Bone regeneration with ß-tricalcium phosphate (R.T.R.) in post-extraction sockets

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Two clinical cases are presented in which ß-tricalcium phosphate "R.T.R." (Septodont) was used for post-extraction bone regeneration to preserve the alveolar ridge in height and width for future dental implants placement. Resorption of the filling material is demonstrated by a histological study as well as good clinical and tomographic results.

Introduction

The dimensions of the alveolar ridge may be seriously affected following dental extraction as a result of normal alveolar bone remodelling.[1, 2] Although the bone loss occurs in both the horizontal and vertical aspects, greater bone loss is observed in the horizontal dimension.[3]
Schropp et al.[1] found that the greatest loss of alveolar height occurred during the first 3 months and less than 50% of the width of the ridge was lost after 1 year. Other studies observed losses amounting to 40% of height and 60% of width after only 6 months.[3,4]

During the 80's and in the early 90's, bone grafting procedures were commonly performed using autogenous bone or fresh frozen allografts, but the advent of efficient and safe processing and the sterilisation techniques led to an increasing use of bone graft substitutes for the procedures of periodontal regeneration and alveolar ridge augmentation.[7, 8]
The main advantages in using bone grafting substitutes are their unlimited availability and the reduction in the morbidity associated with the harvest of autologous bone at a second intraoral or extraoral surgical site.[9]
The development of synthetic or combined biological-synthetic alloplastic materials for bone regeneration has become more widespread during recent years. This type of material may integrate or resorb completely, forming lamellar bone at the site. Inorganic ceramics based on calcium phosphate (α-tricalcium phosphate, ß-tricalcium phosphate and hydroxyapatite) contrast with bone regeneration materials of biological origin in the sense that the synthetic materials have their physical and crystallographic characteristics clearly defined in addition to the chemical properties (chemical composition and purity).[11]

ß-tricalcium phosphate has been used in various studies in animals and in humans in order to demonstrate its efficiency as a bone regeneration biomaterial.

Aims

Histological, tomographic and clinical evaluation of alveolar ridge preservation in width and height following the insertion of ß-tricalcium phosphate "R.T.R". (Septodont) in post-extraction sockets for future dental implants placement.

Materials & Methods

In order to be able to observe whether the alloplastic filling material, ß-tricalcium phosphate "R.T.R." (Septodont) resorbs completely, a histological study was performed 12 months after grafting the material in the alveolar socket, the biopsy being done at the time of implant placement.
This material was used in cone presentation when the post-extraction socket was well preserved by atraumatic extractions. However the material was used in syringe presentation combined with resorbable membranes in bone defects in which the vestibular bone plates were lost. Absorbable polyglycolic acid sutures of 4/0 zeroes with a sharp needle 3/8 circle were used. The grafted sockets were observed radiographically after 6 and 12 months.

Results

The material's ability to resorb and form new bone yielded excellent results, demonstrated by a histological study done 12 months after placement, as well as by a case of bone regeneration using a membrane (imminent vestibular destruction), for which a control tomography was performed after 18 months showing excellent results.

The results obtained in this study confirm the main observations of other clinical and experimental studies performed any other groups of professionals.

Case Report no.1

A 29-year-old woman came with a fistula at the level of tooth 2.5; grade II tooth mobility. On X-ray examination, a radiopaque image was observed in the canal showing a post and core restoration; periapically, a radiolucent lesion was observed, potentially revealing an infectious process.

Fig. 1: Presence of the fistula at tooth 2.5.

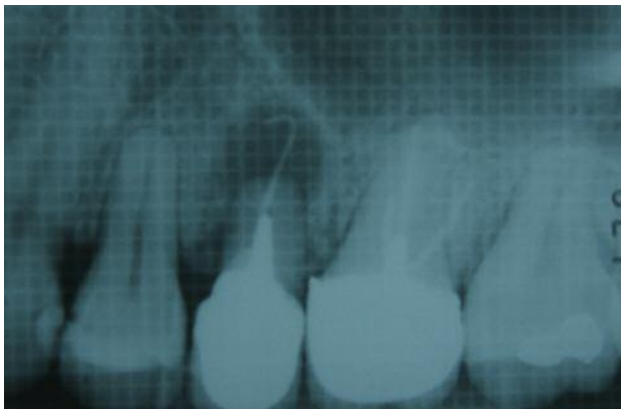


Fig. 2: Fistulography (cone no. 25).

Fig. 3: Panoramic X-ray.

Fig. 4: Atraumatic extraction.

Fig. 5: Extracted tooth.

Fig. 6: ß-tricalcium phosphate (R.T.R.).

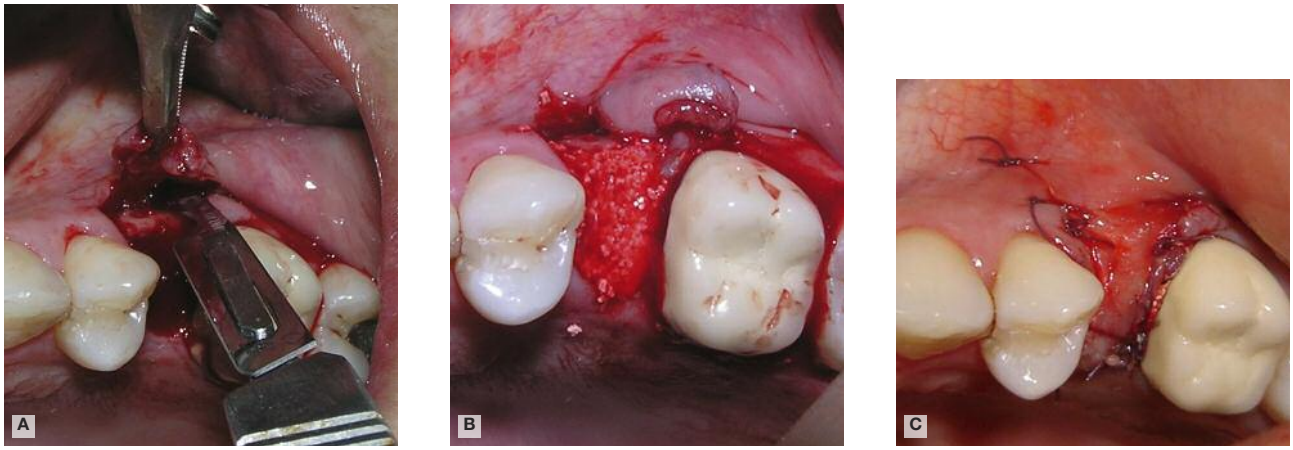


Fig. 7: a) Partial thickness flap, b) Placement of the ß-tricalcium phosphate (R.T.R.) in the alveolar socket, c) Suturing of the flap with Vicryl 5/0 zeroes figure-of-eight sutures.

The tooth was extracted and the ß-tricalcium phosphate filling material "R.T.R" (Septodont) was placed, without a membrane; a partial thickness flap was raised in order to cover the graft and the wound was sutured using 4/0 polyglycolic acid sutures with a sharp needle 3/8 circle.
She was prescribed: Amoxicillin 500 ml/clavulanic acid 125 mg once every 8 hours x 5 days. Ibuprofen 400 mg once every 8 hours for 3 days. Soft diet x 48 hours.
The sutures were removed after 2 weeks.
She was advised to get X-ray controls after 3, 6 and 12 months. After 12 months, the patient returned for consultation; she had been unable to do so before for reasons beyond her control. A clinical examination was performed ***(Fig. 8***) in addition to a periapical X-ray with a metal mesh (grip). On the periapical X-ray done after 12 months a circumscribed radiopaque image, round in shape, was observed in the area of the graft as if it were apparently an encapsulation of the material ***(Fig. 9)***.

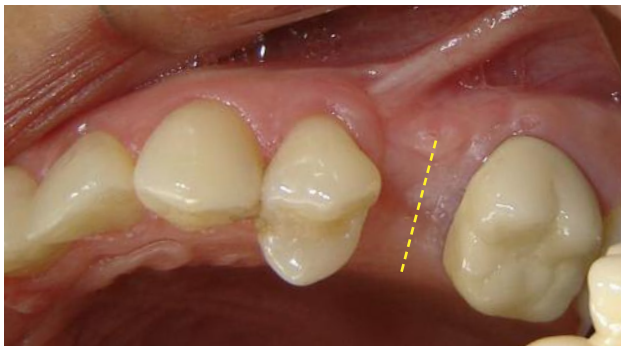


Fig. 8: Clinical examination (12 months).

Fig. 9: Periapical X-ray (12 months).

After 12 months, it could be clinically observed how the alveolar ridge had been maintained both in width and height and in order to verify whether the ß-tricalcium phosphate (R.T.R.) had resorbed completely, we took a sample from the area to be implanted and performed a histological study ***(Fig. 10)***.

The treatment plan was thoroughly implemented for a correct insertion and placement of the dental implant. We knew that computerised axial tomography would provide a more precise diagnosis with respect to bone width and height. However since a single dental implant was involved and moreover a fairly well preserved ridge was clinically observed, we used the clinical mapping method.
Doing our measurements, we had a palatine vestibular width of 8 mm and a width of 7 mm mesiodistally. The calculation of the height using the periapical X-ray done with metallic mesh (grip) and a parallel method gave us an approximation of the actual height, which was 10 mm. After obtaining all the measurements of 8x7x10mm, it was decided to perform maxillary sinus lift using Summer's technique.

Dental implant placement
Using a trephine drill 2 mm in diameter, we removed bone tissue from the alveolar ridge for its histological study in which we wanted to find out whether the ß-tricalcium phosphate (R.T.R.) had resorbed completely. The sample was placed in 10% formocresol.
Then we positioned our surgical guide in order to perform the sequential drilling for implant placement, using helical drills; a control X-ray

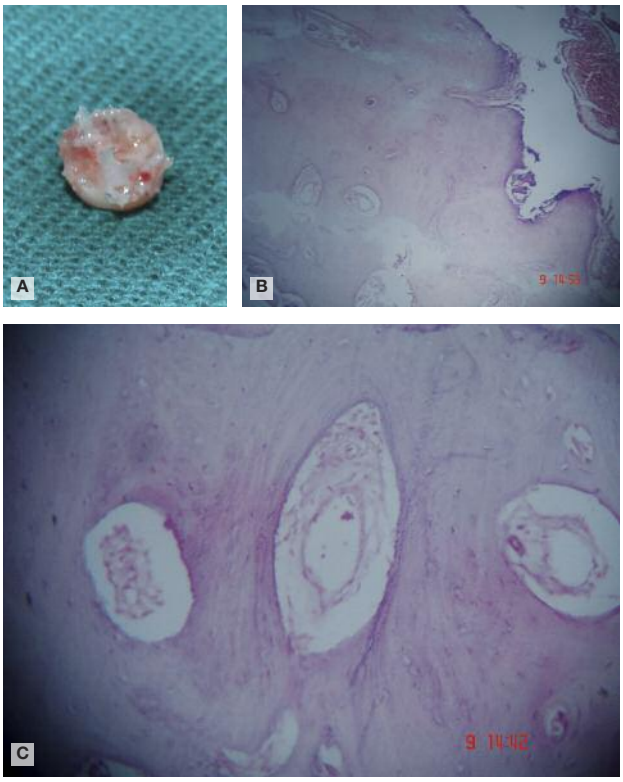


Fig. 10: a) Tissue sample, removed using a 2mm trephine drill, in the area in which the dental implant is to be inserted. b,c) Histological results after 12 months. Haematoxylin eosin tincture under light microscopy. New bone formation at the level of the ß-tricalcium phosphate absorption site.

of the preparation was taken, inserting a paralleling pin in the alveolar socket ***(Fig. 12b)***, which showed us correct parallelism with the preparation; it was observed how the paralleling pin remained exactly 2 mm away from the sinus floor ***(Fig. 12c)***, since it was taken with a grip; then Summer's technique was performed approach to the Schneider membrane using osteotomes, from crestal bone leaving 1-2 mm of residual bone before the floor of the maxillary sinus[13].
This dimension of bone was increased by means of pressure, pushing the membrane upwards

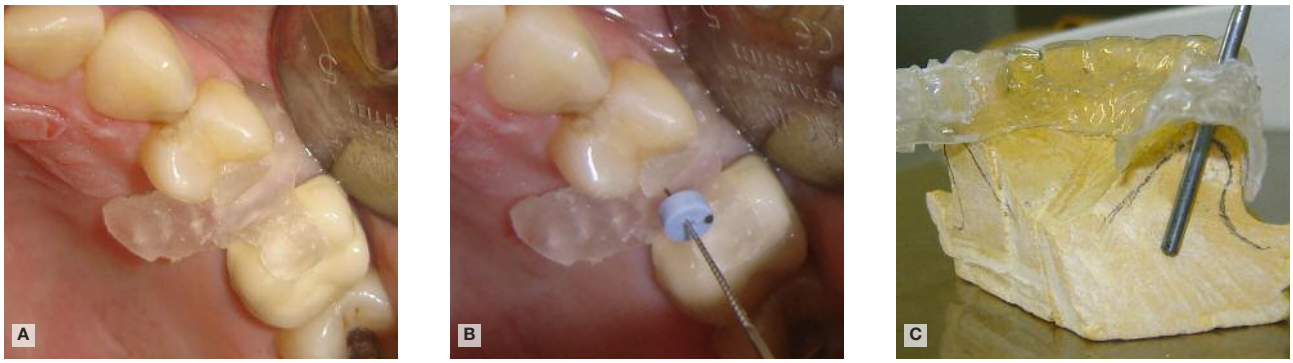


Fig. 11: Clinical mapping. a) Placement of the saddle-shaped acrylic on the area for taking of measurements, tooth 2.5. b) Taking of measurements (file no. 25). c) Transfer of measurements to the trimmed model.

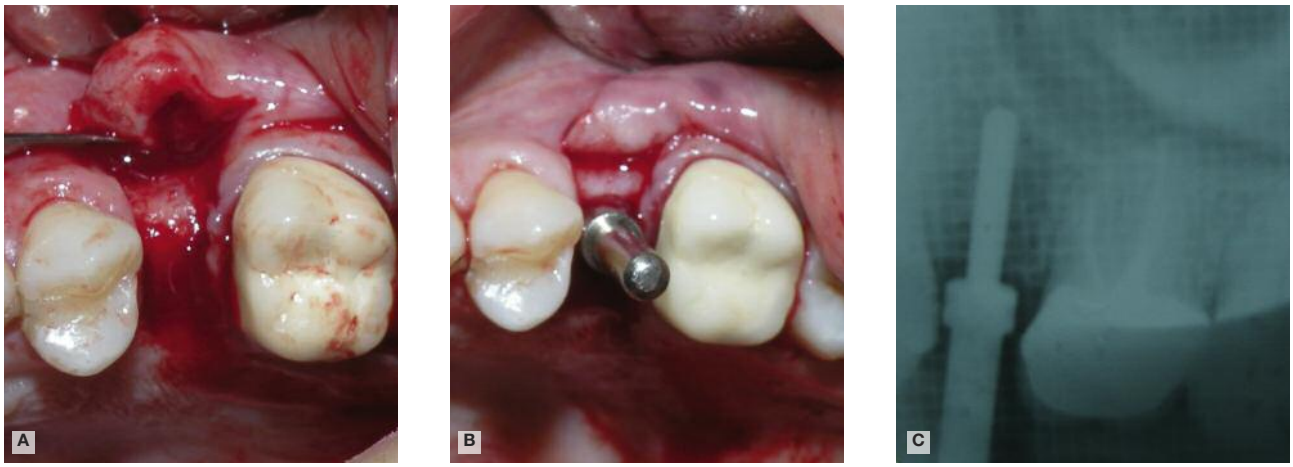


Fig. 12: Preparation for implant placement. a) Paracrestal incision and raising of the flap. b) Insertion of the paralleling pin. c) X-ray showing 2 mm before reaching the maxillary sinus.

without perforating the latter and creating the space required to place biomaterials or the implant.

Once the sinus floor elevation was achieved, which could allow a gain between 3 and 4 mm in height 13-15, the implant, Conexão of 11.5 x 4 mm cylindrical internal hexagon, was inserted; in this case we succeeded in elevating the sinus floor by 3.5 mm. ***(Fig.13)***

Finally, a partial thickness flap was performed with 2 liberating incisions in order to be able to confront the soft tissues in the palatine direction; figure-of-eight sutures and X (cross) sutures were inserted in order to protect the tissue and avoid collapse; the liberating incisions were sutured with circumferential sutures. Vicryl 5/0 zeroes was used for synthesis ***(Fig. 14 a)***. The postoperative X-ray was performed confirming the elevation of the sinus floor by approx. 3.5 mm. ***(Fig. 14b)***

She was prescribed: Amoxicillin 500 ml/clavulanic acid 125 mg once every 8 hours x 5 days. Ibuprofen 400 mg once every 8 hours for 3 days. Soft diet x 48 hours.

The sutures were removed after 2 weeks. The patient was advised to wait for 6 months for osseointegration. The results of the histological study showed bone neoformation with absence of ß-tricalcium phosphate (R.T.R.) filling material.

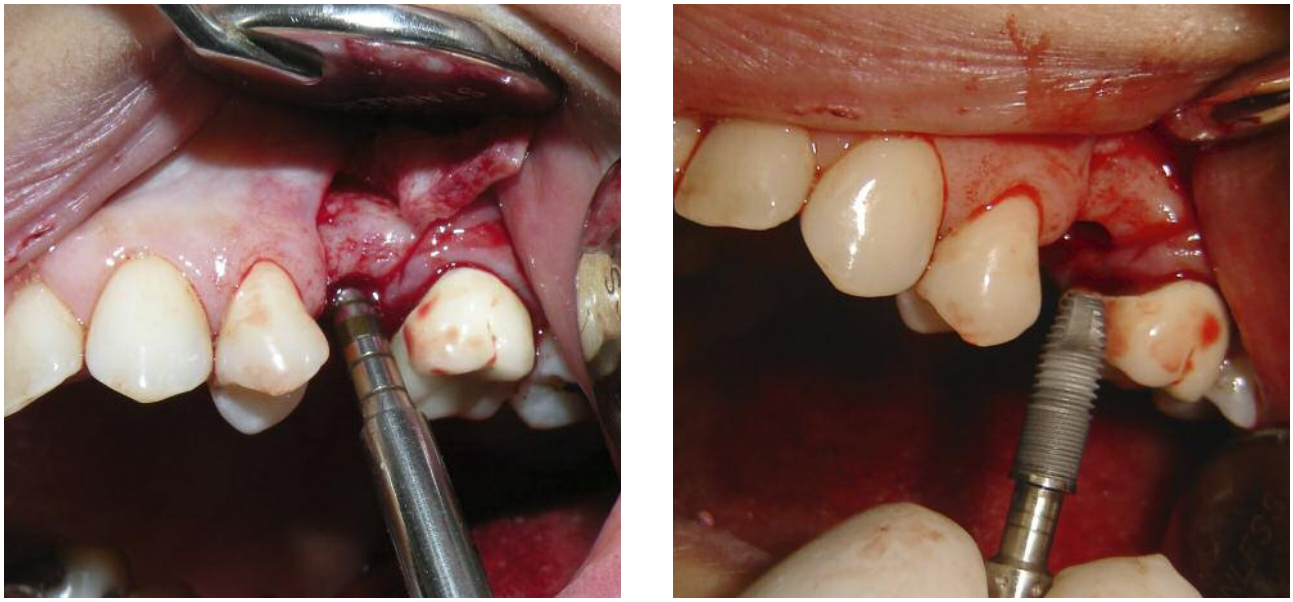
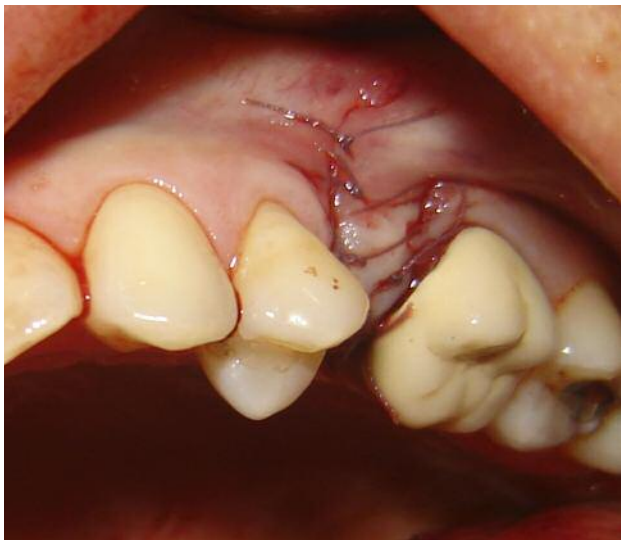


Fig. 13: Maxillary sinus lift with osteotomes (Summer's technique) and placement of the 11.5 x 4 cylindrical, internal connection Conexão implant.



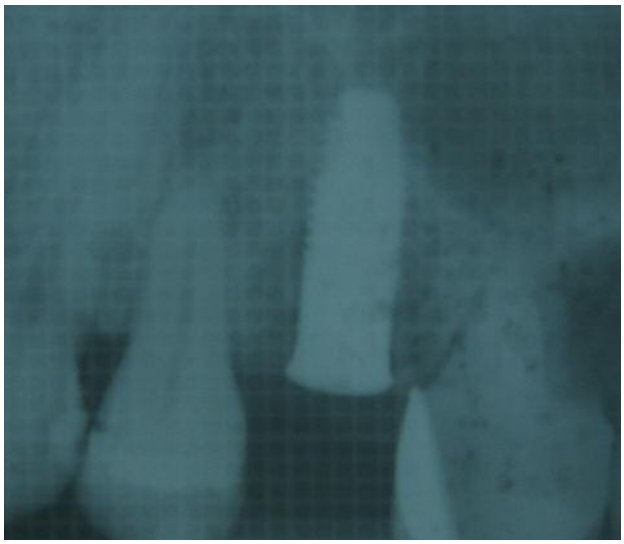


Fig. 14: Full thickness flap and suture with Vicryl 5/0 zeroes. g) Postoperative X-ray showing the 3.5 mm maxillary sinus lift achieved using Summer's technique.

Implant activation

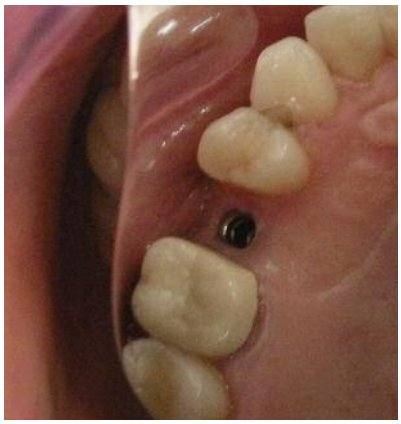


Fig. 15: Open-tray impression taking, application of transfer and analog on the impression.

Fig. 16: Prepared abutment and application of the porcelain crown.

Case Report no.2

A 54-year-old woman came with grade III tooth mobility at tooth 1.1. On X-ray examination, a radiopaque image was observed in the canal showing a post and core restoration. The patient presented with an obvious root fracture on clinical examination.
Atraumatic extraction of the tooth was performed, then the guided bone regeneration procedure with ß-tricalcium phosphate (R.T.R. - Septodont) was done, in addition to the use of a resorbable membrane. A partial thickness flap was performed in order to cover the graft and the membrane, the wound was sutured using 4/0 polyglycolic acid sutures with a sharp needle 3/8 circle. The sutures were removed after 2 weeks. She was recommended to get X-ray controls after 3, 6 and 12 months.

Fig. 1: Initial photo. Tooth 1.1 with extrusion and grade III mobility.

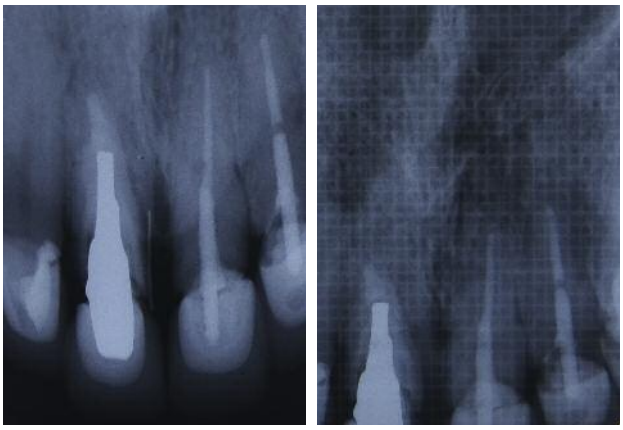


Fig. 2: Initial X-ray. a) Tooth 1.1, presence of an excessively wide post and core, the probable cause of root fracture. b) X-ray with grip.

Fig. 3: The major root fracture can be confirmed when raising the full thickness flap.

Fig. 4: Extraction of tooth 1.1, loss of the vestibular bone plate due to the fracture which remained for a long period in the mouth.

Fig. 5: R.T.R. in cone presentation.

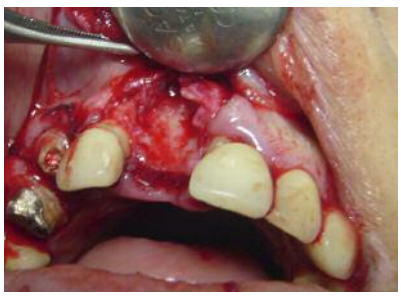


Fig. 6: Major vestibular bone loss.

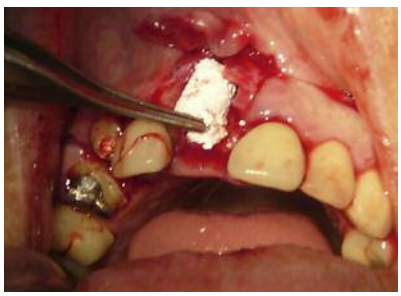


Fig. 7: Placement of the R.T.R. cone.

Fig. 8: Modelling of the R.T.R. cone.

Fig. 9: Insertion of a collagen membrane due to an important vestibular bone loss.

Fig. 10: Interrupted figure-of-eight sutures. A partial thickness flap was performed to cover the membrane.

Fig. 11: Interrupted figure-of-eight sutures. Palatine view.

Fig. 12: Ridge preservation in width and height. The appearance of recessions at the level of teeth 1.2 - 2.2 had been explained to the patient before surgery.

Fig. 13: Final X-ray.

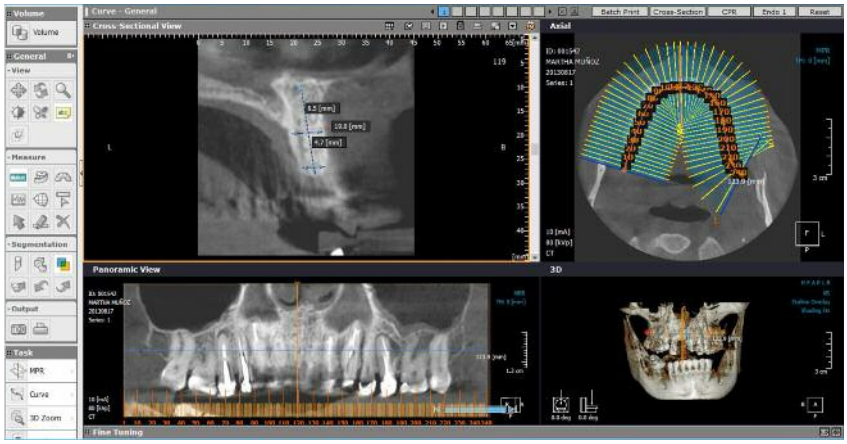


Fig. 14: Tomography 18 months after surgery in order to check bone regeneration before inserting a dental implant.

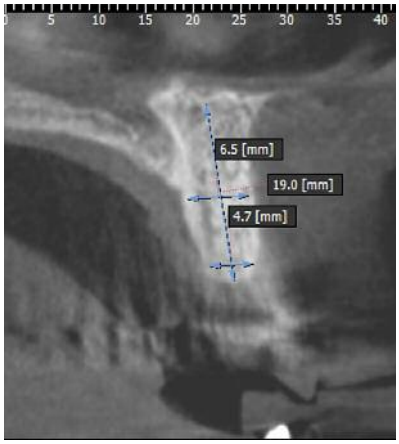


Fig. 15: Bone regeneration in the area corresponding to tooth 1.1 was visible.

Conclusion

- ß-tricalcium phosphate (R.T.R.) has proven to be a good osteoconductive material for bone regeneration following the filling of a post-extraction socket, allowing the preservation of the alveolar ridge in order to place a dental implant.
- Its ability to resorb and form new bone yielded excellent results, demonstrated by a histological study done 12 months after placement, as well as by a case of bone regeneration using a membrane, since vestibular destruction was imminent, where a control tomography was performed after 18 months showing excellent results.
- It is easy to use and handle.
- The results obtained in this project confirm the main observations of other clinical and experimental studies performed any other groups of professionals.

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