Bone Augmentation in Dental Implantology Using Press-Fit Bone Cylinders and Twin-Principle Diamond Hollow Drills: A Case Series

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ABSTRACT

Background: Bone transplants are mostly prepared with cutting drills, chisels, and rasps. These techniques are difficult for unexperienced surgeons, and the implant interface is less precise due to unstandardized preparation. Cylindrical bone transplants are a known alternative. Current techniques include fixation methods with osteosynthesis screws or the dental implant.

Purpose: A new bone cylinder transplant technique is presented using a twin-drill principle resulting in a customized pressfit of the transplant without fixation devices and combining this with the superior grinding properties of a diamond coating.

Materials and Methods: New cylindrical diamond hollow drills are used for customized press fit bone transplants in a case series of five patients for socket reconstruction in the front and molar region of maxilla and mandibula with and without simultaneous implant placement.

Results: The technical approach was successful without intra or postoperative complications during the acute healing phase.

Conclusion: The customized press fit completes a technological trias of bone cylinder transplant techniques adding to the assisted press fit with either osteosynthesis screws or the dental implant itself.

KEY WORDS: bone augmentation, cylinder, diamond drill, hollow drill, press fit, trephan

INTRODUCTION

Bone augmentation prior to dental implant placement is common in cases of insufficient bone mass for implant placement.[1–3] The natural resorption after the loss of teeth leads to vertical and sagittal jawbone resorption.[4,5] Severe inflammation with granualtion tissue and osteolysis around teeth or implants leads to bony defects.[5] Common concept to solve these clinical problem is augmentation with autologous bone, biomaterials, or combinations of both.[1,6] Two augmentation techniques are most commonly used in all recipient regions: bone block grafts and membrane techniques (guided tissue regeneration, also called guided bone regeneration [GBR]) utilizing pure bone, biomaterials, or combinations of both as crushed bone and mesh grafts.[7–9] Simultaneous insertion of dental implants is possible but must be decided on an individual basis and requires sufficient local bone mass.[10,11]

Local donor sites for autologous bone transplants most widely used for bone harvesting include local intraoral regions like chin, mandibular ramus at the linea obliqua, mandibular angle, and maxillary tuber region.[1,11] The most common distant donor site utilized by craniomaxillofacial surgeons is the iliac crest.[12,13]

All techniques involving either GBR or block grafts are individually handcrafted bone transplants. Using

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TABLE 1 Patients Evaluated in the Case Series

	Gender	Age (years)	Reason for Defect	Location of Bony Defect	Procedure	Donor Region
Patient 1	Female	57	Implant loss	11	Dowel transplant and bone chips	Linea obliqua
Patient 2	Female	50	Resorption after tooth loss	31, 41, 42	Dowel transplant and ceramic	Chin
Patient 3	Male	53	Implant loss	23	Dowel transplant and ceramic	Retromaxillary
Patient 4	Female	62	Implant loss	16	Dowel transplant and bone chips	Retromaxillary
Patient 5	Male	46	Tooth loss after trauma	43	Dowel transplant	Chin

standardized bone harvesting drills like trepans to generate bony cylinders is a possible advantage. Existing techniques of this kind employ either osteosynthesis screws or dental implants as fixation devices. They are therefore assisted press-fit techniques.[14–16] We presented a further development in this field using special diamond hollow drills to result in a customized press fit without further fixation of the bone transplant.[17,18] A twin-drill principle with a bigger drill for the harvesting of the transplant and the smaller drill for the recipient site are resulting in an overlap of the transplant and the bony bed as described previously.[17–19] This overlap leads to a proper customized press fit without the need for fixation devices. This case series presents the clinical pilot study of this technique for different indications.

MATERIALS AND METHODS

Patients

Five patients with bony defects requiring vertical and sagittal bone augmentation were selected for customized press-fit procedure (Table 1). The inclusion criteria were: no systemic disorders; no bisphosphonate treatment; and appropriate defect size requiring bone augmentation prior to dental implant placement.

Surgical Procedures

Patients underwent the individual procedure under usual dental local anesthesia and sterile surgical conditions. The diamond hollow drills (inner diameter of the harvesting drill 0.50 mm; outer diameter of the recipient site drill 0.48 mm) used here are certified medical devices provided by Hager&Meisinger Inc. (Neuss, Germany; Dowel drills of Draenert GF). The twin-drill principle and the diamond hollow drills were described previously.[18–21]

RESULTS

Patient 1 suffered from an early implant loss after immediate implant placement alio loco (Figure 1). The procedure started with the explantation and preparation of the bony bed after local anesthesia. The transplant cylinder was obtained from the left linea obliqua area. A dental implant was placed through the transplanted and press fit-fixed bony cylinder (Semados System, Bego Inc., Bremen, Germany). The remaining palatinal defect was filled with easy graft (Hager&Meisinger GmbH). Primary wound closure flowing covered healing concept was performed with a non-resorbable suture material.

Patient 2 suffered from alveolar ridge resorption in the mandibular front area after loss of teeth. The bony bed was prepared after local anesthesia. A bone cylinder was obtained from the nearby chin area. The remaining defect was filled with Bonit matrix (SiO_2/HA/β-TCP) (DOT GmbH, Rostock, Germany) after the press-fit fixation of the cylinder and covered with Bio-Gide® membrane (Geistlich Inc., Wolhusen, Switzerland). Primary wound closure was performed with a non-resorbable suture material.

Patient 3 suffered from an early implant loss after immediate implantation. The bony defect was prepared under local anesthesia. A bone cylinder was generated from the retromaxillary area of the same side and press fit fixed in the crestal defect following the twin principle as described earlier. The remaining defect was filled with easy graft (Hager&Meisinger GmbH). Primary wound closure was performed with a non-resorbable material.

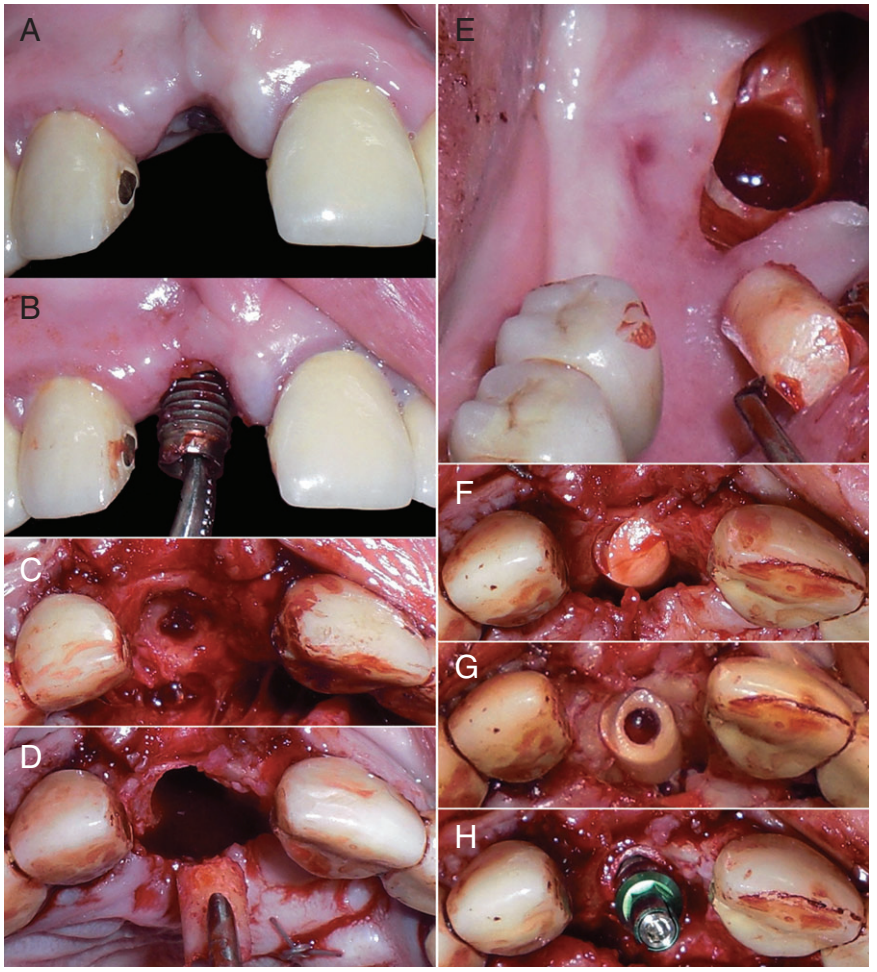

Figure 1 *A–D*, defect situation after failed implant and preparation of the receipient bed for the customized press fit. *E–H*, Harvesting of a bone cylinder from the linea obliqua and customized press-fit fixation in the prepared implant bed, followed by immediate implantation. Different to the technique of Giesenhagen, we provide a primarily press fit of the transplant cylinder prior to the insertion of the dental implant.

Patient 4 showed a crestal bony defect after alveolitis sicca following extraction of tooth 16 (Figure 2). A preparation of the bony bed and a local flap following Rehrmann were performed under local anesthesia.[22] A bone cylinder from the retromaxillary region of the same side was press fit fixed in the grinded recipient bed, and the remaining defect was filled with bone chips from the same donor area. A primary closure was performed with a non-resorbable suture material.

Patient 5 suffered from a traumatic loss of tooth 43. An alveolar ridge reconstruction was performed with a bony cylinder from the chin area following the twin-drill principle and a Straumann ITI® implant (Straumann AG, Waldenburg, Switzerland) was inserted simultaneously. Primary wound closure was performed with anon-resorbable material.

All patients showed typical postoperative swelling and slight pain. The current follow-up of 6 weeks showed no infection or loss of the augmented bone material observed under systemic prophylaxis with a broad-spectrum antibiotic. The suture material could be removed after 10 days. The current surveillance phase revealed no complications so far.

DISCUSSION

A new approach of bone cylinder transplants in dental implantology was established by transferring the customized press-fit principle from orthopedic surgery. This press fit does not require additional fixation with osteosynthesis screws or other devices.[23] A first technical development presented previously was a modified sinus floor elevation using press-fit bone dowels.[17,18] The

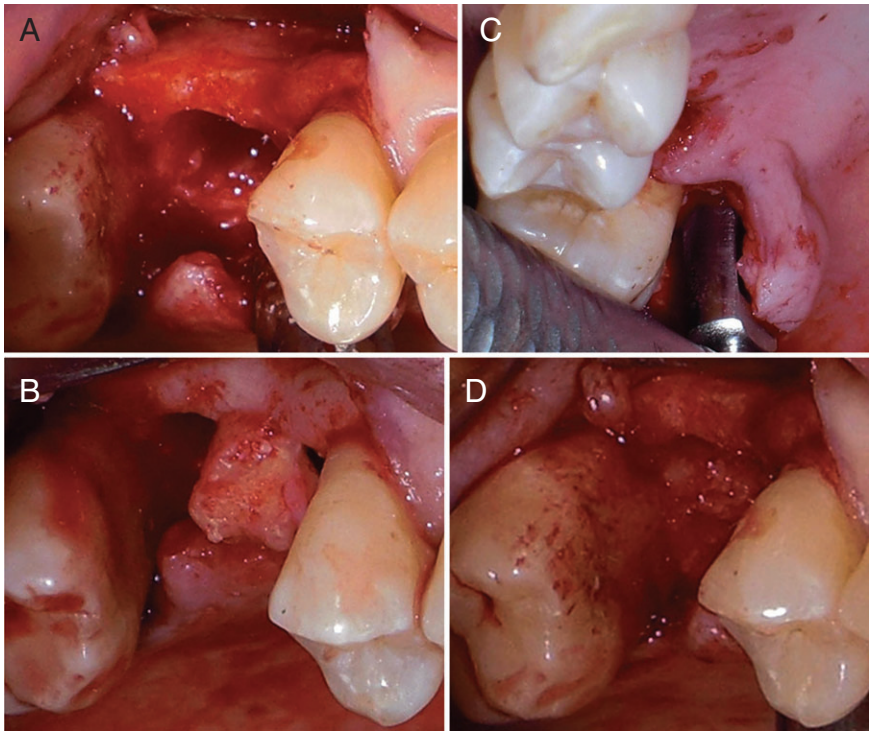

Figure 2 *A–D*, Defect in the right maxillary molar region after tooth extraction, removal of a radicular cyst and preparation of the implant bed. Harvesting of a bone cylinder from the retromolar region of the same side. Insertion of the cylinder and filling of the remaining defect with crushed bone from the implant bed preparation.

current case series applied the twin-drill principle and the customized press fit for alveolar ridge augmentation with bone transplants from local intraoral donor sites.

Cylindrical grafts could offer advantages over the widespread techniques of free bone graft preparation with cutting drills, chisels, and rasps.[5,9,11] The most important benefits are the standardized approach allowing easier training of younger surgeons with less routine, and the technical advantage of an easier and more precise fixation of the cylindrical transplant in a prepared cylindrical implant bed. The bony cylinders are block transplants and share all of their advantages compared with amorphous augmentations with GBR techniques including the reduced resorption.[24]

The first application of bone cylinders described in craniomaxillofacial surgery included the harvesting of iliac crest bone transplants.[15,16] Current techniques established clinically in dental implant surgery include assisted press fit of the cylinders using either osteosythesis screws (Streckbein approach) or the dental implant itself (Giesenhagen approach).[14] The difference of our technique compared with the other approaches is the fixation exclusively based on the customized press fit of the cylinder in the implant bed. The basis of this technique is the twin-drill principle. The outer diameter of the smaller drill fits the size of the transplant cylinder harvested with the bigger drill with an overlap. This principle is different to the existing trepan drills without an overlap used for other techniques. The diamond hollow drills combine the customized press fit with the superior grinding properties of the diamond surface as described in a previous study.[20]

This technique offers an additional option completing the possible application principles of cylindrical drills and providing a triad of technical applications of cylindrical bone transplants (Figure 3). The osteosynthesis method is most appropriate when a severe bone loss is given and a customized press fit cannot be achieved. The additional osteosynthesis material is the hamper of the technique thus overcoming the need of a sufficient implant bed required for the customized press fit. The technique of Giesenhagen is best in situations with a sufficient bony bed for immediate implantation. It provides a vertical bone augmentation with a maximum of fixation.[14] Future clinical application of all the three techniques alongside each other could offer the best approach to gain long-term data and establish indication regiments.

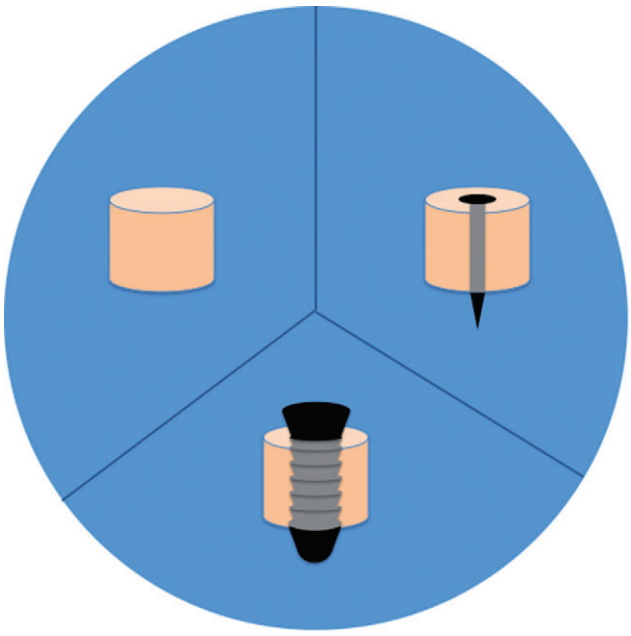

Figure 3 From upper left clockwise: Customized press fit without further fixation devices, only fixed by the press fit in the implant bed; assisted press fit with osteosynthesis material (eg, Streckbein approach); assisted press fit fixed by the dental implant itself (Giesenhagen approach).

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