Clinical case letter

# Simultaneous implantation and reconstruction of the severely resorbed posterior mandible using an early concept of Screw-Guided Bone Regeneration (S-GBR) technique: a 14-year follow-up

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## 1. Introduction

The use of Guided Bone Regeneration GBR techniques is already well documented in the posterior mandible **[1]**. The concept of this technique is to create a protected bone regenerative chamber above the residual alveolar ridges in order to reconstruct a natural implantable bone volume. In this technique, the bone regenerative chamber can be delimited using various kinds of membranes or barriers, and the chamber can be filled with blood clot or various bone materials (autologous, allograft, xenograft, synthetic)**[1-3]**.

The barrier can be a resorbable membrane but a classical form of GBR is requiring non-resorbable membranes such as titanium mesh **[4]** or ePTFE (expanded polytetrafluoroethylene membranes)**[5,6]**, where the regeneration compartment is well delimited and protected from mechanical constraints. The main disadvantages of the non-resorbable membranes are particularly: their complexity of use, as they require very careful modelling and positioning; and the risks related to the gingival healing, as soft tissue dehiscence is frequent and implies serious risk of membranes contamination and destruction of the regenerative chamber **[1,6]**.

Even if the relative abundance of literature on the topic can validate the concept of these techniques, there is no real consensus on their relevance in the resorbed posterior mandible in comparison to the other therapeutic options and their use remains scarce in daily practice. There is also a lack of consensus on the adequate materials and membranes to combine to get adequate results **[1,7]**.

The concept of placing implants at the time of the GBR was already advocated but considered as quite risky in case of contamination **[5,7]**. This concept was described as a GBR with simultaneous implantation, while in fact it may be considered as a real S-GBR (Screw-Guided Bone Regeneration) concept. The idea of S-GBR is that the regenerative chamber is maintained, protected and delimited on the long-term by screws – osteogenesis screws or the dental implants themselves. In the case of a GBR with non-resorbable membrane, the simultaneous implants serve as pillars for the membrane and regeneration compartment, and also as a supporting stake for the bone growth and long-term stabilization.

In this article, we illustrate this early concept of S-GBR as a case of simultaneous implantation and GBR treatment in the posterior mandible with a 14-year follow-up.

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## 2. Materials/methods and results

In this case, a 67-year old female came in the practice in 1998 and required a posterior rehabilitation of the lower right mandible **(Figure 1A)**. The patient was healthy and non-smoker. Her right second premolar and first molar were recently extracted (2 months earlier) due to severe periodontal disease with repetitive abscess and deep bone resorption **(Figure 1B)**. Only the second molar was conserved temporarily, as the tooth was damaged but conservable the time of the bone surgery. On the Computed Tomography CT-scanner, the alveolar bone height available above the mandibular nerve was around 6mm or lower **(Figure 1C)**. It was also noticed that the residual alveolar ridge and mandible body were quite wide.

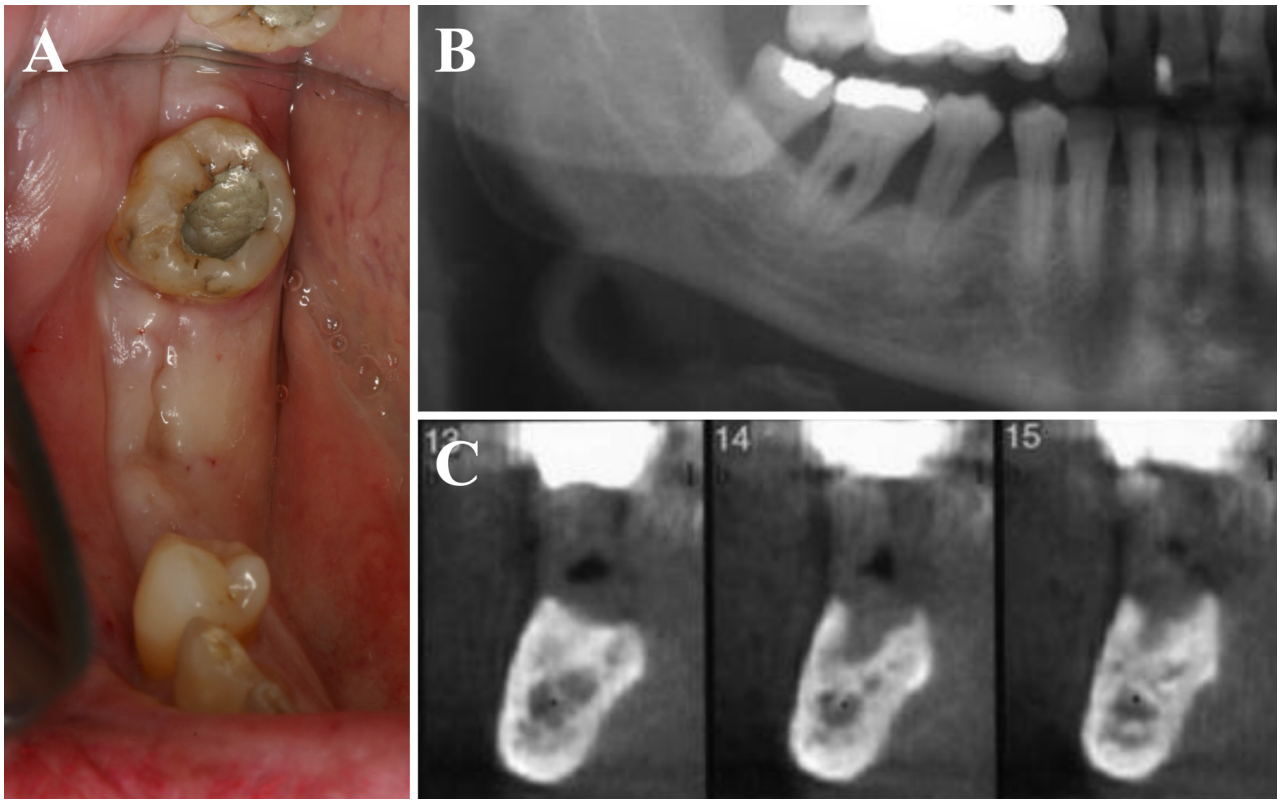


**Figure 1. Initial situation. (A)** The lower right first premolar and first molar were extracted 2 months earlier and the second molar was left temporarily. **(B)** The site was significantly resorbed due to severe periodontal lesions and repetitive abscess around the 2 teeth prior to their extraction **(C)** Two months after extraction, the future implant sites were not completely healed and the remaining bone heights were around 6mm or lower above the mandibular canal.

The surgical site was opened and the alveolar sockets of the previously extracted teeth were only very partially healed **(Figure 2A)**. Fibrous tissue was carefully removed around and in the sockets. Then a bone scraper was used to collect autologous bone fragments all around the surgical site **(Figure 2B)**, and to model the alveolar ridge for the fixation of the regeneration membrane, the implantation and the closure of the gingival flap above the regenerative area without excessive tractions of the soft tissues. The collected bone volume was significant **(Figure 2C)** and was stored in a surgical pot with some drops of

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physiological solution **(Figure 2C')**. Once the surgical site was adequately remodeled, 4 implants were placed (TSV, Zimmer Dental Inc., Carlsbad, CA, USA) with 3.7mm in diameter and 10mm, 11.5mm, 11.5mm and 10mm in length, from mesial to distal respectively **(Figure 2D)**. Their position and axis was selected with the idea to replace functionally 3 teeth, from the second premolar to the second molar, as the second molar was planned for extraction later. The implants were only partially screwed in the residual bone, in order to remain 1mm above the mandibular nerve, and 4mm long of the implant collars remained outside of the bony envelope and could serve as tent pegs for the regenerative chamber.

The collected autologous bone was then grafted around the implants **(Figure 2E)** and the area was then covered with a titanium mesh membrane (Jeil Medical Co., Seoul, South Korea) blocked with 2 screws **(Figure 2F)**. This membrane was adapted carefully to the site anatomy and expected future shape, and served as a physical barrier around the bone regeneration compartment and the gingiva. The barrier was also rigid enough to limit the mechanical constraints on the regenerative bone chamber. Finally, the titanium mesh was covered with a pericardium membrane (Tutogen Medical GmbH, Neunkirchen, Germany)**(Figure 2G)** in order to exclude soft tissue penetration, to reinforce the gingival healing and reduce the risk of gingival dehiscence. Periosteal incisions were performed to extend a little bit the surface of the flap and the surgical site was closed and sutured **(Figure 2H)**.

The post-surgical phase was uneventful and no dehiscence occurred. Three months after the first surgery, it was considered that the regeneration chamber was stable and successful and did not need further protection, and the second molar was extracted. Five months post-implantation and regeneration, the surgical site was fully reopened, and the titanium mesh was removed **(Figure 3A)**. The alveolar bone ridge was well regenerated and the heads of the implants were covered with a significant layer of hard regenerated bone **(Figure 3B)**. All implants were uncovered and the cover screws were removed **(Figure 3C)**. The trans-gingival screws were connected and the flap was sutured. After healing, an implant-supported ceramic metallic bridge was prepared and placed **(Figure 3D)**.

Clinical and radiographic follow-up was done after 6 months **(Figure 3E)** during the first 2 years and then each year. After 1 year, a CT scan control showed stable bone levels **(Figure 3F)**. The position of the 3 posterior implants was observed 1mm above the mandibular nerve, demonstrating how accurate the treatment planning had to be **(Figures 4A, 4A', 4A")**. 14 years after implantation, the rehabilitation was still functional and healthy **(Figure 4B)**. The expected peri-implant bone loss was barely visible after radiographic and clinical examination.

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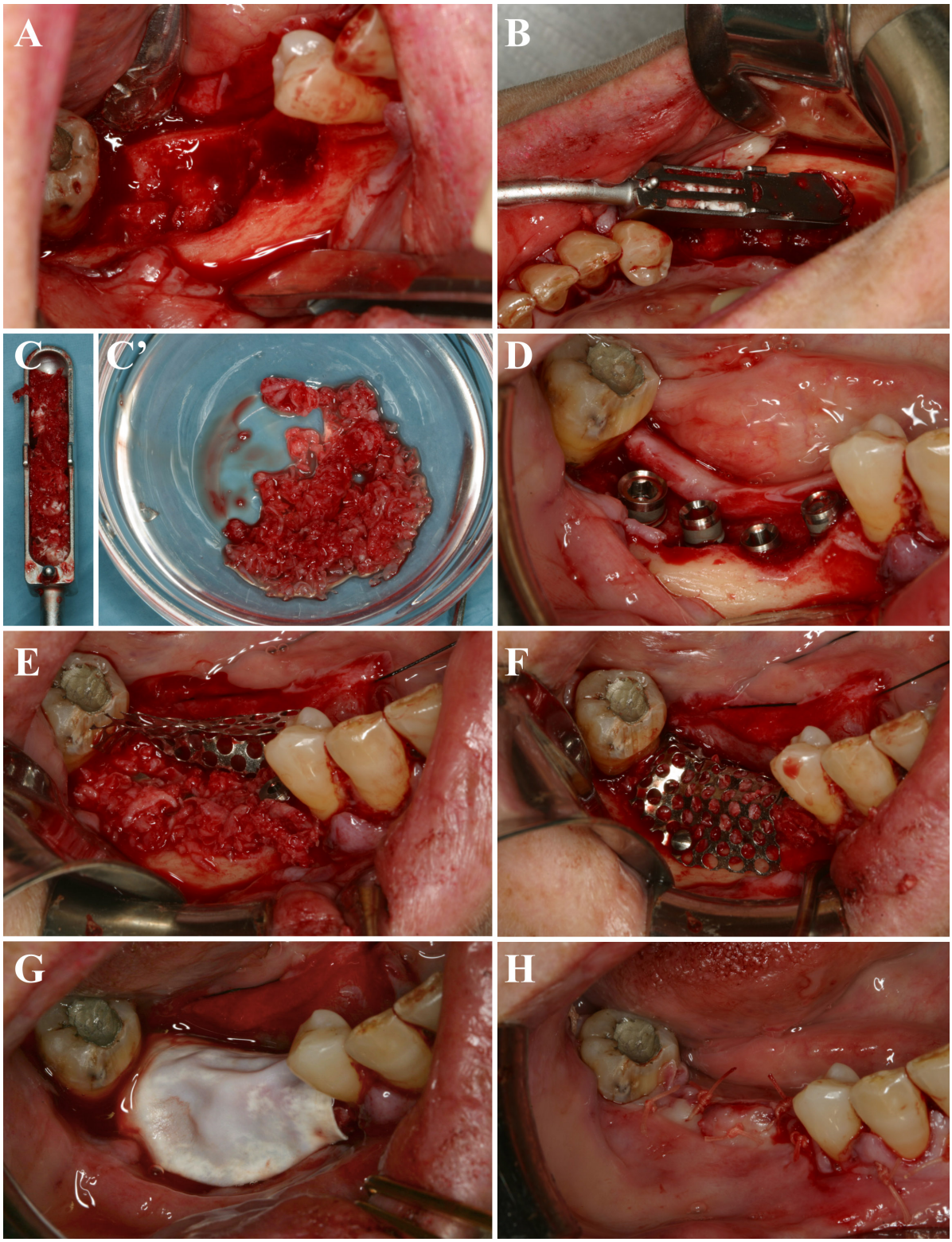


**Figure 2. GBR surgery with implantation. (A)** The surgical site was opened with careful removal of the remaining fibrous tissue. **(B)** The alveolar ridge was modeled using a manual bone scraper **(C, C')** The bone collected with the bone scraper was gathered in a small surgical pot. **(D)** Four implants were placed. A significant part of their collar (around 4mm long) remained outside of the bone. **(E)** The collected bone was grafted around the implants. **(F)** The regenerative chamber was isolated with a titanium mesh blocked with 2 screws. **(G)** The site was finally covered with a pericardium membrane. **(H)** Sutures were finally performed tight.

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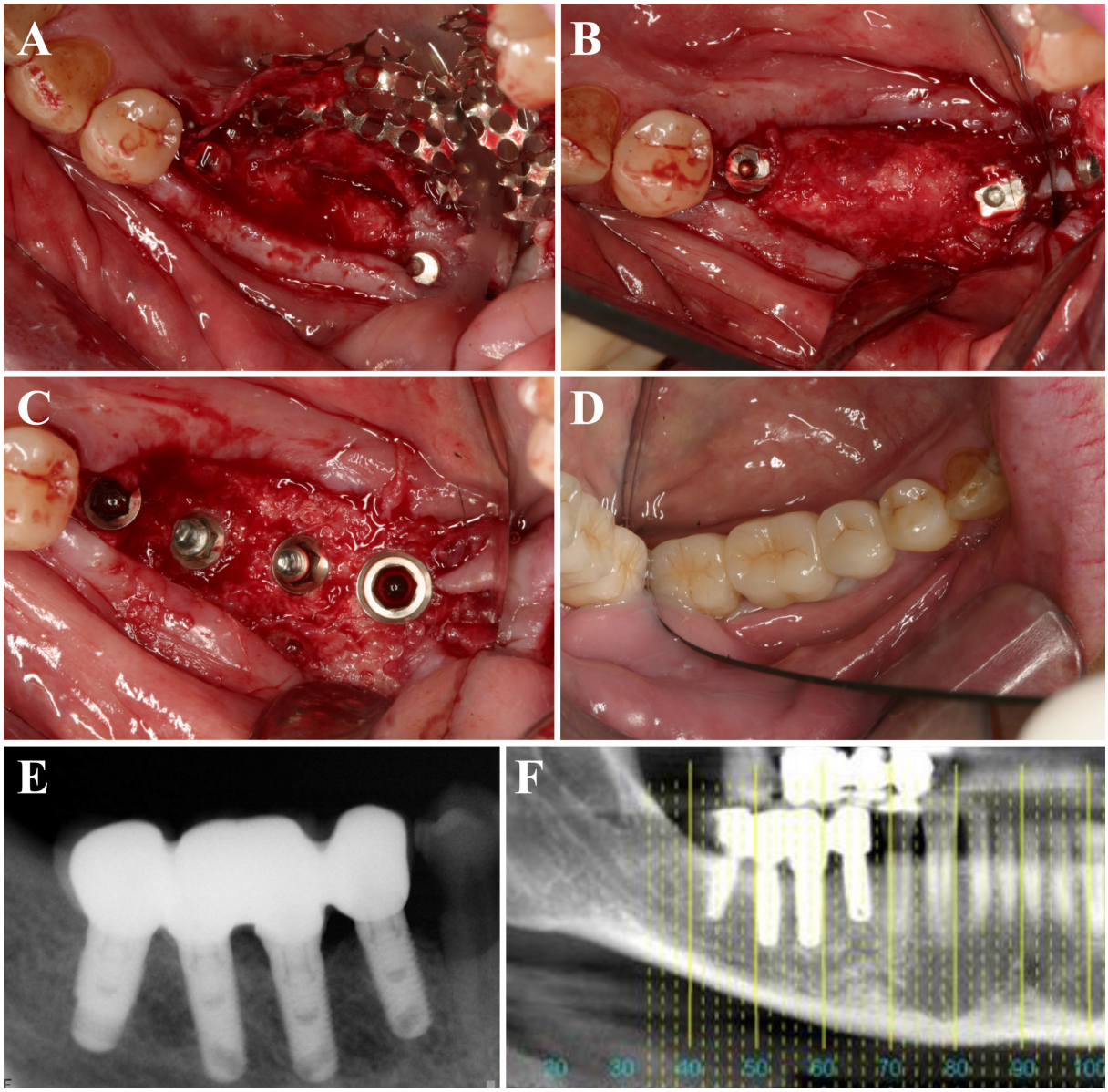


**Figure 3. Second step surgery and prosthetic phases. (A)** Five months after the GBR surgery, the surgical site was reopened and the titanium mesh was removed. **(B)** The alveolar ridge was well regenerated and new bone even covered the head of the implants. **(C)** Cover screws were removed and trans-gingival screws were placed. **(D)** After healing, an implant-supported bridge was placed. **(E)** Follow-up after 6 months revealed a stable peri-implant bone tissue. **(F)** Follow-up CT scanner after 1 year.

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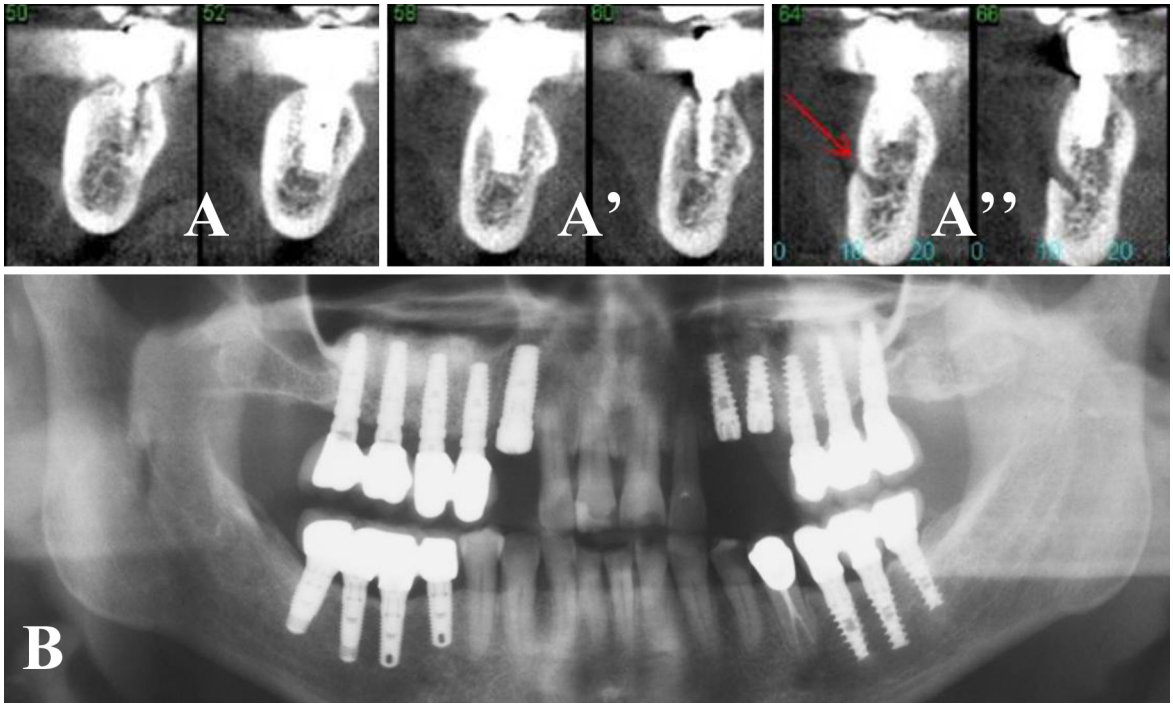


**Figure 4. Radiographic follow-up. (A, A', A")** The CT scanner after 1 year revealed stable peri-implant bone tissue and showed the proximity between the implant tips and the mandibular nerve. **(B)** Follow-up after 14 years. The implants were functional with a stable peri-implant bone tissue.

## 3. Discussion

One of the most important issues of the GBR technique in the posterior mandible is the risk of dehiscence of the gingival flap **[1]**. In case of perforation of the soft tissue, the titanium barrier can be very quickly contaminated with oral bacteria and the regenerative chamber is often impossible to protect and recover. In such situation, the grafted material must be removed with the membranes, and the final clinical situation may be even worst than the initial situation of the patient. In this case, we tried to reduce the risk of dehiscence by combining several techniques and materials.

First, the residual alveolar ridge was remodeled during the collection of the bone fragments with the scraper. This allowed to reduce the potential hard angles of the bone that may be too aggressive for the gingival cover after sutures. Moreover, by reducing laterally the bone volume, the flap became *de facto* a little bit more extended than the remaining alveolar ridge and some covering surface of the flap was therefore gained.

Second, the second molar was kept temporarily after the S-GBR main surgery, in order to protect the regenerative chamber from mechanical constraints. The presence of this residual tooth was an easy way to reduce the stress on the surgical area during the early critical phases of healing.

Finally, a pericardium membrane was used above the titanium mesh in order to promote the healing of the soft tissue, but also to protect the gingiva from the potentially sharp angles of the titanium mesh. If such case was treated nowadays, the use of L-PRF

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(Leukocyte- and Platelet-rich Fibrin) membranes would be probably beneficial above or in replacement of the pericardium membrane. L-PRF is a fibrin membrane rich in growth factors **[8,9]** and is very useful to promote gingival healing and quick wound closure **[10]**.

The bone levels after 14 years were very stable in this case. The simultaneous implantation during the GBR surgery seems a very reasonable approach, as the presence of the implants in fact reinforced the regenerative chamber. The implants serve as tent pegs under the barriers and membranes, add some biomechanical strength to the regeneration compartment during the early sensible phases of healing and can reduce the impact of mechanical constraints on the reconstructed ridge. Finally, the implants also serve as pillar to guide the growth of bone in the chamber, and the organization of the regenerated bone directly around the implants may promote a better long-term integration of the implants in the bone volume under reconstruction. This S-GBR approach is similar to the various techniques of simultaneous implantation and sinus-lift, where the implants serve as space maintainer like tent pegs with excellent clinical results **[11]**.

As a conclusion, GBR remains a difficult surgery that requires careful planning and experience. When this technique is well performed and succeeds, the long-term results are very stable. This article also shows that the concept of simultaneous implantation and GBR should be in fact perceived as a slightly different concept, named S-GBR, as the presence of the screws has logically a significant impact in the therapeutic strategy and final outcome.

## Disclosure of interests

The author has no conflict of interest to report.

## Acknowledgement

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