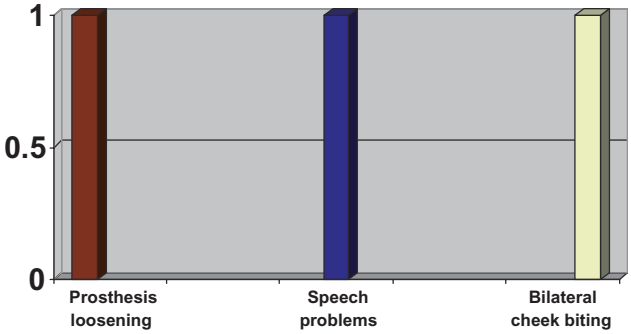

Figure 4 Early prosthetic complications.

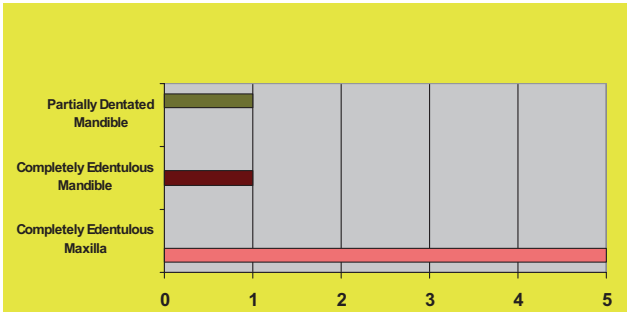

Figure 7 Distribution of late implant failures in treated dental arches.

failures were longer than 10 mm in length. There was only one failed implant that was shorter than 10 mm in length.

Of the seven late implant failures, five were placed in completely edentulous maxillary arches, one in a partially dentated mandibular arch, and one in a completely edentulous mandibular arch, as shown in Figure 7.

Only one late failure occurred in the maxillary anterior region. Other failures were in the posterior regions with two failures in the maxillary molar sites, two in the maxillary bicuspids, and one in the mandibular bicuspid and molar sites, respectively (Figure 8). There were more failures in the maxilla than in the mandible.

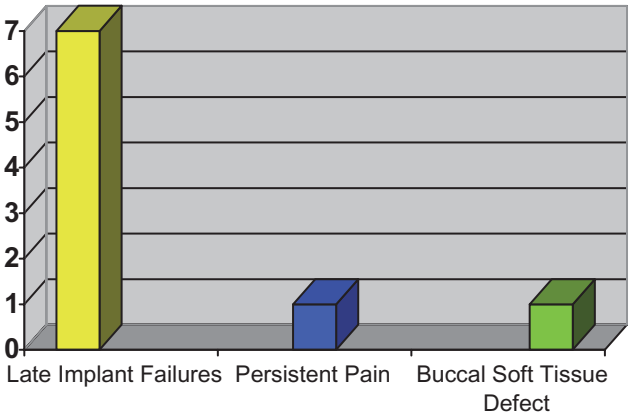

Figure 5 Late surgical complications.

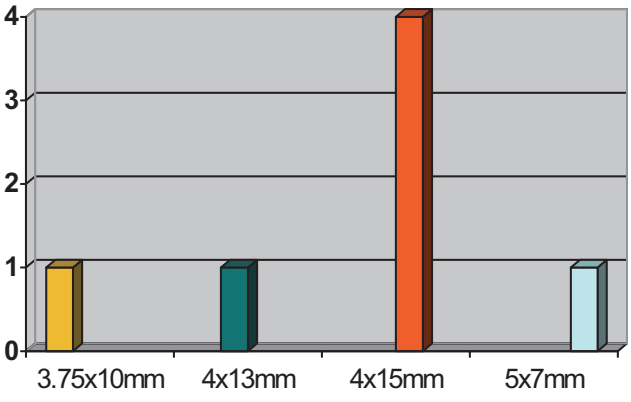

Figure 6 Dimensions of late implant failures.

Late Prosthetic Complications

There were nine recorded late prosthetic complications (Figure 9). Two of the prostheses had heavy occlusal wear and two had loosening of screws. Fracture of prosthesis was observed in three of the prostheses. There was one case of aesthetic dissatisfaction and one case of pressure sensitivity while chewing.

Eight of the nine complications (88.9%) occurred in the prostheses made from carbon fiber frameworks with acrylic teeth.

DISCUSSION

This case series that utilized CAD/CAM-guided implant placement and restoration demonstrated that prosthetic complications outnumbered surgical complications both in the early and late treatment phases.

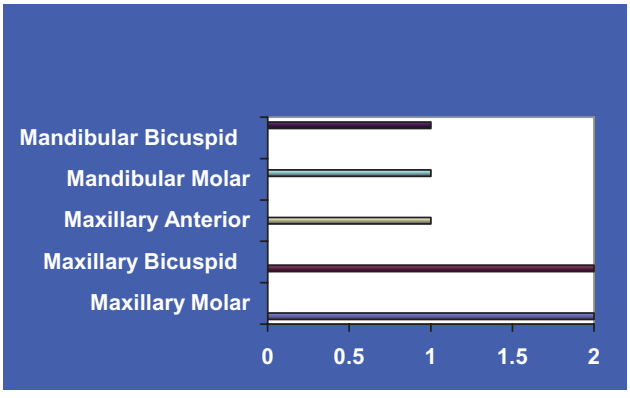

Figure 8 Late implant failure locations.

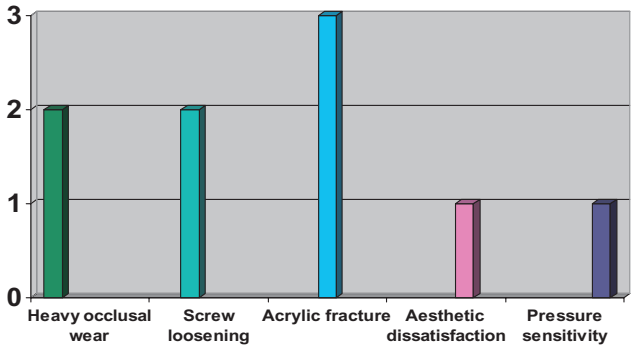

Figure 9 Late prosthetic complications.

The most frequently occurring early surgical complications were bony interferences that prevented complete seating of the prosthesis. These were because of knife-edge contours of the alveolar ridge and overcome by using a specifically designed bone mill to reduce the excess bone from around the heads of the implants. The surgical procedure was also complicated by poor access in posterior quadrants because of the relatively long drills and thickness of the surgical guide. The poor visibility made it difficult for the surgeon to ensure complete depth of drilling and instrumentation especially in the posterior regions of the partially dentate patient (Figure 10).

Most late surgical complications were associated with implant failures. It was interesting to note that the majority of the failed implants were more than 10 mm in length. It is believed that with guided surgery, using the drills through the guide increases the likelihood of overheating the bone. This is because of the inability of the coolant to reach to the tip of the drill where most heat is generated. In addition, bone dust accumulates in the flutes of the drills. Hence, it is important to remove the drills from the drill guide during the preparation and have the osteotomy sites irrigated well. Bone dust that is accumulated on the drill flutes must also be removed routinely.

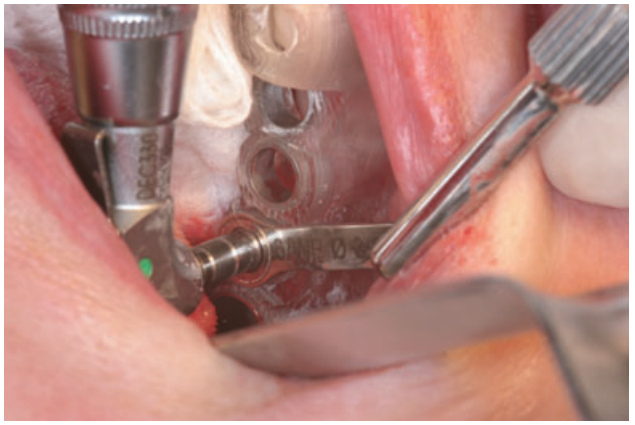

Figure 10 Poor access and visibility in the posterior regions of a partially dentate patient.

Figure 11 Fracture of prosthesis with carbon fiber framework.

The completely edentulous maxillary arch had the highest incidence of implant failures. This is in line with clinical findings from conventional methods. Because of the lower density of bone found in the maxilla and the unique axis of rotation from a fixed prosthesis generating a higher fulcruming force, the maxillary implant success rates were lower compared to the mandible.

In terms of implant locations, more implant failures were identified in the posterior regions than in any other sites, specifically the posterior maxilla.

The majority of late prosthetic complication was because of fracture of the prosthetic frame, with the highest incidence found in the carbon fiber framework (Figure 11). Heavy occlusal wear and loosening of prosthetic screws were also observed.

CONCLUSION

The NobelGuide system is a reliable treatment modality; however, complications may be encountered. It is recommended that the dental team maintains strict adherence to the established protocol to minimize or prevent the occurrence of complications.

REFERENCES

1. Widmann G, Blae RJ. Accuracy in computer-aided implant surgery – a review. Int J Oral Maxillofac Implants 2006; 21:305–313.
2. Fortin T, Bosson JL, Coudert JL, Isidori M. Reliability of preoperative planning of an image-guided system for oral

implant placement based on 3-dimensional images: an in vivo study. Int J Oral Maxillofac Implants 2003; 18:886–893.

3. Campelo LD, Camara JRD. Flapless implant surgery: a 10-year clinical retrospective analysis. Int J Oral Maxillofac Implants 2002; 17:271–276.
4. van Steenberghe D, Naert I, Andersson M, Brajnovic I, Van Cleynenbreugel J, Suetens P. A custom template and definitive prosthesis allowing immediate implant loading in the maxilla: a clinical report. Int J Oral Maxillofac Implants 2002; 17:663–670.