Case Study 45

Regenerative Surgery: a Clinical Case from Extraction to Prosthetics

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AlphaBio TEC
Simplantology

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Dr. Luca Savio, BDS

After graduating with honors in dentistry from the University of Wales, College of Medicine (1999), Dr. Savio continued his education and obtained a "Certificate in Restorative Dentistry" from Eastman Dental Hospital, UCL, London (2001). Additionally, Dr. Savio completed a one-year periodontology course at SICOR, Turin (Drs. Abundo and Corrente, 2003), and a one-year implantology course at SICOR, Turin (Drs. Abundo and Corrente, 2004).

He then went on and completed an implantology and periodontology internship at Harvard University, Boston (2004-2005), an implantology and periodontology internship at Penn State University, Philadelphia (2007-2008) and a two-year fixed, mobile and implant prosthesis course (Dr. Gracis, Milan, 2007-2008).

He also took courses at Dr. Kois's practice in Seattle, focusing on fixed prosthesis interfaced with periodontology and gnathology.
He has coauthored publications on implantology and periodontology with a special focus on the use of short implants.
Dr. Savio also provides simultaneous interpretation at a number of training courses both in Italy and abroad, and is aspeaker at implantology courses held in Italy. He has a private practice in Turin.

Abstract

This case report describes the clinical steps involved in the rehabilitation of a missing tooth, from pre-extraction to prosthetic finalization. Tooth 15, entirely decayed, was beyond recovery and showed a periapical lesion with vestibular probing exceeding 15 mm. A total lack of vestibular cortical bone was assumed, and as a result, there would be a reduction in the size of post-extraction recovery, impeding the proper placement of an implant fixture. It was decided to apply a bone regeneration technique after the complete healing of the soft tissues (45-60 days after extraction) to resume the adequate spaces that will allow proper prosthetic placement. Final rehabilitation also included tooth 14, previously missing.

Introduction

Post-extraction alveolar bone atrophy is a well-known phenomenon, caused mainly by bone reshaping in the initial healing stage [1]. Factors such as periodontal disease, periapical disease or injuries, occurr in geither pre-extraction or during extraction, can further reduce the amount of bone available for the placement of an implant fixture [2]. Adequate bone volumes and a favorable structure of the alveolar ridge are essential for achieving ideal function and aesthetic prosthetic reconstruction following implant therapy.
In the 1980's, Nyman et al. described the principles underlying GTR [3]. In the following years, it was

understood that bone regeneration occurs in the same way as tissue healing.
Specific cells contribute to the formation of specific tissues and as a result, the need to exclude epithelial tissues in the bone healing stage is essential forachieving accurate clinical results. Due to these principles, the use of membranes in regeneration surgery was developed. Schenk et al. demonstrated histologically how in membrane-protected bone defects, the healing stages follow the same sequence as in natural bone healing [4].

Background

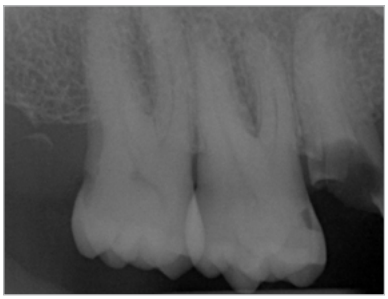
The patient, a healthy 68-year-old male, was a non-smoker, with no particular systemic conditions that may imply contraindications to dental treatments. His medical history included a complaint of recurrent discomfort with swelling and occasional pain in the first sextant.

Intraoral examination

The patient arrived to his first visit with poor hygiene maintenance and the presence of root residues and cavity infiltrations in a number of dental teeth. There was also horizontal reabsorption, about 30% homogeneous, with site-specific vertical bone defects in the fifth sextant.

X-ray examination

An intraoral X-ray (Fig.1) of tooth 15 showed a decayed, unrecoverable root residue with a periapical lesion.



1 Initial intraoral radiograph

Materials Used

Alpha-Bio Tec's bovine bone
Alpha-Bio Tec's collagen membrane
Collagen sponge (Alpha-Bio's Graft, Alpha-Bio Tec, Israel)
2 ICE implants Ø 3.7 x L 11.5 mm (Alpha Bio Tec, Israel)

Prosthetics

Prosthetic finalization included two contiguous teeth, 14 and 15. Two CAD/CAM threaded titanium abutments and two metal ceramic crowns were used as well.

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Treatment Plan

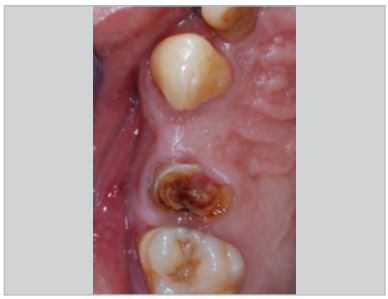
The treatment plan comprised three surgical stages and one prosthetic stage for the rehabilitation of the two missing teeth in the first sextant. In the first stage, the unrecoverable root of tooth 15 was extracted.

After reviewing Van der Weiden's review [5], we decided to follow the clinical protocol proposed therein to reduce the complications associated with GBR procedure and to achieve better predictability. Subsequently, when the soft tissues completely healed (approximately 45 days), bone regeneration surgery was performed with the use of granulate bovine-derived biomaterial and a collagen membrane to restore the bone defect in question. After an initial four-month healing period, two implant fixtures in site 14 (native bone) and site 15 (completely regenerated) were surgically inserted. After a further four-month recovery, the implants were initially loaded with temporary crowns, later followed by definitive metal ceramic crowns.

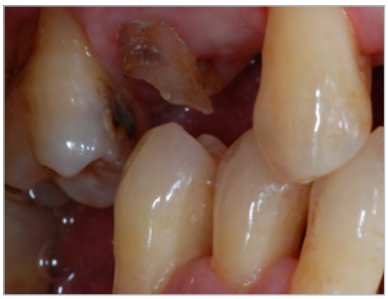
Surgical Stage

Stage One

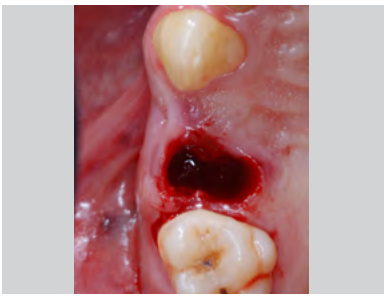
After the administration of local anesthesia (Articaine 1:100.000), the root was extracted (Figs. 2-3) without detaching a flap. The use of osteotomies enables low-trauma extraction, preserving the surrounding soft tissues (Fig. 4).



2 Occlusal view of the initial situation



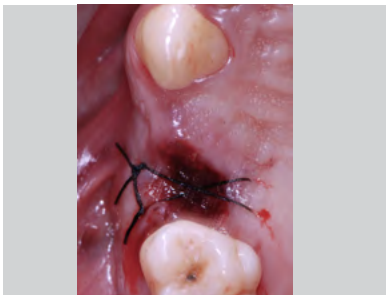
3 Lateral view of the initial situation



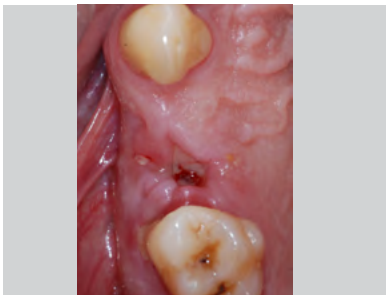
4 Post-extraction alveolar socket with missing vestibular cortical area

The residual alveolus was curetted to remove all the granulated tissue and then examined to evaluate the residual anatomy. At this stage it appeared that the chronic infection of the root led to the complete loss of the vestibular cortical bone with ample lesions extending beyond the apex. For this reason, it was decided to wait for the soft tissues to completely recover (approximately 45 days) to obtain an initial closure and to perform a more predictable bone regeneration surgery intervention.

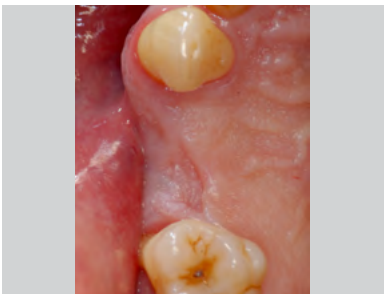
A collagen sponge was placed in the alveolus to stabilize the clot (Fig. 5) and it was sutured with silk 4/0, removed two weeks later (Fig. 6). The tissues were checked one month later to plan the second surgical stage, and an intraoral X-ray was performed (Figs. 7-8).



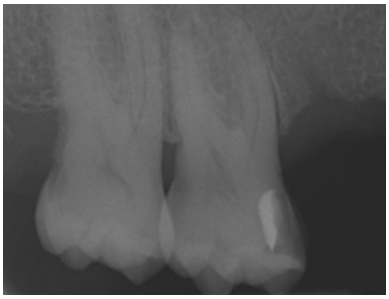
5 In situ suture of post-extraction alveolar socket



6 Alveolar socket healing at two weeks



7 Soft tissue healing 45 days post extraction

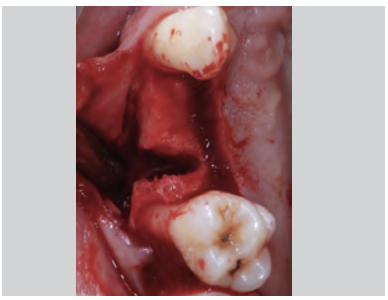


8 Intraoral follow-up radiograph 45 days post extraction

Stage Two

After evaluating the complete recovery and firmness of tissues, it was decided to perform regenerative surgery. The proper evaluation of soft tissues, keratinized gingiva, and alveolar mucosa is essential before planning the surgery, because the latter must be completely healed to withstand the tension of the sutures that will allow submerged healing of the surgical site, leading to better surgical predictability.

Following the administration of local anesthesia (Articaine 1:100.000) a mucoperiosteal flap was detached, extending from tooth 16 to tooth 13 with no relieving incisions and apically 2 mm beyond the bone defect to obtain easy access to the surgical site (Fig.9).



9 Surgical site access 45 days post extraction

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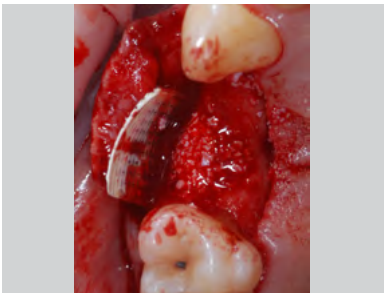
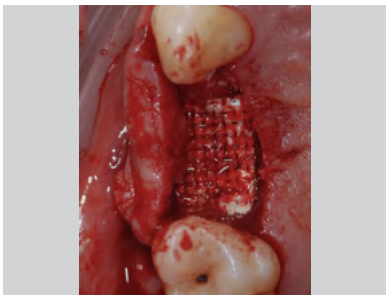
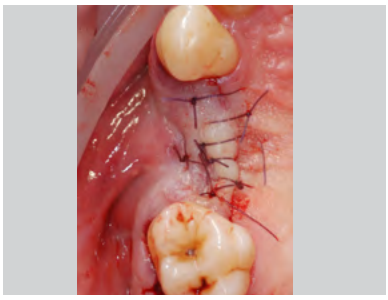
Additional cleansing was performed in the residual alveolus with surgical spoons, and with diamond inserts on a piezoelectric device to eliminate any risk of cellular competitiveness during the bone regeneration healing stage. The 25x15 membrane was cut to the required size to provide the missing sidein the vestibule of the defect, thereby creating a socket. It is important to ensure that the margins of the membrane are well supported by the bone edges distal from the defect to prevent its collapse, resulting in the loss of an essential support to ensure success. The defect was later filled with 0.2-1 mm granular bovine-derived biomaterial mixed with the patient's clot and the membrane was folded over to cover the ridge area (Figs. 10-11).
Before suturing the flap for the first intention (Vicryl 5/0, Ethicon, USA) an additional incision was made at half thickness in the apical area of the flap to achieve total flap laxity and to prevent damaging tensions during the post-surgical stage, which may cause the exposure of the membrane and biomaterial (Fig. 12).



10 Membrane inserted buccally to create a barrier around the defect



11 Membrane covering the crestal defect

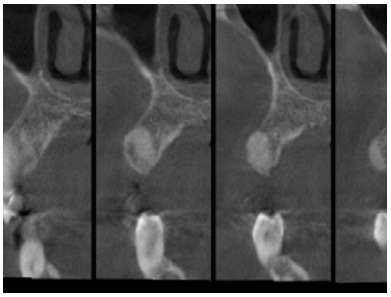


12 Sutured flap with first intention closure

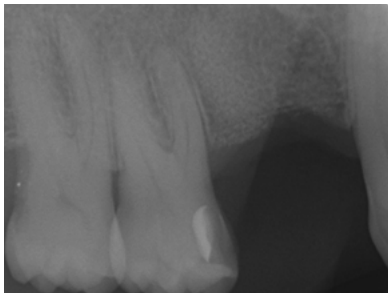
Post-surgical treatment included the administration of Augmentin 1g 2x daily for six days, initiated the day before surgery, Brufen 600mg 2x daily for the first three days and Chlorhexidine 0.12% spray applied 3x daily for the first 15 days. Ice was applied on the first day and a soft, lukewarm diet was recommended for the first week. The first check-up was performed 10 days later and sutures were removed at that time.

Stage three

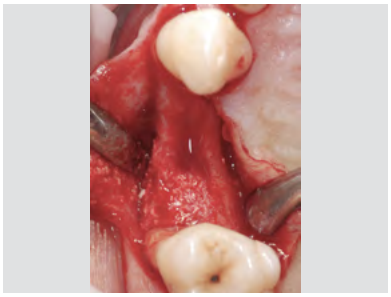
Four months after regeneration surgery, an intraoral X-ray was performed and a CBCT of the site was taken for a more in-depth evaluation and planning of implant surgery (Figs. 13-14).
The presence of biomaterial granules was well integrated with surrounding bone tissues, resulting inuniform anatomy with the ridge, adjacent to the graft site.
We proceeded with the administration of a local anesthetic (Articaine 1:100.000) before detaching a ridge flap in the area of the missing teeth and intrasulcular area on two contiguous teeth (Fig. 15).



13 Cone beam section of regeneration at four months

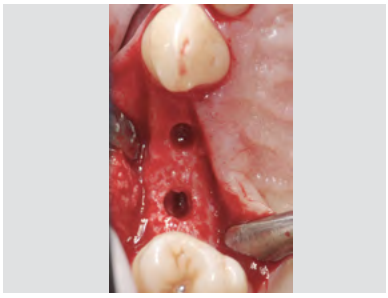


14 Periapical radiograph at four months

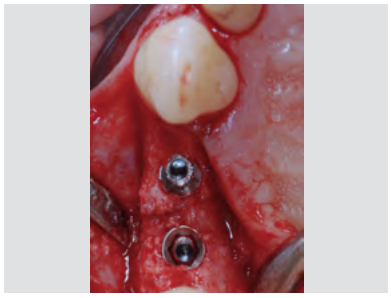


15 Access four months after surgery

After detaching the flap, a bone biopsy was performed using a core drill measuring 2.7 mm in diameter and 10 mm in length in the grafted site (tooth 15) (Fig.16).
The preparation of the implant sites was completed with the appropriate burrs, and the Ø 3.7 x L 11.5 mm implants (ICE, Alpha-Bio Tec, Israel) were inserted (Fig. 17) initially with a micromotor at a speed of 25 RPM and finally with adynamometric ratchet, obtaining a final stability of over 35N.

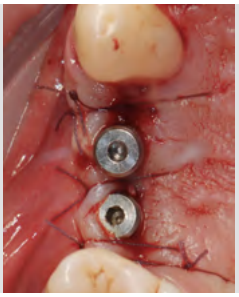


16 Preparation of implant sites – distal site fully regenerated

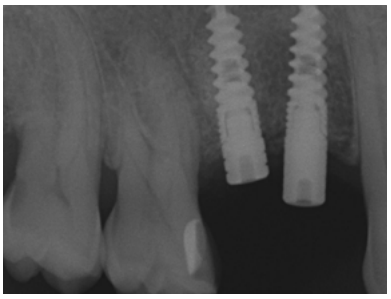


17 In situ implants, preservation of the regenerated vestibular crest

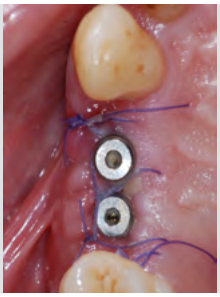
The implants were left exposed with a 3 mm healing screw and the peri-implant tissues were sutured with alternate sutures, with abundant keratinized gingiva on the vestibular and lingual sides, essential for good tissue stability over time (Fig. 18). At the end of surgery, a follow-up periapical X-ray was taken to check the implant placement (Fig.19). The post-surgery therapy protocol matched the protocol described above. The patient was examined 10 days later when the sutures were removed (Fig. 20).



18 "One stage" implants, in situ suture



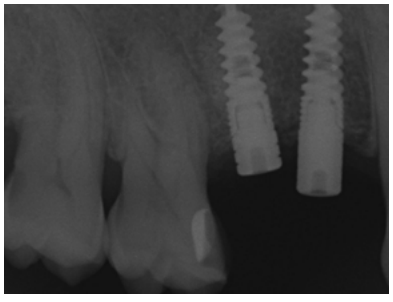
19 Postoperative periapical follow-up radiograph



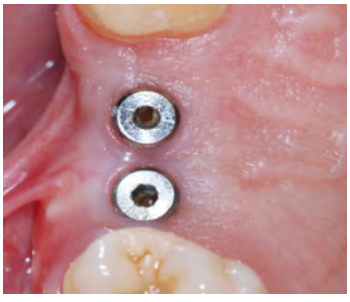
20 Healing 10 days after implant surgery

Prosthetic Phase

Radiographic assessments of the implants at two and four months (Fig. 21) confirmed a clinically normal healing process. Therefore, it was decided to proceed with prosthetic loading. In this phase, it should be noted that the regenerated bone and the peri-implant soft issues stabilized and maintained their volume after the second implant surgery procedure (Fig. 22). An impression was taken with an open tray transfer pick-up using heavy and light body VPS impression material.

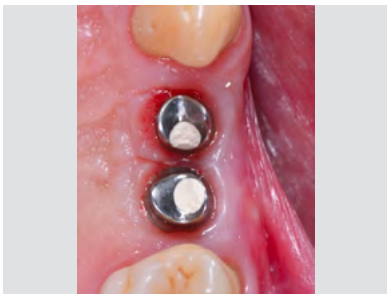


21 Pre-loading periapical follow-up radiograph

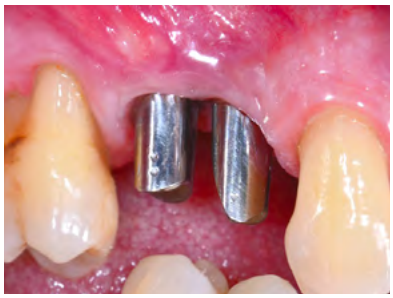


22 Occlusal view showing bone volume preservation

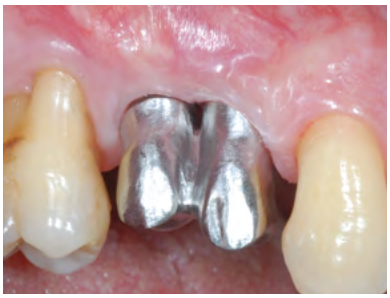
The prostheses were designed using planning Exocad software based on the scanned master model. Two anatomical titanium abutments were manufactured (Figs.23a, 23b) to obtain accurate emergence profiles, and a frame was created in a precious metals alloy (palladium gold alloy) for subsequent ceramic layering (Fig. 24). Temporary PMMA crowns were also designed and produced using the CAD/CAM technique (Fig. 25) and a composite glaze was applied to their surface.



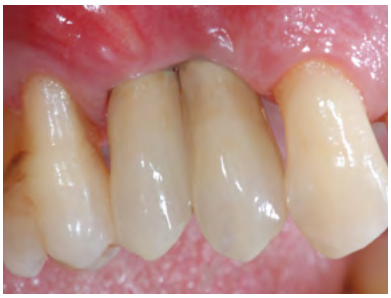
23 **a:** Occlusal view of titanium abutments



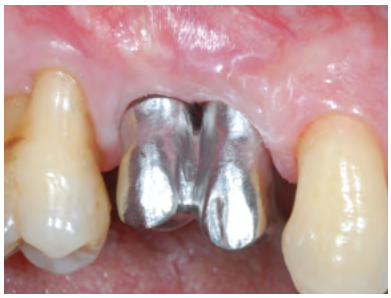
23 **b:** Vestibular view of titanium abutments



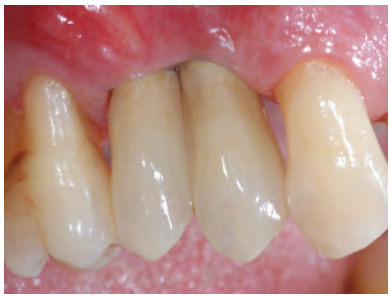
24 In situ frame test



25 Cemented temporary PMMA abutments

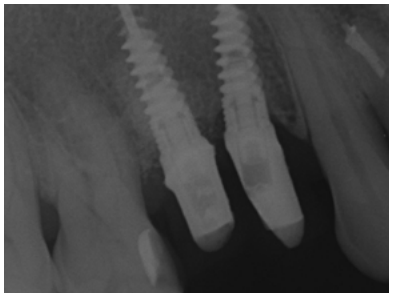


26 In situ frame test

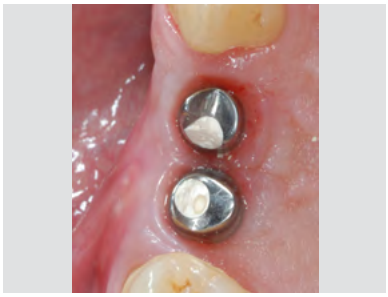


27 Cemented temporary PMMA abutments

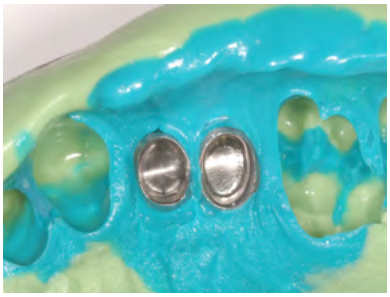
The temporary crowns were kept in place for about four months, mainly to check the correct integration of the implants, especially on the site of tooth 15, and that they were completely inserted in the regenerated bone. Following a radiographic assessment four months after loading (Fig. 28) and accurate clinical evaluation (Fig. 29) with peri-implant probing, it was decided to apply the permanent prosthesis. A situation impression of the frame was taken after manufacturing an occlusion key with photopolymerizable resin (Fig. 30) to recreate a master model and subsequently finalize the prosthesis with metal-ceramic (Figs. 31a-31b). Thanks to the abutments' anatomical design and their juxtagingival margin placement, luting was much easier, and the risk of localized chronic inflammation due to cement residues in the peri-implant gap was reduced.



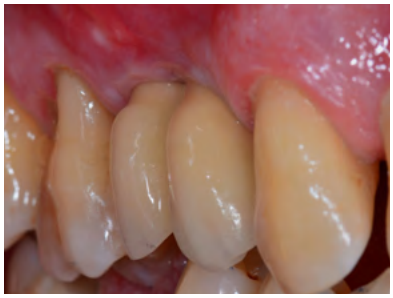
28 Post-loading follow-up radiograph at four months



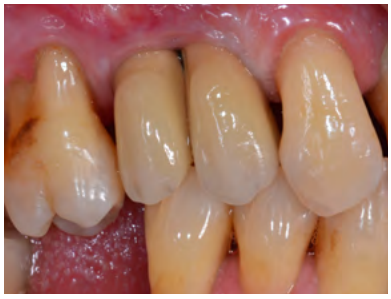
29 Post-loading occlusal view at four months



30 Situation impression for ceramic frame coating



31 **a:** Frontal view of the final gold-ceramic prosthesis



31 **b:** Lateral view of the final gold-ceramic prosthesis

Conclusion

This article describes a case of prosthetic implant placement following bone regeneration surgery with bovine-derived biomaterial and slow-resorption double-layered collagen membrane, as the bone defect was considered to be too extensive to allow placement of the implant with post-extraction or delayed technique and a subsequent peri-implant regeneration technique. Undoubtedly, the surgical approach adopted in this case prolonged treatment time, but in situations of extended bone resorption mainly due to endodontic/periodontal infections, intervening with a regenerative technique, following GBR protocols is recommended [6]. This approach allows the stabilization of peri-implant hard and soft tissues to achieve more natural cosmetic results which will remain stable around the prostheses for years to come.

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