JOURNAL of
OSSEOINTEGRATION

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Immediately loaded implants placed with simultaneous sinus lift procedure and cross-arch rehabilitation. A case report after five years

ABSTRACT

The immediate loading treatment concept in implant dentistry seems to be successful in cases of cross-arch stabilization.
This report presents the restoration of an edentulous maxilla using an immediately loaded prosthesis supported by six implants with a progressive thread design placed in poor bone qualities. Specifically, two of these implants were inserted simultaneously after a sinus lift elevation and augmentation of the sinus cavity using autogenous bone grafting material. A cross-arch stabilization using a provisional bridge provided immobilization of the implants until healing. The final restoration was delivered 4 months after loading. The case report presents clinical and radiographic evaluation of the immediately loaded implants with an excellent result 5 years after loading.

KEY WORDS Immediate loading; Sinus lift.

INTRODUCTION

Recent literature reviews including analysis of the literature (1, 2) show that the concept of immediate functional (occlusal) loading in poor bone qualities especially in the posterior part of the maxilla, is not very well established and seems to be critical. The high risk of micromovements might result in a fibrous encapsulation leading to early implant failure. Therefore, to compensate such effect, it was suggested to place a higher number of implants in order to reduce the micromovements at the implantbone interface and to immobilize the implants in compromised bone qualities. However, there are clinical indications when implants have to be placed in the posterior maxilla with a simultaneous sinus lift procedure. A lateral window approach (3) or a sinusdirected osteotome technique with vertical elevation of the sinus membrane and the sinus floor (3-6) has been previously reported. The use of bone grafting materials in this later technique is not always necessary (7). The data of the simultaneous sinus lift and implant placement procedures show a long-term predictability if the primary stability of the implant is achieved through a sufficient height of the residual ridge and an adequate stability due to the implant design. A mean height of 4-5 mm from the top of the ridge to the sinus floor has been demonstrated to be sufficient for initial stability of the implant in the combined approach (4, 8-9). When implant stability is questionable, a delayed approach is recommended. As previously mentioned, the chances of achieving osseointegration are increased when the implant is not subjected to micromovements, either through implant thread (screw) design or with the help of external fixation, or cross-arch stabilization.
This report presents a clinical case with unilateral sinus augmentation combined with simultaneous implant placement and immediate functional (occlusal) loading to restore the entire maxillary arch using a fixed cross-arch cemented implant-supported restoration.

CASE REPORT

A 54-year old male patient presented at the Dept. of Oral Surgery and Implant Dentistry at the University of Frankfurt (in the year 2002) for the treatment of his edentulous maxilla. According to the clinical and radiological examination, an insufficient height in the left posterior maxilla for implant placement was found. The opposing lower jaw teeth were already restored with an implant-supported fixed prosthesis. The patient was informed of the treatment protocol as well as the alternatives of treatment and signed the informed consent. Based on the treatment plan, a duplicate of his full denture was used as a surgical guide for the implant placement. After local anesthesia with Articain DS forte® (1:100,000; Aventis, Bad Soden, Germany) a mucoperiosteal flap with midcrestal incision from #1-16 and distal vertical incision for a better access in the region of #15-16 including the left tuberosity was raised. A window preparation at the lateral aspect of the maxilla was performed for a conventional sinus lift procedure (Fig. 1). The medial wall was visualized after a careful elevation of the sinus membrane using the sinus curettes and then the sinus walls were scratched to allow a sufficient blood supply as has been previously suggested (10). Autogenous bone graft from the left tuberosity was harvested for the sinus augmentation. Six Ankylos® implants (Friadent-Dentsply, Tulsa, OK) were placed according to the manufacturer's protocol without tapping of the osteotomy. The selected implant lengths were all 14 mm (right canine and premolars, left canine and first premolar), except one implant with the length of 11 mm (left second premolar), all with a diameter of 3.5 mm (Fig. 2). The implants placed in the sinus had lengths of 14 mm (left first premolar, # 12) and 11 mm (left second premolar, #13). All implants had initial stability. Angled abutments (15 degrees) were connected with a final torque of 15 Ncm, according to the manufacturer's recommendations (Fig. 3). After the sinus augmentation, a collagen membrane (Biogide®, Geistlich, Wolhusen, Switzerland) was used to cover the lateral window (Fig. 4). The membrane was fixed with titanium tags (Frios®, Friadent, Mannheim, Germany). Immediately after surgery, resin caps protecting the abutment margins were placed and the mucoperiosteal flap was closed using silk 4-0 sutures (Resorba®, Nürnberg, Germany). Using a template and resin material (Protemp®, Espe, Seefeld, Germany), a fixed cemented temporization was fabricated chair-side and cemented with Temp Bond® (Kerr, Orange, CA) (Fig. 5). Before the cementation of the temporary bridge, the implant stability was evaluated using the Periotest device (Gulden, Bensheim, Germany). The used occlusal scheme was group function without the presence of

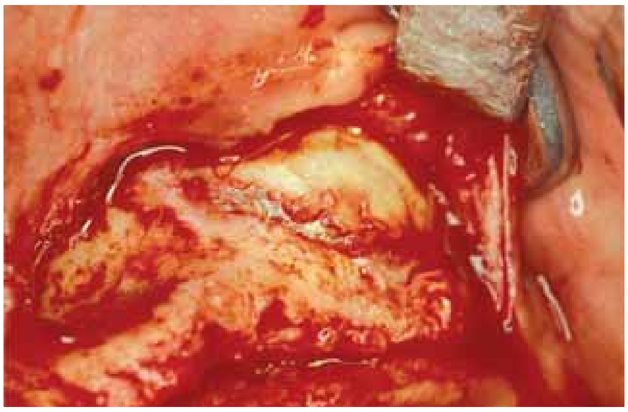

Fig. 1 *Lateral window preparation for sinus lift procedure and implant placement.*

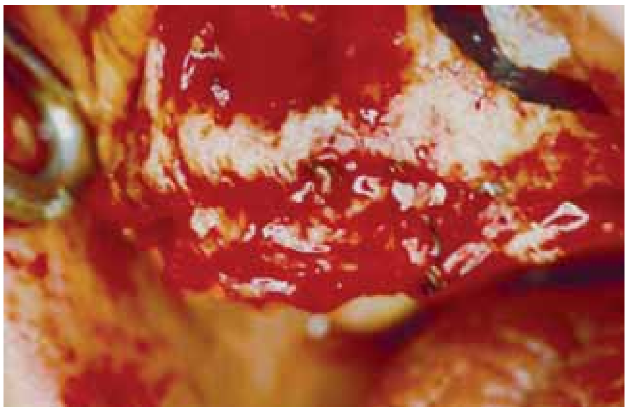

Fig. 2 *Implant placement with simultaneous sinus lift procedure. Implants are placed in the sinus cavity immediately before augmentation.*

Fig. 3 *Abutment connection immediately after sinus lift procedure.*

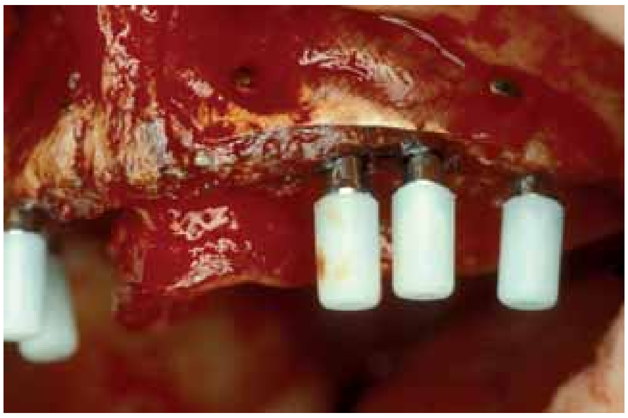

Fig. 4 *Lateral window coverage with a collagen membrane. The resin caps were placed on the abutments for the fabrication of the temporary bridge.*

Fig. 5 *Provisionalization in place immediately after surgery (immediate occlusal loading).*

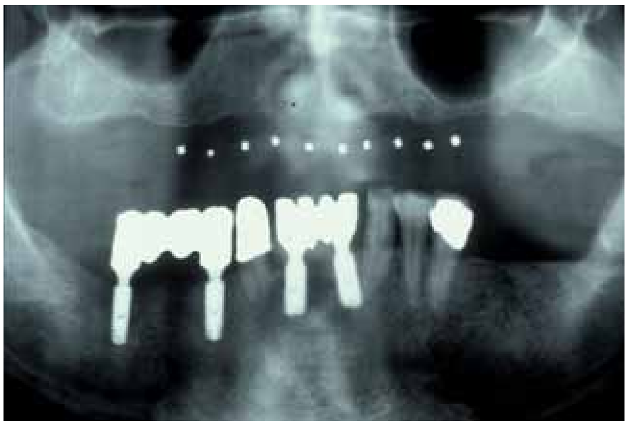

Fig. 6 *Panoramic radiograph immediately before implant insertion and sinus lift procedure.*

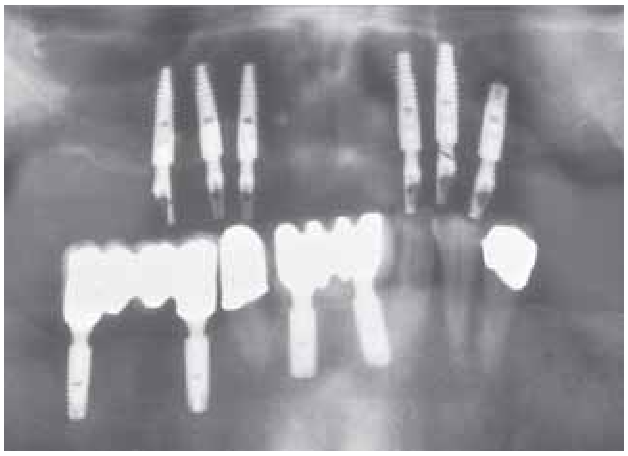

Fig. 7 *Panoramic radiograph immediately after implant insertion with simultaneous sinus lift procedure.*

Fig. 8 *Occlusal view of the final implant-supported restoration five years after immediate loading.*

distal cantilevers. A postoperative Panorex confirmed the implant position and the relation with the sinus augmentation in comparison to the preoperative radiograph (Fig. 6, 7).

A postoperative antibiotic administration with Augmentan® (500 mg, t.i.d.) was prescribed for the first 10 days. A soft/liquid diet was mandatory for the first 3-4 months after loading.

Ten days after surgery, the provisional was removed very carefully using a hemostat, the sutures were removed and irrigation with saline to remove the fibrin was performed. At this stage of the healing, peri-implant soft tissue measurements were performed to evaluate the soft tissue condition (Table 1). Three months after loading, a new Panorex examined the bone formation at the sites #12 and #13. The temporary was removed again and measurements evaluating the implant stability and peri-implant condition were performed (T1). A final abutment level impression was performed using resin impression caps. The metal framework was delivered two weeks later. The final metaloceramic prosthesis was delivered 4-6 weeks later and cemented with Temp Bond® permitting easy removal and allowing periodical evaluation of the implant stability (Periotest) in the follow up visits (T2). Two distal cantilevers at the sites #2 and 3 as well as one at the site #14 were incorporated in the prosthesis design (Fig. 8). The periimplant soft tissue and Periotest (PV) measurements in the entire follow up period (T3) are presented in Table 1. In the last follow up examination, after 64 months of loading (in the year 2008), a Panorex as well as periapical radiographs were taken to assess the crestal bone level. The implants presented an excellent prognosis and bone integration according to the radiographic examination. No crestal bone loss was found in the entire loading period (Fig. 9, 10).

DISCUSSION

The present case report demonstrates a unique prosthetic rehabilitation of the maxilla using a fixed

Fig. 9 *Periapical radiographs of the immediately loaded implants placed at the # 4-6 presenting no crestal bone loss five years after loading (platform shifting).*

Fig. 10 *Radiographic evaluation of the immediately loaded implants placed simultaneously with a sinus lift procedure presenting no crestal bone loss (platform shifting) 5 years after loading and an excellent new bone formation. The augmentation material has been remodeled in an excellent way due to the loading forces; no margin between the sinus floor and the bone grafting material could be observed (excellent remodeling).*

Misurazione	Indice placca	SBI	PPDm	PPDb	KM	PV
#4						
To	0	0	2	2	2	3
T1	0	0	2	2	2	1
T2	0	0	1	2	3	3
T3	0	1	2	2	2	1
#5						
To	0	0	1	2	2	-1
T1	0	1	2	2	2	0
T2	0	1	2	1	2	1
T3	2	3	2	4	3	-2
#6						
To	0	0	1	2	4	0
T1	0	0	2	2	4	2
T2	0	0	2	1	4	-1
T3	1	3	2	4	3	-1
#11						
To	0	0	2	1	5	2
T1	0	0	2	2	5	-1
T2	0	0	2	2	4	-2
T3	0	2	3	4	3	-2
#12						
To	1	0	2	1	4	2
T1	1	0	2	1	4	2
T2	0	0	2	1	4	-2
T3	1	0	3	3	3	-3
#13						
To	0	0	2	2	4	5
T1	0	0	2	2	4	2
T2	0	0	2	2	4	0
T3	0	2	2	3	3	-3

Tab. 1 *Evaluation of the periimplant indices during the entire loading period. SBI = sulcus bleeding index; PPDm = probing pocket depth (mesial) in mm; PPDb= probing pocket depth (buccal) in mm; KM = width of keratinized mucosa in mm; PV = Periotest value.*

implant-supported cross-arch restoration reducing the entire treatment period significantly considering the day of the surgery as a baseline. Specifically, two implants placed in combination with simultaneous sinus lift procedure and loaded immediately after surgery using a provisional fixed implant supported bridge. Soft/liquid diet was advised for the first 3-4 months of healing to reduce the micromovements at the implant-bone interface.

According to Wolf's theory (11), new bone formation is dependent of the functional ability of this bone ("form follows function"). In the present case, it seems that the bone grafting material at the sinus floor have been remodeled under the influence of functional loading. The provisional restoration was resin-made having some elasticity during loading, allowing in that way the bone formation in the sinus cavity without resorption of the autogenous grafting material (Fig. 10). This bone adaptation to the loading forces especially using the progressive thread design has been demonstrated after immediate functional lading in the weak bone qualities in monkeys (12).

There is no doubt that the histological evaluation of the new bone at the augmented sites would be of interest, however this is not possible in a human clinical report.

Based on this treatment protocol, it may be concluded that the initial stability achieved primarily using an implant design with high mechanical stability in the residual lamellar bone and secondary using a cross arch immobilization (splinting) with the adjacent implants. All implant systems have different primary stability affecting possibly the immobilization at the interface (13). The implant surface seems to be important during the healing period to support and modify the healing process and speed up the osseointegration. The splinting with the

adjacent implants increases the stability of the implant at the osteotomy site and may control the micromovements at the interface.
The used implant system has a progressive thread design allowing the loading force transmission primarily to the apical part of the implant, as has been previously documented with finite element studies (14) and optoelastic measurements (15). Because of the higher loading forces at the apical thread part of the implant, the bone at the augmented site (autogenous bone graft) may be remodeled better and becomes denser. Bone under compression or tension leads to new bone formation (16) and extra-axial forces at the implant interface characterize this dynamic remodeling (17). For that reason, autogenous bone has been used in the present clinical case instead of other bone grafting materials, which have not the same properties for regeneration. In further studies, it would be important to evaluate the potential of other bone grafting materials in the remodeling process under the influence of the occlusal loading forces.
However, high forces in the bone with microstrains over 200,000 could be dangerous for the apatite formation and did not show any new mineralization at the ultrastructural level (18).
Biomechanical considerations, such as a tight conical implant-abutment connection may be important to provide a virtual one piece implant, which will be connected without the risk of micromovements. Using this type of connection an abutment fixation will be established with only 15 Ncm torque, according to the manufacturer. Therefore, within the limits of this case report we were able to prove that immediate functional loading in the maxilla or in general in poor bone qualities do not need per se a torque of 30-40 Ncm, as different studies suggested previously (19). The insertion torque of the implants was not measured in the present study but seems to be low in the posterior maxilla in the area of the sinus. The necessary torque for the abutment fixation should be considered in the future in various consensus reports and protocols of immediate loading. The additional benefit of a platform switching (shifting), which also is characteristic for this implant system, may be also a reason for crestal bone stability (20, 21). This has been documented extensively with this implant system in clinical studies (22-24). Additional positive results presenting the crestal bone stability have been documented in monkeys (12, 24-27) and also in humans (27, 28) using immediate functional loading. In all of these studies the role of soft/liquid diet in the concept of immediate loading has been emphasized, as has been previously reported elsewhere (29-31).
As a conclusion, this case report shows the possibility of immediate loading of oral implants in combination with a simultaneous sinus augmentation if some special requirements are considered.
There is a general acceptance that sinus lift technique is a well established surgical technique for the posterior maxilla presenting high survival rate of the implants. This has been shown in systematic literature reviews presenting also a new bone formation around the grafting materials placed in the sinus (32, 33).
The excellent primary stability and the immobilization of the implants due to splinting through cross-arch stabilization are in general mandatory. Based on our experience in such clinical cases, the use of soft/liquid diet for the first 3-4 months of loading is considered mandatory. Further clinical cases with more data using this treatment protocol and different implant designs should be performed in order to improve the concept of immediate loading in poor bone qualities and quantities.

ACKNOWLEDGEMENT

The author would like to thank the dental lab technician Mrs. Susanne Roth (Dental School Frankfurt, Dept. of Prosthodontics, Frankfurt, Germany), for her support in this case report.

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