Implant treatment of canine agenesis with a full zirconia PATENT™ implant

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Introduction

Full zirconia implants are now considered a valid alternative to titanium in certain indications, such as metal intolerance and reconstructions in aesthetic areas.[1,2] Osseointegration of these implants and success rates comparable to titanium implants have been demonstrated.[3] On the other hand, their white colour unquestionably gives them an aesthetic advantage. Their ZrO_2 structure and physical properties give zirconia implants a very favourable biological behaviour towards peri-implant soft tissues.

The challenges of modern implantology are increasing as patients demand more natural-looking reconstructions.

With zirconia implants, we have the tools to achieve this challenge, and in certain critical situations we can meet patients' demands thanks to advances in tissue engineering, developments in microsurgical protocols and the properties of zirconia implants.

In this article, the case presented illustrates this evolution and the potential offered by the combination of minimally invasive peri-implant surgery and the use of zirconia implants.

Initial situation

The patient comes to my consultation to consider replacing her lacteal canine, which has been showing signs of weakness for some years.

This patient is particularly keen to have a reconstruction that respects the adjacent teeth, which she does not want to be touched. She wants a prosthesis that fits naturally into an aesthetic and functional context that she doesn't want to change. Quite simply, she wants a definitive canine that nature could have given her if she hadn't had agenesis.

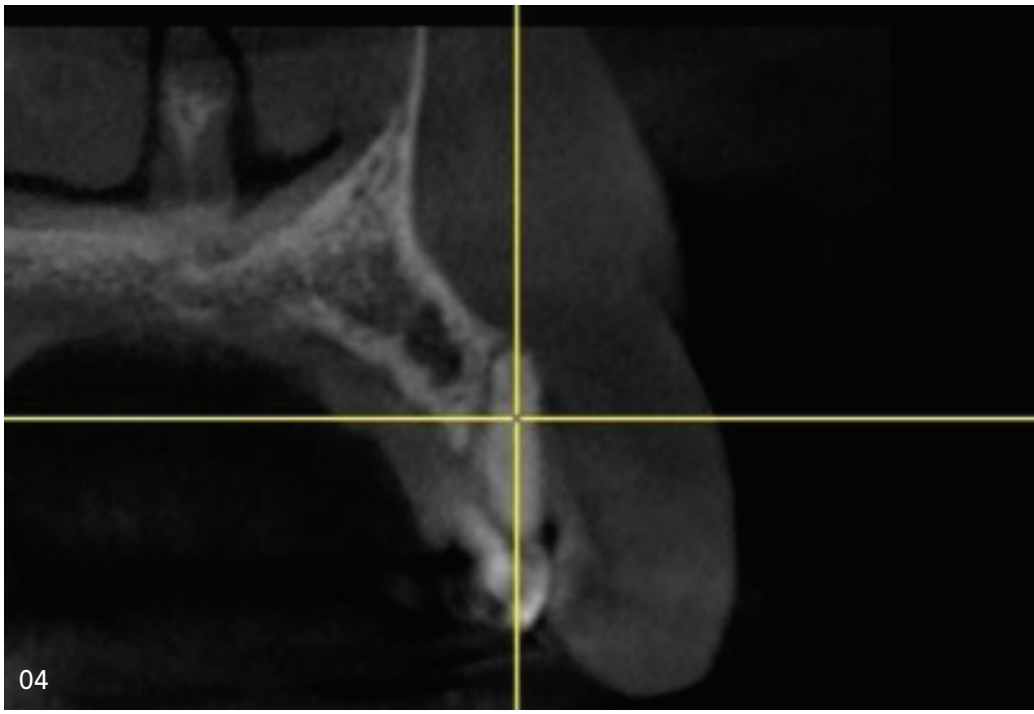
01
Reconstruction of the peri-implant environment of a canine tooth to treat agenesis with a full zirconia implant.

"The goal is simple, but the challenge is great."

The canine is a difficult tooth to reconstruct in implantology, because its position on the arch is always highly vestibular at root level: forming the canine hump, which is very complex to reconstruct. The vestibular cortical bone is often very thin. This situation requires surgeons to carry out extensive invasive bone reconstruction and/or place implants in the palatal position. For their part, dental technicians modify the emergence profile and axes of the prostheses to offer patients an aesthetically acceptable solution.

In the present case, the situation is even more complex, as the agenesis is accompanied by a total absence of cortical bone and a basal bone volume incompatible with the prosthetic axis that the canine must have. We cannot benefit from the natural bone volume of a permanent canine in place, which could be preserved by an extraction and immediate implantation procedure with vestibular filling.

02+03
Placement of a full zirconia implant driven by the prosthetic project to reconstruct the natural anatomy of the canine.



04
Preoperative 3D examination showing the natural position of the lactate canine. To restore the natural prosthetic axis, the bone volume must be largely reconstructed.

"In this case, everything must be reconstructed."

The reference for implant reconstruction is given by the prosthetic project elaborated in the preoperative planning. This planning determines the ideal implant position in 3D. It will be used to produce a surgical guide that will enable the surgeon to control the position of the implant in the prosthetic axis.

Preoperative examinations

Clinical examination shows a thin periodontum and close dental relationships. The patient wishes to preserve the "natural aesthetics" of her teeth, and does not accept any interference with adjacent teeth, nor any modification of her smile.

CBCT examination

We see here that the situation is complex and risky. The implant position must be completely outside the natural bone volume. Only the coronal part of the bone volume can stabilise the implant in native basal bone.

The correct choice of a zirconia implant to meet the patient's requirements

In this high-risk aesthetic and anatomical context, the indication of a zirconia implant that can be milled like a natural tooth seemed the best alternative. Thanks to a patented manufacturing process, the Y-TZP zirconia implant (PATENT™) can be milled.[4] This represents a real paradigm shift in implantology. This technical option gives us flexibility and aesthetic safety margins: implant-prosthetic reconstructions are treated like natural teeth. The ability to mill the implant and prosthetic abutment offers the prosthetist an infinite range of possibilities for adapting to the clinical situation of the implant-supported reconstruction. In a case such as the one presented here, this advantage provides us with decisive security in meeting the patient's requirements.

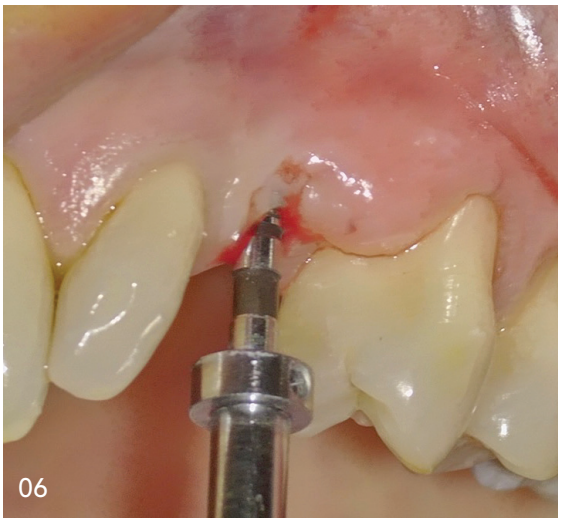
The white colour of the implant, which allows light to pass through partially, does not dull the appearance of thin peri-implant soft tissue in the absence of bone cortex. In such a critical case the risk of tissue and peri-implant recession is high; and the colour

of the implant provides comfort and security for better integration of the implant-supported restoration.

As part of the informed consent process, the patient was informed and involved in the therapeutic choices and materials used. In particular, the delicate subject of peri-implant bone reconstruction was discussed in detail. A minimally invasive tunnel approach was chosen for peri-implant filling. This subperiosteal tunnelling technique enables us to take full advantage of the healing potential, while preserving the vascular supply as far as possible, particularly that of the micro-incised periosteum.

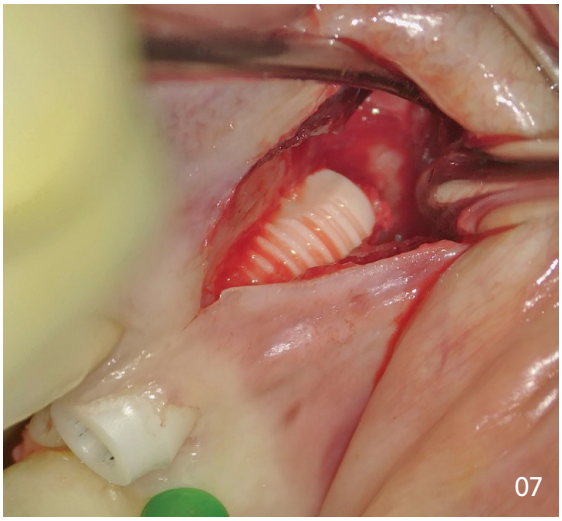
05
The surgical guide to control implant site preparation according to the prosthetic project.

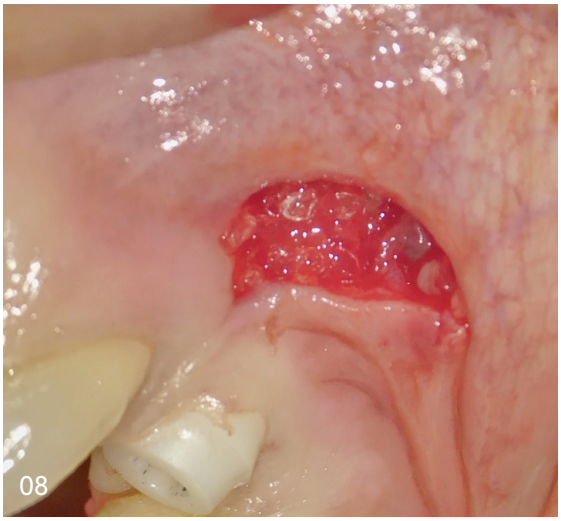
06
Checking the prosthetic axis and integrity of the implant bed. Here, the drilling is outside the cortical bone. The periosteum left in place prevents any slippage in the drilling sequence and alteration of the bone cortex.

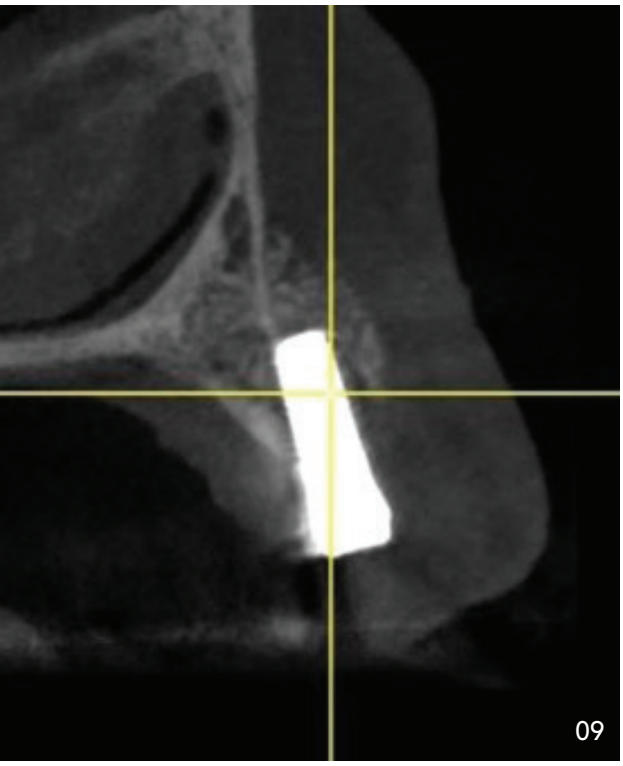


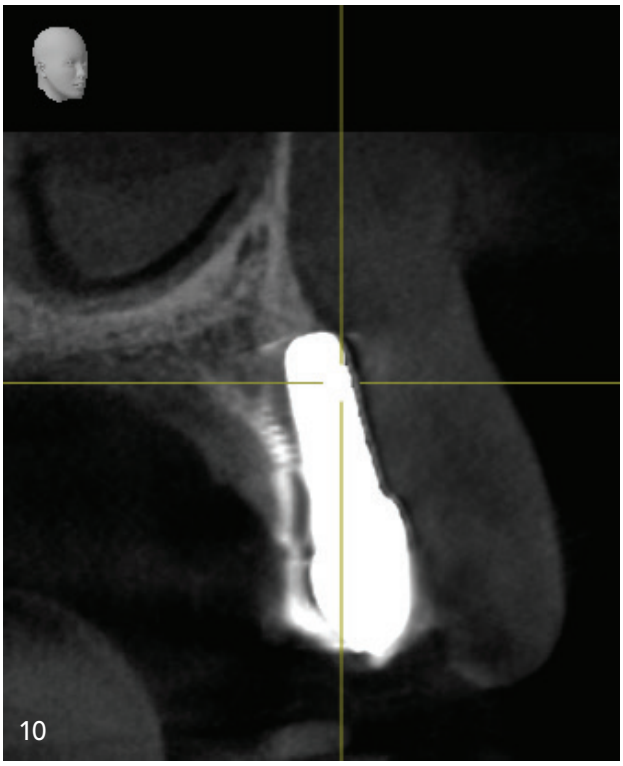
08
The filling is covered by the mucoperiosteal layer, which is sutured with three simple stitches.

07
Tunnelling of the periosteum to ensure subperiosteal filling around the widely exposed implant.









09
Immediate postoperative filling. An overcorrection is performed.

10
3D view at four months postoperative. Significant bone apposition at the implant apex and a very thin, radiolucent bone layer on the implant surface: a highly biomimetic bone regeneration process.

This approach was chosen in this case because the concave bone environment was ideal for stabilising the filling. Filling is performed using tissue engineering. It is obtained using a mixture of autogenous plasma and 45S5 resorbable silica[5]:

- Autogenous plasma (PRF) stimulates angiogenesis and is a source of stem cells and growth factors that help enhancing the osteogenesis process.
- Through its ionic dissolution, 45S5 possesses osteogenic and antiseptic properties[6], and stimulates angiogenesis[7,8], all of which contribute to its improved integration. It is a totally resorbable material that leaves room for fully formed natural bone.[9]

Surgical sequences

The case was performed entirely under an operating microscope (Altion 550) to increase precision and perform minimally invasive procedures.

Surgical protocol

As we have seen, preoperative planning was carried out to produce a surgical guide for placing the implant in the strict prosthetic axis. The guide is used for flapless drilling to maintain control of the peri-implant tissues and the actual situation of the adjacent teeth: this flapless approach allows the surgeon to visualise a projection of the prosthesis during implant placement.

The reaming drill and implant site preparation sequence is carried out without the guide, taking care to maintain the prosthetic axis. This procedure is carried out without detaching the periosteum, whose toughness provides maximum protection for the very thin cortex. As the drills pass through and the implant is placed, the presence of the unstripped periosteum stabilises the fine bone cortex and maintains the correct implant axis. This prevents deviation due to lack of vestibular support.

Planning allows us to know exactly where the implant will be located: here, outside the bone cortex.

11+12
Preparing the implant and abutment by gentle, controlled milling to adapt the implant-prosthetic structure to the clinical situation. A prosthetic protocol very similar to that used on natural teeth.

13+14
Digital workflow and prosthetic fabrication on the full-zirconia implant.

15+16
Integration of the prosthetic restoration on the full zirconia implant in a reconstructed osteo-mucosal environment. The emergence profile of the canine is very close to that of the natural tooth. A new paradigm in implantology, thanks to zirconia implants that can be milled.

Tunnel preparation

Through a lateral mucoperiosteal incision of a few millimetres, the periosteum is gently peeled away over the entire surface of the site to be filled by using a micro-detacher. The laxity of the mucosa gives us a perfect view of the implant and the site to be filled, enabling us to insert and pack the silica/PRF mixture under the periosteum. The tunnel is closed by three simple stitches on the stabilised filling.

Prosthetic preparation of the implant

After four months of healing and osseointegration, the peri-implant volume is assessed by 3D examination and the prosthetic green light is given.

A glass-fibre abutment is bonded to the implant, and the abutment–implant complex is milled to achieve prosthetic requirements. Note that a ferrule effect is created by milling a coronal part of the implant for around 2 mm. This ensures that the prosthetic reconstruction is mechanically stable and adapts naturally to the peri-implant tissue environment.

A simple optical impression is used to provide the prosthetic laboratory with the elements required to produce the crown, which in this case is made of layered zirconia.

We can see here that the prosthetic management of this implant-supported reconstruction is very close to that of a natural tooth. The biomimicry of this system simplifies and secures the approach to complex implant therapies, as in this case. We succeeded in completely reconstructing the canine hump and placing the implant in the exact position required by the prosthetic plan.

Conclusion

With millable zirconia implants, we are experiencing a paradigm shift that extends the scope of implant reconstruction. We are moving away from the rigidity of implant-prosthetic fittings, which attempt to adapt, often in complex ways, to a variety of clinical situations by multiplying the number of prosthetic parts. The zirconia implant system presented here offers greater simplicity: it is infinitely adaptable, because it can be milled like a natural tooth. Biomimicry brings a new dimension to implantology and new perspectives, and that perfectly illustrates the hope that the future of implantology is written in white.

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Literature

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