Focus on a new technique

Closed hydraulic sinus floor elevation with simultaneous implant insertion

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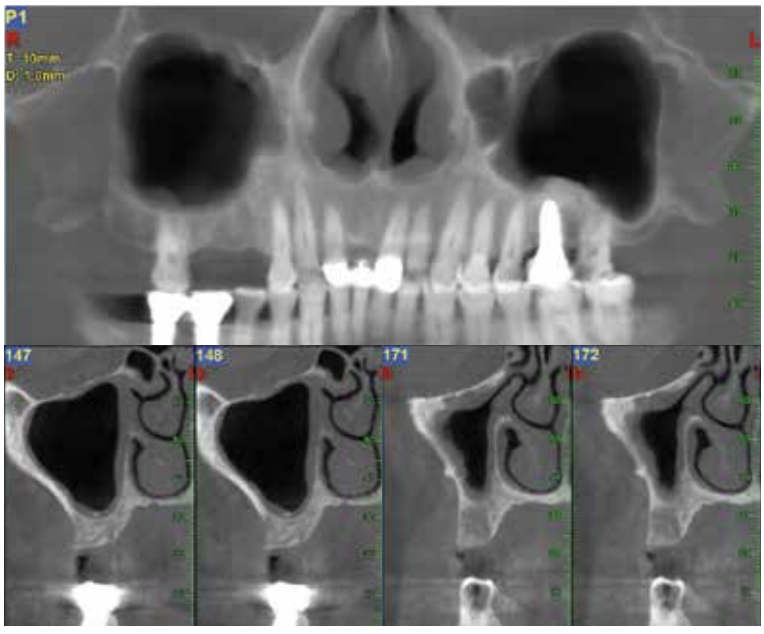
The closed sinus lift was first performed by Tatum in 1974 and later published by Summers in 1994 [1]; it is now known as the "Summers technique". This technique involves a crestal incision. The sinus lining is lifted transcrestally using an osteotome. The procedure is considered minimally invasive, with patients experiencing less swelling and discomfort postoperatively compared with traditional open sinus lift procedures. The most common complication of the open sinus lift grafting is intra-operative perforation of the Schneiderian membrane. Reported perforation rates range from 20 to 44 per cent, whereas perforation rates for the closed sinus lift have been reported as 0 to 25 per cent [2-4]. In addition, postoperative swelling and haematoma have been reported in 65 per cent of patients with an open sinus lift [5].

Chen and *Cha* first described the hydraulic sinus floor elevation in 2005. Here, a 3-mm round diamond bur was used to start the osteotomy, the drill stopping about 1 mm short of the sinus floor. A 2-mm sinus bur was used to create a pinhole bore at the end of the osteotomy. Hydraulic pressure was applied to the osteotomy site by a high-speed air turbine handpiece to raise the Schneiderian membrane, followed by the condensation of grafting materials below the raised membrane.



1 I Preoperative CT showing bone height at sites 16 and 15.

This article describes a new technique for the hydraulic closed sinus lift using a specialized implant (iRaise, Maxillent, Israel) that has a built-in internal channel to act as sinus floor elevation device. This internal channel facilitates the introduction of fluids and bone-graft materials through the implant body into a space beneath the Schneiderian membrane. It also allows a simultaneous sinus lift and full-length implant insertion in a single procedure.

Clinical case

A 61-year-old male patient presented with missing teeth 15 and 16. A CT was taken and confirmed a residual bone height of approx. 5 mm at site 16, which was not sufficient for a regular-length implant. The bone height at site 15 was adequate. The treatment plan included a sinus lift and grafting with simultaneous implant placement at site 16 and a conventional implant at site 15. The right maxillary sinus appeared to be healthy on the CT scan (Fig. 1).

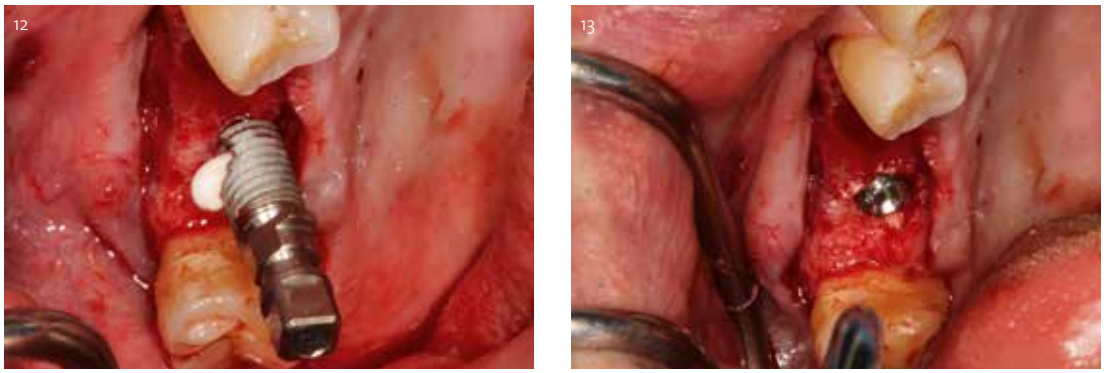
2 to 7 I
Marking drill, pilot drill, flat drill, cortex drill.

8 and 9 I
The sinus-lift implant; insertion of the implant in the osteotomy.

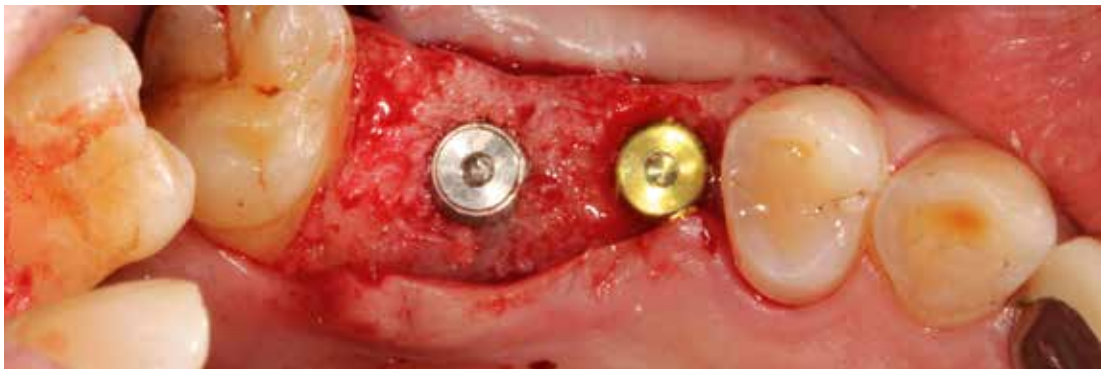
10 and 11 I
The tube connector in place with saline and bone-graft injection.

Surgical phase (Figs. 2 to 14)

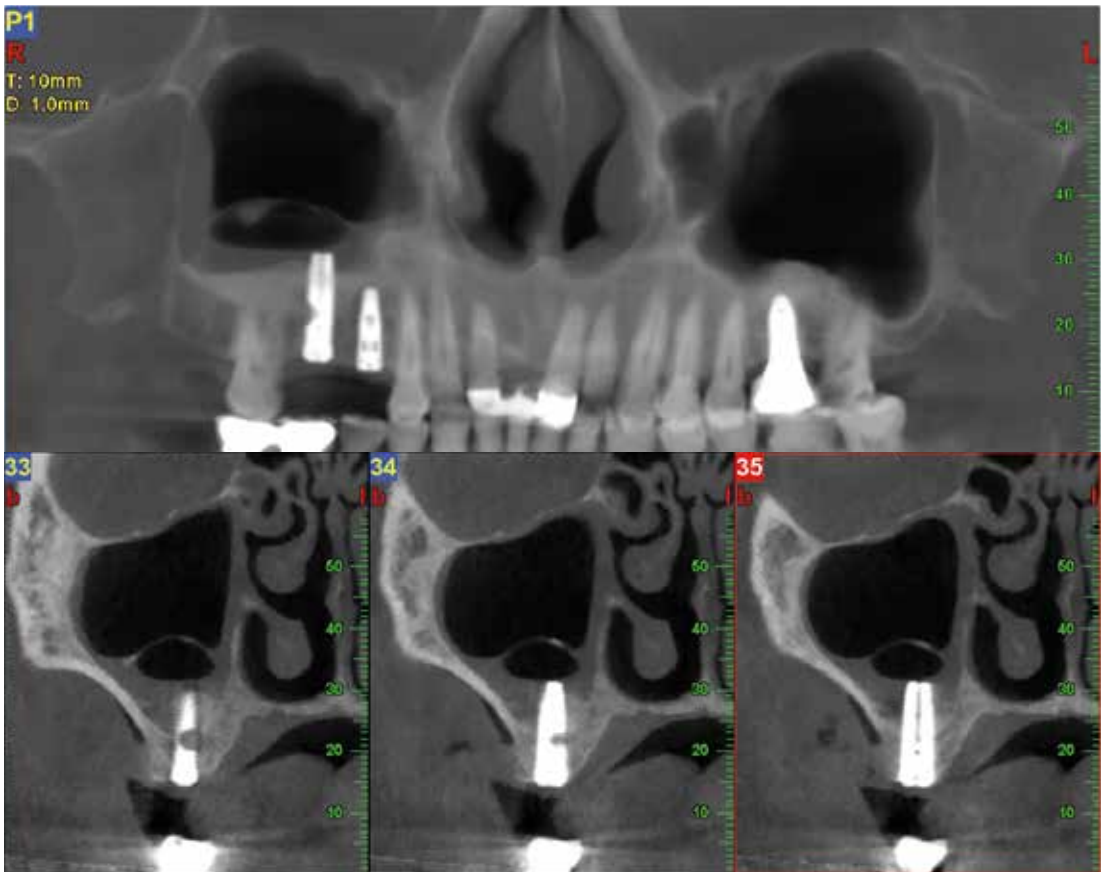
An iRaise (Maxillent, Israel) sinus-lift implant was used to perform the hydraulic sinus floor elevation and bone grafting. A crestal incision was made over the implant recipient site and a full thickness unilateral mucoperiosteal flap was raised. The implant at site 16 was placed first; its position was marked with a 2-mm round bur, followed by the 2-mm pilot drill. The flat drill was then used to continue the osteotomy until the cortex of the sinus floor was reached. Finally, the cortical bone of the sinus floor was weakened by a diamond cortex drill. The sinus-lift implant was inserted into the osteotomy site to penetrate the sinus floor; blood came out from the coronal opening of the channel once the implant reached below the Schneiderian membrane. The tube connector was adapted onto the implant body. 2 ml saline solution were injected through the internal channel, which pressed against the sinus membrane and detached it gently from the sinus floor. The saline was drained from the sinus, and bone-graft material was injected into the sinus by the same route. The adapter was removed and the implant fully inserted into the osteotomy. The cover



12 and 13 | Bone-grafting materials are extruded from the opening of the internal channel; the sinus-lift implant has been fully inserted.



14 | A regular implant was placed at site 15. Cover screws in situ.



15 | Immediate postoperative CT showing the lifted sinus lining.

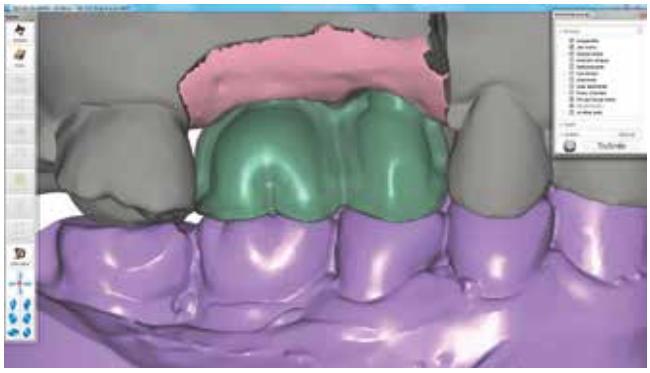
screw was connected and the flap closed with absorbable Vicryl sutures. The postoperative CT (Fig. 15) showed that the sinus lining had been raised about 15 mm without perforation. The sinus-lift implant was well seated inside the bone graft in the cavity created. There was minimal pain and swelling during the postoperative period. The patient was able to resume his daily activities the next day.

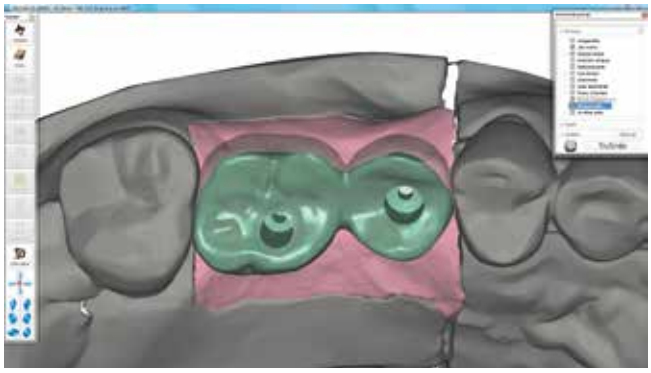
16 I Following an uneventful three-month period in the maxilla, the definitive impression was taken at implant level using open-tray impression copings (15: NobelBiocare, Sweden; 16: Maxillent iRaise, Israel). A digital radiograph was used to verify the complete seating of the impression copings. The impression was taken using a custom tray and polyether (Impregum, 3M Espe, Germany).

17 I Implant analogues (NobelBiocare, Sweden; Maxillent iRaise, Israel) were connected to the impression copings. A master cast was fabricated with soft-tissue analogue (G Mask, GC, USA) and type IV dental stone. Non-engaging temporary abutments were screwed onto the master cast. Maxillary and mandibular casts were mounted on a semi-adjustable articulator (Artex, AmannGirrbach, Germany). A temporary bridge was fabricated with a low-shrinkage acrylic resin (GC Pattern Resin, GC, USA) and acrylic teeth (Ivoclar Vivadent, Liechtenstein).

18 I The temporary bridge was tried in in the patient's mouth and checked for interproximal contacts and occlusal adjustment. The design of the implant framework was to provide for metal on the occlusal surface and a buccal ceramic veneer. The precise occlusal contacts on the temporary bridge were greatly important for the subsequent scanning workflow.

19 I The mounted master casts, soft-tissue analogue and tried-in temporary bridge were digitized by a model scanner (Zfx Evolution, Zfx, Germany).





20a and b I The cut-back for the buccal ceramic veneer (0.8 mm) was performed by CAD software (Zfx CAD Software, Zfx, Germany).

Restorative phase

The steps of the restorative phase are shown in Figures 16 to 25.

Discussion

The sinus-lift implant offers several advantages over the conventional open sinus augmentation. There was minimal postoperative pain, swelling and bruising

21 I The final CAD data of the implant-supported bridge framework was sent to the milling centre and subsequently milled.

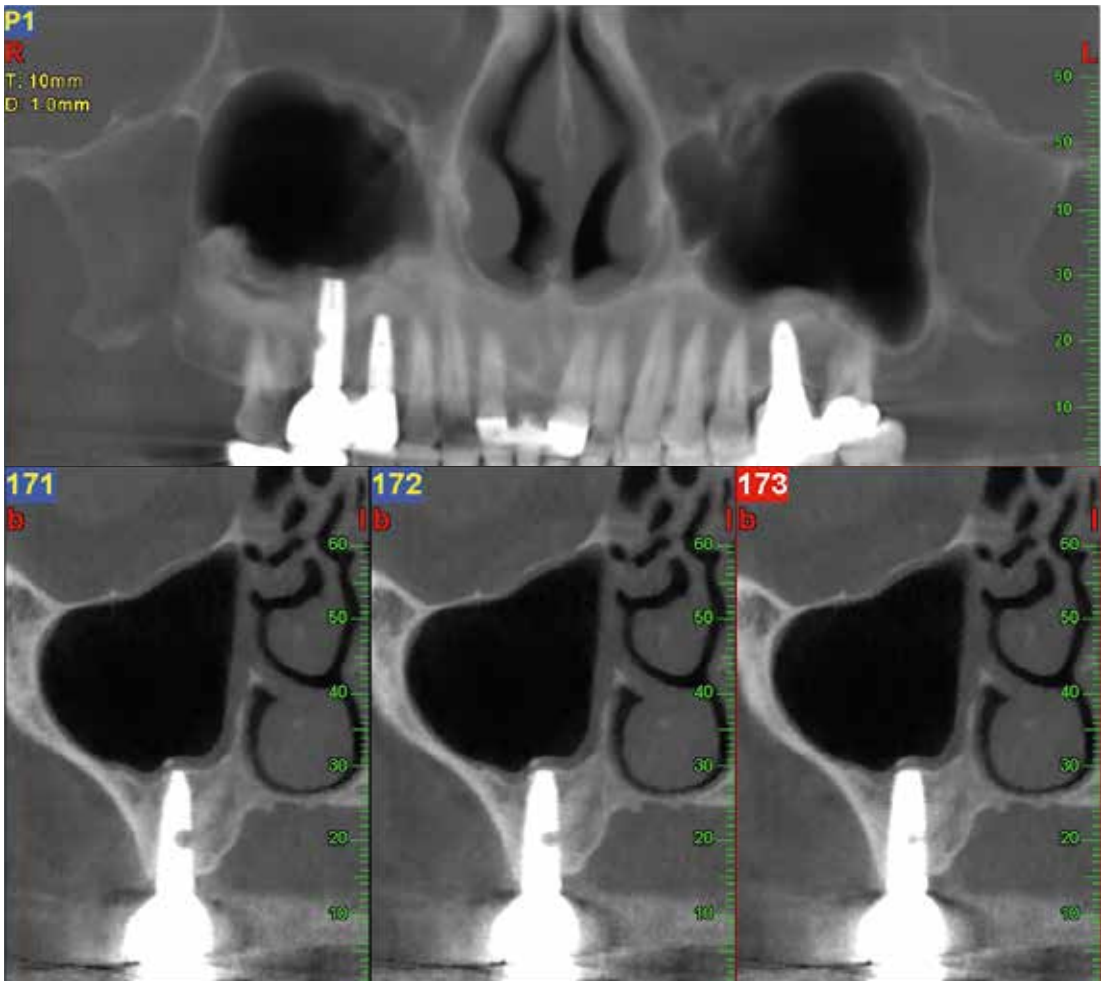
22 I The fit of the cobalt-chromium framework (Zfx, Germany) was assessed on the working cast.

23a and b I A dedicated ceramic material (VM13, Vita, Germany) was used for ceramic veneering with a coefficient of thermal expansion of 13.1–13.6 K^{-1}. The ceramic veneer was fabricated according to the manufacturer's instructions.

because extensive flap raising and bone removal were avoided. The procedure can be performed under local anaesthesia, whereas the conventional open sinus lift usually requires intravenous sedation or general anaesthesia. Therefore, the procedure is suitable for patients with a high anaesthetic risk. Moreover, the extent of the sinus floor elevation was much greater than with the closed sinus lift using the osteotome approach, which was essentially a mechanical tenting of the sinus lining.

This patient had received an open sinus lift on the contralateral side (teeth 26) a year previously. He reported that the postoperative recovery was more rapid and the discomfort was much less with the sinus-lift implant compared with the open sinus lift. The author has completed five comparable cases

24 I The definitive implant-supported CAD/CAM bridge with metal occlusal surfaces was inserted. A periapical radiograph was taken to verify the complete seating of the implant bridge on the implants. The abutment screws were tightened according to the manufacturer's instructions (35 Ncm). The CAD/CAM system can reproduce the interproximal and occlusal contacts of a temporary bridge or resin pattern precisely (to within 20 µm). No occlusal adjustment was required.



25 I Six-month post-operative CT showing the consolidated sinus graft and finished restoration.

so far. No perforation and no infection have occurred, and all implants were successfully restored. ■

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