The challenge of reconstructing a central incisor with an implant-borne restoration

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A 28-year-old female patient fractured her right central incisor in a fall. Despite immediate dental treatment, the natural tooth could not be saved and had to be extracted. A removable temporary denture was fabricated and inserted to replace the missing tooth (#11). The patient was referred to us for the placement of the implant and the subsequent prosthodontic work.

Owing to the good condition of the hard and soft tissue, pre-implantological augmentation was unnecessary. As Figure 1 clearly demonstrates, the Premillium labial extended into the implant zone. As a result, it was relocated during the implant procedure. This measure was taken to prevent gingival recession around the implant bed at a later stage. After three months of non-submerged healing, an impression was taken with a tray that allowed the proper three-dimensional positioning of the implant, and the material and design of the abutment. We prefer to use zirconium-oxide (ZrO2) abutments with a titanium base, which ensures excellent fit in the implant owing to the industrially milled titanium base. Furthermore, the ZrO2 abutment (emergence profile) can be individually customised.

The emergence profile of tooth #11 was subsequently waxed up. The wax-up was then used to create a silicone template of the palatal aspect and another one of the vestibular aspect. The abutment base (ST Astra Tech) was screwed into the laboratory analogue, and the ground emergence profile and the base were isolated (Ceramill Sep) and light-curing resin composite (Ceramill Gel, both from Girrbach) was applied (Fig. 5). Preliminary curing was considered to be necessary at this stage to achieve complete polymerisation of the light-curing material in the depth of the sulcus. Subsequently, the super-gingival part of the abutment was built up and light-cured.

In order to obtain flat surfaces and a defined preparation margin along the abutment, the cervical areas were milled para-gingivally. The labial proximal and the palatal surfaces were milled according to a conical shape with a two-degree gradient.

The gradient and the palatal surface were cut by hand. The available space was checked with the previously fabricated wax-up.

In our laboratories, the abutments are rendered in ZrO2 using the copy milling technique. Alternatives to this method can be conducted with CAD/CAM systems by using the double scan method or abutment design software.

The green body was smoothly over copy milling. A chamfer was cut at the gingival level for the subsequent creation of a ceramic shoulder. Then the restoration was shaded and sintered (Fig. 4). After the sin tering process, only very fine adjustments had to be made in order to ensure the final fit. In this case, the implant was coated with IPS e.max Ceram ZirLiner (Ivoclar Vivadent). Next, the reduced shoulder formed of IPS e.max Ceram was briefly fired on the restoration (Fig. 5). Furthermore, a thin layer of ceramic was placed over the entire ZrO2 abutment.

The abutment created in this way has three advantages. The glass-ceramic coating allows the abutment to be etched, which is a prerequisite for adhesive bonding of the crown and the abutment. Light transmission in the gingival area increases dramatically owing to the light transmission of 3 mm ZrO2 layers in the para-gingival areas of the abutment dropping to almost zero. Finally, once IPS e.max Ceram ZirLiner and the layering ceramic have been applied to the restoration, fluorescence increases significantly. Usually, the fluorescence of ZrO2 is quite low.

An important aspect of this type of abutment is the bond between the titanium base and the ZrO2. We advise against the use of popular laboratory luting agents such as Nimenti Cem or AgC Cem. A study conducted by K. Meyer, MDT, demonstrated that bonding to the ZrO2 abutment is not possible because it is exposed to oxygen.

There are several ways to prevent this problem. After the zirconium part has been attached to the bonding surface, excess composite can be completely removed and a glycerine gel (for example, AIRBLOCK DENTSPLY) applied to prevent the formation of an inhibited layer. The excess composite, on the other hand, can also be left in place. The cement joint was not cleaned after the two had been joined and the excess cement was removed with a sharp instrument after polymerisation. It is important to
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take care not to damage the re- 
ment joint at this stage. Finally, 
the cement joint was finished 
and polished in a high gloss with 
rubber polishers. Our efforts 
resulted in an impeccable joint 
(Fig. 7).

In the next step, the coping for the 
Ips e.max lithium 
disilicate glass-ceramic (Ivoclar Vivadent) was fabri-
cated. The screw access hole 
was sealed (for example, with 
silicone putty) and the abut-
ment was treated like a normal 
abutment tooth. In other words, 
it was coated with spacer (for 
example, IBUKI die spacer, 
Axadenta).

The coping was waxed up to 
create a reduced tooth shape 
(anatomically). This was done to 
ensure controlled shrinkage during the 
veneering step. Depending on the tooth that is 
being restored, that is, depending 
on its translucency and 
brightness, either an Ips e.max 
Press (Ivoclar Vivadent) low 
translucency or a medium opaci-
ety ceramic ingot is used to 
press the coping.

After the restoration had 
been pressed, the screws were 
removed and the coping was 
carefully tried in and finished. 
Foundation firing was con-
ducted before the main firing 
cycle (Fig. 8) because it en-
hances the bond between the 
layering material and the 
pressed coping. Moreover; the 
coping was characterised with 
fluorescent stains in order to 
create areas where the chroma 
is higher right at the beginning 
of the procedure. After the 
characterisation step, dentine 
powders, for example, were 
sprinkled on the coping, which 
was subsequently fired. For 
foundation firing, we use a tem-
perature that is 20°C higher 
than the temperature of the first 
dentine firing cycle. The fired 
layer contains all the internal 
characteristics of the tooth.

For the second firing, the 
tooth was built up slightly larger 
than its ultimate size. As a 
result, the shape and surface 
texture of the restoration could 
be adjusted to the characteris-
tics of the adjacent tooth by 
grinding (Fig. 9).

During glaze firing, I main-
tained the final temperature for 
only 20 seconds in order to 
brighten any mat surface. The 
desired level of gloss was subse-
quently achieved with a polish-
ing machine, using a wet felt 
wheel and pumice. The inner 
surface of the crown was not 
sandblasted, as this would have 
compromised its strength. After 
the restoration had been tried 
in, the inner surface of the crown 
and the surface of the abutment 
were cleaned with alcohol.

In preparation for insertion, 
the ceramic surfaces were 
etched (for example, with IPS 
Ceramic Etching Gel, Ivoclar 
Vivadent). The surface of the 
abutment, which was covered 
with IPS e.max Ceram (nano-
fluorapatite glass-ceramic), 
showed a large retentive etch pat-
tern after a reaction time of 
20 seconds (4.5% HF). The 
lithium-disilicate inner side of 
the all-ceramic crown was also 
etched for 20 seconds. Finally, 
both parts were conditioned 
with silane (Monobond Plus). In 
order to prevent the luting com-
pound from entering the sulcus, 
a retraction cord was placed 
(001 Ultrapac, Ultradent).

The restoration was seated 
with a luting composite (for 
example, Variolink II, Variolink 
Veneer or Multilink Implant; 
Ivoclar Vivadent). It is impor-
tant to note that Variolink Ve-
eneer should only be used to 
place translucent crowns and 
restorations with light shades 
through which light can pene-
trate adequately, as this cement 
requires light to polymerise. 
A luting composite that cures 
only when it is exposed to light 
(such as Variolink Veneer) of-ers the operator the advantage 
of being able to remove all ex-
cess cement without any time 
constraints. Subsequently, the 
material was cured from all 
sides for 50 seconds (the time 
depends on the curing light 
used). The retraction cord was 
removed and the restoration 
was carefully examined with 
surgical lys for any rem-
nants of excess cement. The af-
ected hard and soft tissues 
were in healthy condition three 
months after the crown had 
been placed (Figs. 10 & 11).

Discussion

Tackling a complex abut-
ment design of this kind is only 
possible if the gingival biotype is 
thin and normal (according to 
flans-Peter Weber and John 
koio). Thin, scalled gingival 
tissue (the keratinised gingiva 
is 0.6 to 0.9 mm thick) is char-
acterised as follows:

- small amount of attached gin-
giva;
- triangular clinical crown with 
narrow interdental contact zone;
- soft-tissue recession as a re-
tection to surgical/prosthetic 
interventions;
- predisposition to formation 
of defects due to resorption 
processes after tooth extrac-
tion with collapse of the inter-
dental papilla; and
- outline of a periodontal probe 
shows through the gingival tissue.

All these aspects have to 
be taken into consideration in 
order to achieve lifetime results. 
If the gingival biotype is thick 
(the keratinised gingiva is 1.0 to 
1.5 mm thick), the sele-
cion of the abutment does 
not have such a great influ-
ence on the pink aesthetics of 
the restoration. In these cases, 
a metal abutment or a ZrO2 
abutment without an addition-
ally fired ceramic shoulder 
would suffice.

Nevertheless, ZrO2 is far su-
perior as an abutment material 
with regard to white aesthetics. 
Unlike metal substrate materi-
als, it allows light to penetrate 
from different angles (for exam-
ple, light from the side). The 
thick gingival biotype exhibits 
an even soft tissue and bone 
architecture:

- minimal difference amongst 
buccal, marginal and pro-
Ximal soft tissue and bone 
heights;
- short interdental papillae;
- flirnum character of soft tissue; 
tendency to scar;
- square anatomic crowns with 
rounded convex surfaces;
- large contact area between 
clinical crowns;
- minimal tendency to recede; and
- a periodontal probe does not 
show through the gingival tissue.

Non-submerged healing

The decision to follow a non- 
submerged protocol was based on 
the following reasons:

1. ample time for maturation of 
the soft tissue before the 
prosthodontic work begins;
2. avoidance of a second surgi-
cal procedure;
3. maintenance of blood supply 
to the area; and
4. reduction in the treatment 
time and less inconvenience 
for the patient (according to 
Anthony G. Sclar).

This approach is only possi-
ble if there is adequate gingiva. 
Attachment. If soft tissue has 
to be augmented, submerged 
healing is essential. In the pres-
ent gingival biotype, the fermen-
tum labi had to be relocated, 
since it extended into the at-
tached gingiva and may have 
cause the tissue to recede.

In the case discussed, an in-
ter-sulcular incision was made 
without a relieving incision. 
This approach allowed the 
vestibular bone lamella to be 
visually checked. Only very lit-
ttle connective tissue had to be 
removed.

As a result, there was mini-
mal bone loss and scarring did 
not occur.

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