Strategies for the treatment of extremely curved root canals

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One of the major challenges in endo-
dontics is the enormous complexity of
root canals. Among other things, a large
number of difficulties must be over-
come in terms of the num-
ber, position, possible branches and
curvatures of the canals. Case stud-
ies are used to demonstrate how
detectable treatment results can be
achieved in adverse anatomies too.

The aim of root canal preparation
is the complete removal of all vital
and necrotic tissue, infected canal
wall dentine, foreign matter and root
filling material. Adequate chemical
disinfection should be made possi-
ble and shaping should allow wall-
to-wall obturation of the canal system.

In the presence of very pronounced
curvatures, especially abrupt or even
5- or 6-angled curves, it can prove
tremendously difficult to im-
plement these guidelines. The angle
of curvature is not the only factor
here, the length of the distance af-
ter the curvature is also decisive for
the success of treatment. As the degree of difficulty increases, the
risk of step formation, splitting and
instrument fracture quite naturally
increases.

Treatment planning

Initial information is provided by the prep-
ared panoramic radiographic image. In
complex anatomies, such as those
that often occur in the posterior re-
gions, a CBCT scan provides valuable
information on 3-D curvatures and
the confluence of canals. This infor-
mation is extremely important for
treatment planning, as it allows the
dentist to determine a strategy re-
garding the instruments to be used
and canal preparation in advance.

For example, very narrow, strongly
curved roots should, if applicable, be
prepped with a smaller ISO size or a
slimmer taper, even very flexi-
bile nickel-titanium (NiTi) files systems
become exponentially stiffer with in-
creasing dimensions, which entails
unwanted transportation or even
strip perforations as risks. Each case
should be considered individually to
allow sufficient removal of infected
tissue without risking unwanted ex-
cessive removal of dentine.

In vital cases, the size of the prepara-
tion may be more moderate than in
cases of pulp necrosis or revisions,
as less removal of dentine will be
required here. Ultimately, of course,
the treatment size should be de-
termined by apical guaging [apical
measurement]. As this is only practi-
cable to a limited extent in the case
of very severe, even opposing
curvatures, even more attention
should be paid to tactile feedback
during instrumental canal prepara-
tion. Sufficient preparation is always
required for root canal irrigation
and subsequent obturation so that
a shape of at least size 30.04, or better
of size 30.06 or 35.06 (rarely larger in
the case of strong curvatures), which
is usually required in extreme cases,
must be prepared manually using
a step-back technique. Otherwise,
it will not be possible to achieve suf-
ficient disinfection and filling of
the root canal.

Notes on preparation

The preparation of an optimal pri-
mary and secondary access cavity is
extremely important, particularly in
the case of strong curvatures. Them-
eselves, a most straightline access to
the canal system is an indispen-
sable part of the preparation, since
the instruments, as well as the un-
necessary removal of dentine. Fur-
thermore, the chemical preparation
of the canal system is an indispen-
sable part of the preparation, since
only part of the canal wall surface is
addressed during mechanical prepa-
ration.

Case 1: Pulp necrosis in an S-shaped
canal

In November 2013, a 46-year-old
emergency patient with acute symp-
toms of tooth #25 presented. The
tooth had been restored with a re-
neramic inlay, the sensitivity test for
cold was negative, and the tooth was
sensitive to percussion and pressure.

The preparative radiograph re-
vealed periapical periodontitis (Fig.
1). The diagnosis was pulp necrosis
after a previous episode to close
the pulp. The inlay was removed and
an adhesive pre-endodontic build-
up was fabricated from composite.

During trepanation, pus drained
from the canal entrances. Working
length was then determined, fol-
lowed by initial preparation with
Kerr files up to only ISO size 8, for
time reasons, together with inter-
mittent irrigation with heated 6%
sodium hypochlorite (NaOCl). Sub-
sequently, a drug deposit was insert-
ed by rotating in Ledermix. Owing
to the small preparation size, the use
of calcium hydroxide would only have
been possible to a limited extent.

Root canal therapy was continued
approximately six weeks later: after
anaesthesia and placement of a rub-
ber dam, tooth #25 was trepanned
under the microscope (Fig. 4). The
glide path was first prepared manu-
ally with C+ Files of ISO sizes 6 and 8
(Dentsply Maillefer), then mechan-
ically with Pathfiles of size 13.06 and
19.06 (Dentsply Maillefer). The more
flexible Hyflex Glidepath files (COL-
TENE) were not yet available at the
time of treatment.

A detailed image of the brand-new Pathfile illustrated how extremely the S-shaped canal configuration had stressed the rota-
tory NiTi instruments after a single-use
(Fig. 3). It depicted the plastic defor-
mation of the instrument, a clear in-
dication that this instrument could
only withstand the requirements with
good fortune. A fractured in-
strument would certainly have been
within the realms of possibility.

After radiographic confirmation of
the working length, the canals were
prepped with the Hyflex CM (con-
trolled memory) NiTi files (COLTENE),
Figs. 4 & 5). The following sequence
was used: 15.04, 20.04, 20.06, 25.04,
25.06, 30.04 and 30.06. Intermit-
tent irrigation was again per-formed
with heated 6% NaOCl.
After apical gauging, the final preparation was performed in steps of 0.25 mm from ISO size 35 to ISO size 60 using manual NIT Kerr files in the step-back technique for safety reasons. Thus, a cone of ten was created in the apical region. Although possible in principle, the use of a 35.06 HyFlex CM was deliberately abstained from, as while these instruments offer high flexibility in general, the stiffness might still have been too great for the S-shaped course of the canals. Finally, irrigation was performed with a 17% EDTA solution and 6% NaOCl, activating the irrigation liquids by ultrasound.

After the master point try-in with configured gutta-percha points, warm vertical root canal filling was performed using the modified Schäfer technique (Figs. 6–8). The tooth was sealed adhesively with a glass-fibre pin and a composite (Fig. 19). Postoperative radiographic control after one year and approximately 4.5 years showed continued uneventful apical conditions (Figs. 20 & 21).

Discussion
These cases demonstrate that the safe preparation of even extreme curvatures is predictable owing to the use of highly flexible instruments such as the HyFlex CM.

Meanwhile, additional instruments have become available in sizes 15.01, 15.02 and 20.01, as has HyFlex EDM size 10.05, which are superior to the files used at the time in terms of material properties and thus offer greater safety in difficult cases (Figs. 22 & 23). Furthermore, it can be seen that hybridisation with manual instruments can be helpful or even necessary to minimise the risk of fracture and to control abrupt curvatures. The file sequences used are of course material-intensive, especially since the files were discarded after use in each patient case. This procedure is costly, but offers the best possible safety to avoid cross-contamination and instrument fracture.

Conclusion
The postoperative radiographic checks after several years proved that even very complex anatomies can nowadays be treated safely, predictably and sustainably with suitable instruments. For the patient, this implies the long-term preservation of the natural dentition, even in challenging cases.

Editorial note: A full list of references is available from the author.

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Taper hand files S1 and S2 (Dentsply Maillefer), which were prebent with the Endo-Bender (Kerr) Rotary preparation was performed with the HyFlex CM.

In this case, the following sequence was used with ascending sizes and tapers: 15.04, 20.04, 20.06, 25.06, 30.04, 30.06 and 35.06. The path of the canal was manually expanded intermittently with prebent ProTaper hand instruments F1 to F3 and then perfectly shaped with the corresponding rotary HyFlex files, as the instruments were stopped in the mesial root by the speed limiter of the endodontic motor owing to the extreme curvature. The entire preparation was performed under intensive irrigation with heated 6% NaOCl. In addition, an ultrasound-activated final irrigation with 17% EDTA and NaOCl was performed three times for 20 seconds. After the master point try-in, the root canal was obturated vertically with warm gutta-percha using the modified Schäfer technique (Figs. 16–18). Tooth #37 was sealed adhesively with a glass-fibre pin and composite (Fig. 19). Postoperative radiographic control after one year and approximately 4.5 years showed continued uneventful apical conditions (Figs. 20 & 21).