Immediate ceramic implant in the molar region - A 3-year follow-up case report

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ABSTRACT
Purpose: Ceramic implants are considered to be a valid therapy in implant supported oral rehabilitation with short-term survival rates and osseointegration patterns similar to titanium.
Case Report: This case report with ceramic implants showed almost no radiographic and volumetric alterations over a 3-year post-rehabilitation period.
Conclusion: Immediate implant placement combined with the ceramic implant is a procedure with a short-term therapeutic prognosis where research validation is still needed.

KEYWORDS
Immediate implants, Ceramic Materials, Implantology

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INTRODUCTION

Tooth extraction initiates a continuous cascade of events that lead to hard/soft tissue volumetric and linear changes.[1, 2]

Two of the main aims of Implant dentistry have been to understand alveolar socket remodeling biology and to ensure the lowest impact with as low morbidity and aesthetic problems as possible.[3] Immediate implants (ImIm), represent a treatment procedure that, with the proper clinical indications, may mitigate most of these changes.[4]

Although there has been extensive research into anterior teeth, evidence reports in molars are scarce. In order for Immediate implants to be successful and reduce the risk of esthetic complications, strict criteria should be respected such as: the absence of hard and soft tissue defects, flapless surgery, bone grafting, and adequate tridimensional implant positioning.[5] Therefore, proper case selection and careful case evaluation is mandatory to achieve successful end results.[6]

Systematic reviews have reported lower survival rates (compared to anterior teeth) in immediate molar placement (IMP), reporting a drop from 98.38% in healed ridges to 95.21%.[7] Immediate molar placement early failing was confirmed by clinical control trials showing an implant/restoration survival rate of 73.3% at the 1-year evaluation, and marginal bone remodeling on average of 0.17 mm. This latter value is not very different from the percentages for titanium.[8]

Lower clinical performance is often attributed to technique. If anatomical and biological principles are present, they may have similar survival rates (to those of anterior sites), with a beneficial clinical impact for the patient (decreasing time and number of surgeries).[9]

Volumetric Tissue alterations in titanium IMP, drop significantly from -0.88 (33%) to -0.03 (0.7%) buccally and -0.45 (12%) to -0.02 (0.4%) lingually.[10]

Titanium dioxide was one of the first metals studied and used for osseointegration[11] and the first material to be used in immediate implants, but the recent demand for implant alternatives has made clinicians/researchers seek out other options capable of osseointegration and one of these was ceramics.[12, 13]

Ceramic implants differ in their composition, design and surface treatment. The two most used and evaluated are yttria-stabilized tetragonal zirconia (YTZ) and alumina-stabilized tetragonal zirconia (ATZ).[17]

Systematic reviews and meta-analysis show a 1-year survival rate for commercially available ZrO2 implants of 98.3% and a 2-year survival rate of 97.2%.[14]

The principle physical and chemical properties of Zirconia allows it to exhibit high fracture toughness; flexural strength[15, 16, 17, 18, 19]; low modulus of elasticity; low thermal conductivity[19, 20] and resistance to wear and corrosion.[20]

These enhanced properties found in Zirconia made the industry shift to two-piece systems to allow for prosthodontic flexibility and to be clinically acceptable. Although promising, they still need research validation for widespread use.

The use of zirconia implants has become a strong alternative to titanium due to an increase in patient specific requirements for metal-free implants and the positive results seen in preclinical and clinical studies.[16, 19]

Several clinical features are linked to the use of ceramic implants, with low inflammatory patterns[21] and the ability to reduce plaque[22] together with spectrophotometric enhanced features of the final restoration[23] and healing abutments.[24]

Osseointegration in healed ridges with ceramic implants it has been proven in the research, but their behaviour in an immediate model still needs data.

This is a case report of a successful immediate two-piece ceramic implant in a molar position.

MATERIALS AND METHODS

A forty-year-old healthy, female patient presented a hopeless molar (#36 – FDI notation), due to high secondary decay (Figure 1).

No parafunctional habits, smoking, alcohol abuse or other substance issues were recorded.

Intra-oral clinical analysis revealed a deep secondary carious lesion, confirmed in imaging exams. The Periogram showed a healthy and disease-free state with probing (tooth #37, #36 and #35) not exceeding 4 millimetres (mm), and well-maintained bone crest levels providing potential for soft tissue support (Figure 2 a, b).

It was decided at the visual clinical and radiographic inspection, that an immediate implant was possible since all the anatomical and biological criteria were present.

The patient was informed of the decision but didn't want to receive a titanium implant and opted for a screw-retained two-piece pure ceramic implant, (Pure Ceramic 2 Piece Zirconia ZLA®, diameter 4.1 mm, length 12 mm, Institute Straumann AG, Basel, Switzerland).

Articaine 4% 1:100,000 mg epinephrine buccal infiltration and 4% 1:200,000 mg lingual infiltration (Artinibsa, Inibsa Portugal)

Figure 1. Initial intra oral examination showing a deep secondary decay

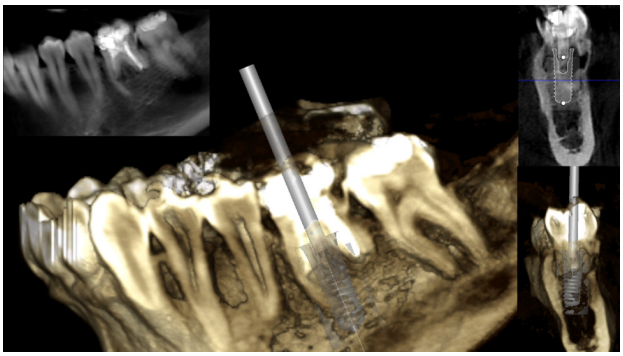


Figure 2a,b. Intra-Oral Radiograph showing a deep furca lesion and a distal root fracture apical resorption

was administered, followed by root section (minimally invasive extracted, with no mucoperiosteal flap), debriding and rinsing with saline solution (Figure 3).
Implant preparation was undertaken according to the manufacturer's instructions and anchored in the septa and apical

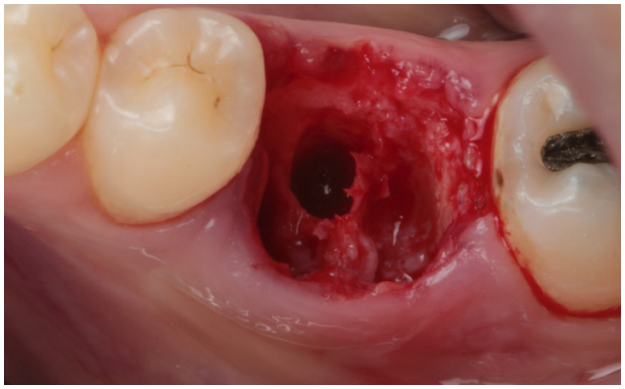


Figure 3. Atraumatically tooth extraction and 3D implant osteotomy

basal bone with 35 n/cm^2 insertion torque. It was placed 2 mm lingual from the mesial distal line that divides the socket in two, and three mm apical from the marginal bone crest. (Figure. 4)
A provisional peek (prefabricated) was filled with restorative composite (Tetric EvoFlow, Ivoclar Vivadent) to hold the emergency socket profile - anatomical healing abutment – AHA, (Figure.5) and the gap filled with anorganic hydroxyapatite (Geistlich Bio-Oss®) flattened to the marginal bone crest (Figure 6).
The patient was medicated with 2 g amoxicillin 1-hour prior to surgery and left with an analgesic regimen of paracetamol 1g every 8 hours and checked radiographically seven days later for bone level assessment.

Figure 4. 3D implant position of the two-piece ceramic implant. Note the lingual and apical position.

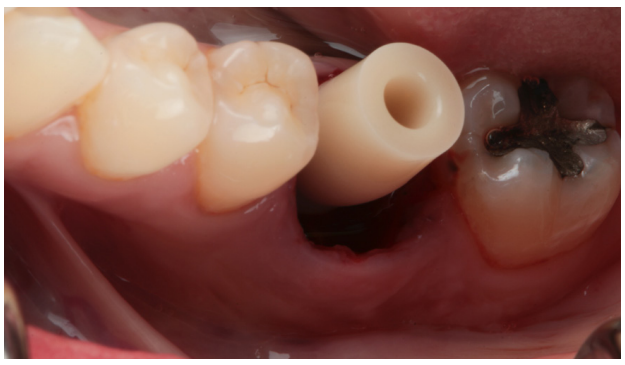


Figure 5. Clinical view of the prefabricated peek abutment for anatomical healing abutment production

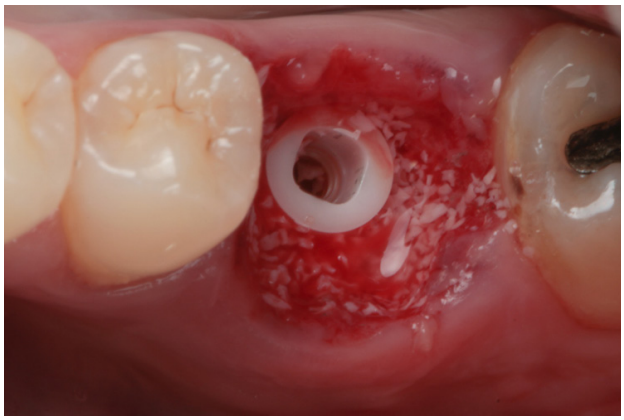
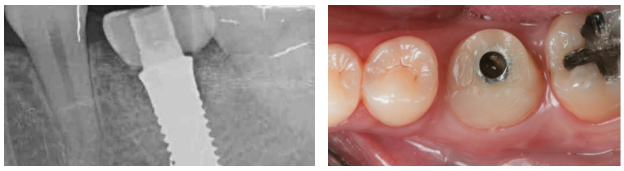


Figure 6. Implant Position and gap filled with inorganic hydroxyapatite

Twelve weeks following the implant placement, we confirmed that, healing, tissue stabilization and implant osseointegration was on course (Figure 7 a, b, c).
The prosthetic final rehabilitation included a scan body placement and 3D image acquisition of both the emergency profile and implant position (Trios 3 Shape ®) (Figure. 8).
A zirconia CAD-CAM framework (CORiTEC Imes-Icore®) crown (Figure 9) was cemented to a feldspthatic veneered interface (Institute Straumann AG, Basel, Switzerland Variobase ®) and screwed in at a 35 N/cm2 final torque. The occlusion was verified (200 µm articulating paper with contact and 80 µm without contact) and the contact points rechecked (Figure 10).



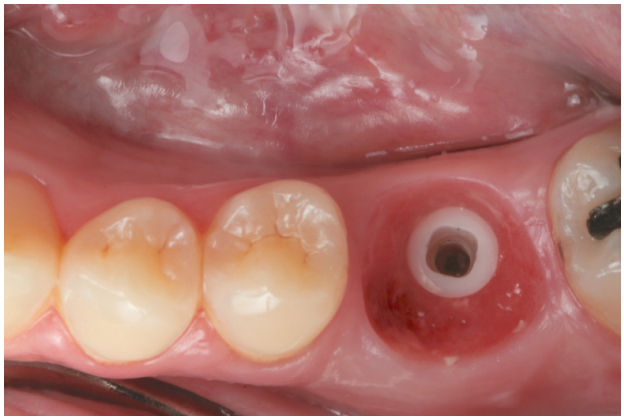


Figure 7a, b c. Clinical and Radiographically healed ridge with the anatomical healing abutment pattern after three-months

Figure 8. Scan body for intra-oral scanner image acquisition

Figure 9a, b, c. 3D printed models, framework production and feldspathic veneered crown fabrication

Figure 10. At the day of insertion

Implant stability and patient comfort were controlled at two months, and 3 years after insertion.

FOLLOW-UP

A three-year follow up was made with an intra oral scanner impression and localized CBCT for routine control. Clinical and radiological images showed a stable bone response to the ceramic implant (Figure 11 a, b, c,d).

DISCUSSION:

When a titanium implant is used, immediate implant is a well established technique with high survival rates and predictability. Ceramic implants in healed ridges have proven biocompatibility and osseointegration patterns, measured in bone-to-implant contact[25,26], but ceramic immediate implant ranked lower (than titanium) in evidenced based research, and some clinical parameters have still no medium/long term follow-up available. There is however a lack of research in relation to immediate molar placement.

To ensure clinical success in immediate implant, different clinical stages need to be performed: atraumatic extraction (keeping the alveolar socket intact, buccal plate and soft tissue) with no open flap surgery[27], correct 3D positioning of the apicocoronal and buccal lingual, primary stability, managing the gap, and ensuring the emergency profile from day one.[28]

Buccal gap management with a ceramic implant is open to discussion, since there is scant data on biomaterial selection and outcomes when compared to titanium implants. Biomaterial grafting simultaneously with immediate implant placement has shown the ability to treat the gap between buccal bone and implant surface, reducing the risk of esthetic complications.[5]

The discussion to fill this gap or not, was based on alveolar extraction socket physiology in which some reports show good healing and bone to implant contact in type 1 sockets with no graft,[29] but most publications (systematic reviews and consensus proceedings) show volume reduction (bone and soft tissue) that can produce an aesthetically deficient outcome.[30, 31]

The healing pattern of inorganic hydroxyapatite placed in a socket gap is a predictable technique with a titanium implant in

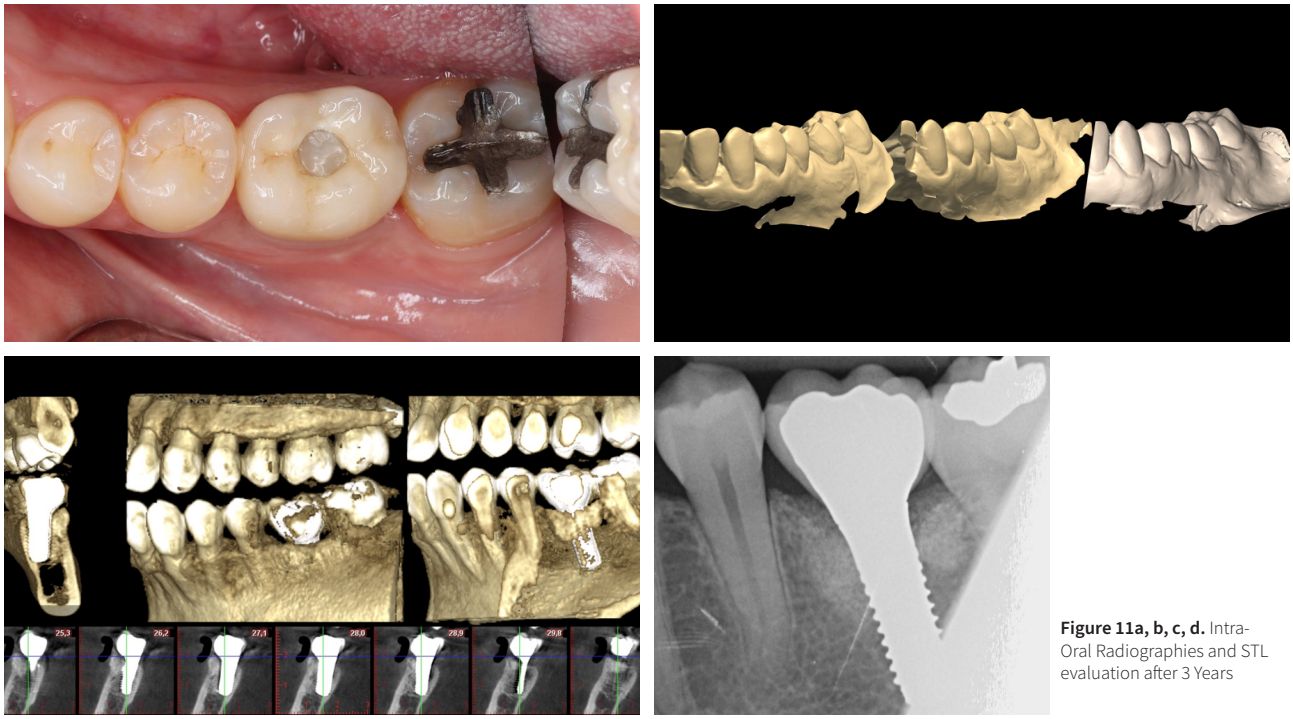


Figure 11a, b, c, d. Intra-Oral Radiographies and STL evaluation after 3 Years

single root teeth[4] as in the multiple root of posterior areas.[9]
Customized sealing socket healing abutments in immediate implant in molar sites allow for optimization of the biological response of the transmucosal portion area without compromising the stability of the fixture during healing.[32]
Placing an immediate implant in a molar position requires some knowledge of the healing cascade and volume changes. In immediate molar placement, the implant is placed lingually and apically to compensate for buccal and apical volume loss.
Osseointegration in immediate implants when using ceramic implants have proven histological parameters that show a tendency to behave at least equally to titanium in preclinical studies[33] and are prone to the same limitations and complications.

CONCLUSION

This is a 3-year immediate molar placement follow-up case, demonstrating good performance of a two-piece ceramic implant in an immediate implant single tooth clinical procedure.
Recent studies demonstrate that cofactors such as implant design, loading protocol, simultaneous bone augmentation and type of prosthetic reconstruction do not significantly influence the survival rate of ceramic implants.[14] In this sense we strongly believe that although in this case we had confounding variables, it was a good clinical choice.
Marginal bone remodelling in healed ridges of the monotype ceramic implants in a systematic review with 11 publications and up to 7 years, showed a mean of 0.98 mm loss[18] and was confirmed with the same numbers in 19 publications in a separate review[34]. However, there is little information on the behaviour of immediate molar placement and marginal bone remodelling.
Implant choice in this case was a patient preference supported by the dentist and corroborated by evidence-based data.
Titanium based implantology is not problem free and has several potential problems in late outcome such as mucositis and peri-implant pathology. Scientific studies describe an incidence of 43% for mucositis and 22% for peri-implantitis.[35]
The foundation of this decision was never based on the immediate outcomes such as osseointegration or immediate soft tissue response, but on the potential that this therapy has for lowering the rate of periimplantitis in long-term outcomes.
This is visible on the periapical parallelometric measures bone stability against the ceramic implant and optimal soft tissue performance after 2 years.
Since this implant supported rehabilitation with the ceramic implant has passed the early outcome, it is now dependent on factors that influence marginal bone resorption, bone breakdown and tissue infection.
All factors identified in the literature that lead to a pathological state, such as plaque accumulation, inflammatory patterns, ion release, and interleukin expression, appear to favour ceramic over titanium.
Even if there is active infection, peri-implant disease in ceramic implants also seems to progress differently to that of titanium.[36]
Immediate implants with ceramic implants placed in an evidence based procedure and at the correct clinical level are currently a viable alternative to the titanium implant. The short-term data supports this, but more clinical evidence is needed, particularly in the midterm 5-year data with the two-piece implant.
Although this is a case report with the lowest levels of evidence, it is recorded to contribute to the literature and the accumulation of higher levels of evidence in the future.

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