AH Plus® Endodontic Sealer:

The new generation of resin-based endodontic sealer

Fact File

1 AH Plus® Endodontic Sealer

The AH Plus® brand is recognised as the “gold standard” for Endodontic sealers and is trusted by clinicians due to its extensive research and proven reliability [1]. The next generation of AH Plus®, now AH Plus® Endodontic Sealer has been developed to combine all the benefits and favorable features of the legacy product while improving its consistency and enhancing bond strength to gutta-percha [2].

Figure 1
The next generation of AH Plus®, now AH Plus® Endodontic Sealer, AH Plus® Jet Endodontic Sealer, and AH Plus Neo® Endodontic sealer.

2 Basic properties of AH Plus® Endodontic Sealer

AH Plus® Endodontic Sealer consists of an epoxide paste and an amine paste [3]. When the two pastes are mixed in equal volumes, a thermal polyaddition reaction is initiated. The process provides a working time of about 4 hours and setting within 24 hours (Table 1). No initiators or catalysts are needed, distinguishing it from light-cured materials. When measured per ADA#57:R2012, after 30 days there is a slight expansion of the sealer of 0.3 ± 0.1% [4]. The sealer was proven to be biocompatible and compliant with ISO 10993-1:2018 [5]. All the physical properties studied according to ISO 6876:2012 are displayed on Table 1.

Table 1
Physical properties of AH Plus® Endodontic Sealer according to ISO 6876:2012.

Properties	Requirements	AH Plus® Endodontic Sealer	Reference
Setting time	≤ 24 h	20.5 h	**[6]**
Flow	≥ 17 mm	21 mm	**[6]**
Film thickness	≤ 50 µm	13 µm	**[6]**
Solubility	≤ 3 wt%	0.0 wt%	**[6]**
Radiopacity	≥ 3 mmAl/mm	11 mmAl/mm	**[7]**

3 Excellent sealing ability

To test the long-term sealing ability of AH Plus® Endodontic Sealer, root canals of extracted human teeth (N=20 per group) were shaped up to ISO size 40 (RECIPROC Blue R40). The canals were then obturated using single cone technique and stored at 37°C and 100% humidity for 7 days. Then, the resistance to leakage along the root fillings was tested using a fluid transport model as described by De-Deus (2008) [8]. This model tracked the volume of fluid leakage from coronal to apical through the obturated root canals over 2 hours. Afterward, teeth were stored in water for 6 months at 37°C (artificial aging). Leakage measurements were reperformed 6 months after obturation. Low leakage values indicate favorable sealing ability. In sum, AH Plus® presented the lowest short- and long-term leakage of all tested sealers (including bioceramic sealers) in both time points (Figure 2). AH Plus® Endodontic Sealer and AH Plus® showed no differences in short and long-term leakage profiles. The 6-month water-storage stress had no significant effect on the excellent sealing ability of AH Plus® Endodontic Sealer [9].

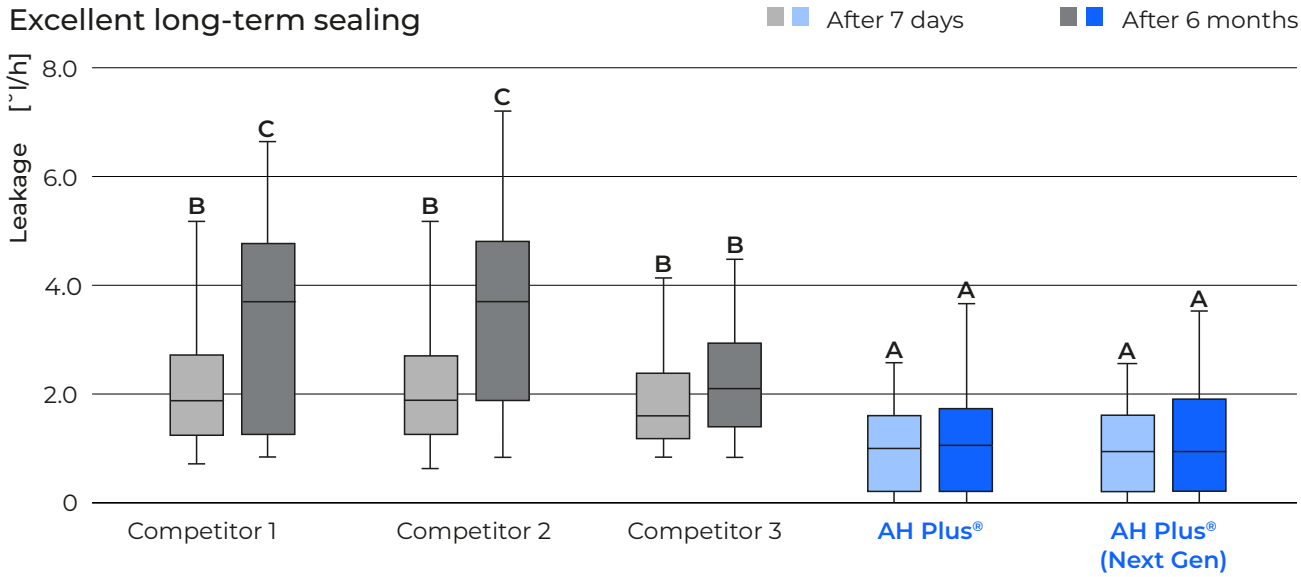


Figure 2
Median (minimum, maximum) of the leakage of the sealers 7 days (black letters) and 6 months (blue letters) after the obturation and immersion in water. Different letters represent significant differences (Kruskal-Wallis and Wilcoxon tests; $p<0.05$).

4 Superior radiopacity

Radiopacity of AH Plus® Endodontic Sealer was measured according to ISO 6876:2012. Discs with 1 mm of thickness were prepared with different sealers. The radiopacity of these discs of sealers should be ≥3 mmAl/mm on a radiograph. Among all tested sealers, values of radiopacity were the highest for AH Plus® Endodontic Sealer (Figure 3) [7].

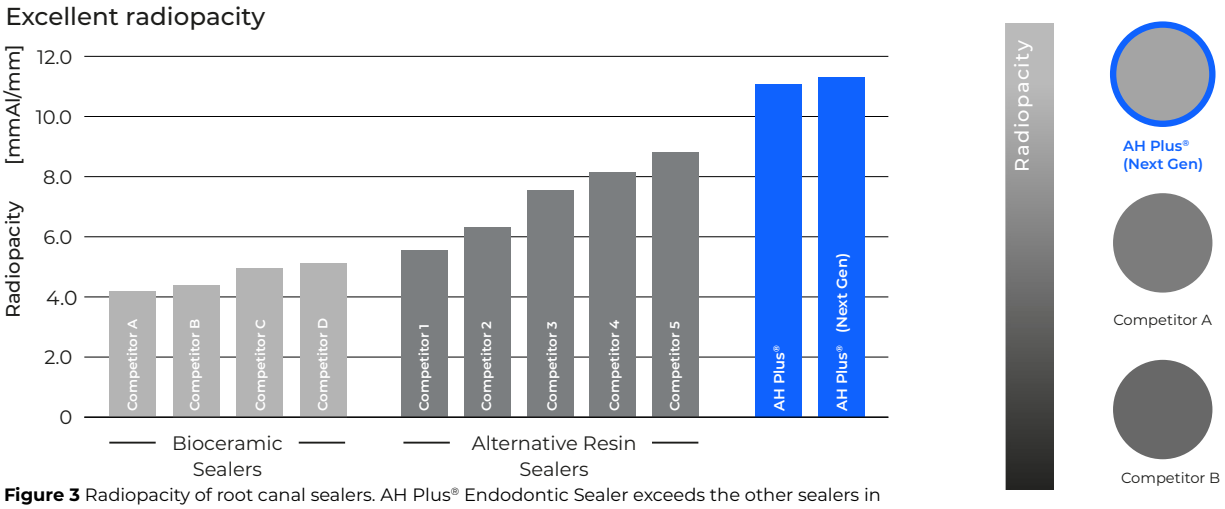


Figure 3 Radiopacity of root canal sealers. AH Plus® Endodontic Sealer exceeds the other sealers in radiopacity.

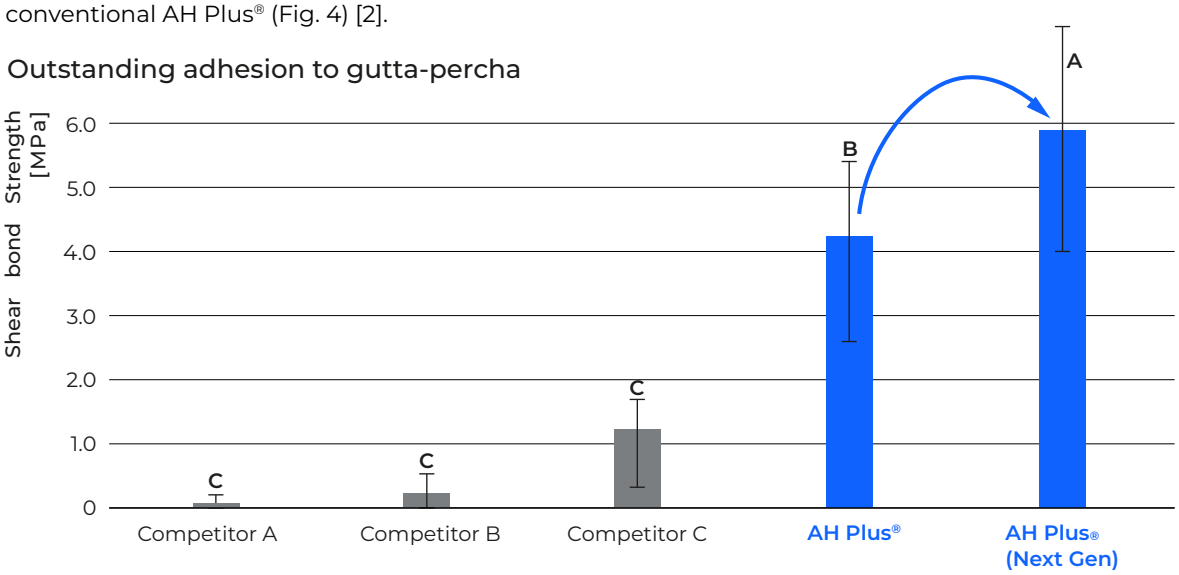
5 Compatible with irrigants

AH Plus® Endodontic Sealer is compatible with all standard irrigation solutions in standard concentrations when applied according to state-of-the-art irrigation protocols such as sodium hypochlorite, EDTA, chlorhexidine, Q-Mix® 2in1, ethanol, as confirmed by shear bond strength testing on extracted human teeth after drying of dentine surface [10].

6 Adhesion to dentine and gutta-percha

AH Plus® Endodontic Sealer adhesion was determined for sealer-dentine and sealer-gutta-percha interfaces by shear bond strength tests. Regarding the first, tests in extracted human teeth indicate that adhesion to dentine is similar for AH Plus® and for the new AH Plus® Endodontic Sealer [11].

The experimental results showed a significantly higher adhesion for AH Plus® Endodontic Sealer to the gutta percha compared to all tested bioceramic sealers. Moreover, the AH Plus® Endodontic Sealer outperformed the conventional AH Plus® (Fig. 4) [2].



HiFlow™ **Figure 4** Median (minimum, maximum) of the shear bond strength between sealers and gutta percha (N=10 samples per group). Different letters represent significant differences (One-Way ANOVA and Tukey tests; $p<0.05$).

7 Deep dentine tubule penetration

Dentine penetration of AH Plus® Endodontic Sealer was tested and compared to that of AH Plus® and of bioceramic sealers. Teeth were shaped and obturated using cold single cone technique. After that, they were immersed in physiological solution, at 37°C, for one week. Then, the canals were sectioned to evaluate the dentine penetration depth of the sealer. AH Plus® Endodontic Sealer overall presented the highest mean intratubular penetration value compared to bioceramic sealers, especially in the coronal part (Table 2 and Figure 5) [12].

Table 2
Mean of the maximum penetration points for each slice of each tested sealer (N=10 per group; in pixels).

Sealer	Coronal part (11 mm from apex)	Middle part (7 mm from apex)	Apical (4 mm from apex)
AH Plus® Endodontic Sealer	103.22	81.92	59.55
AH Plus®	87.45	83.89	55.87
Competitor A	71.86	55.23	51.24
Competitor B	77.98	66.49	36.04
Competitor C	83.27	64.80	49.38

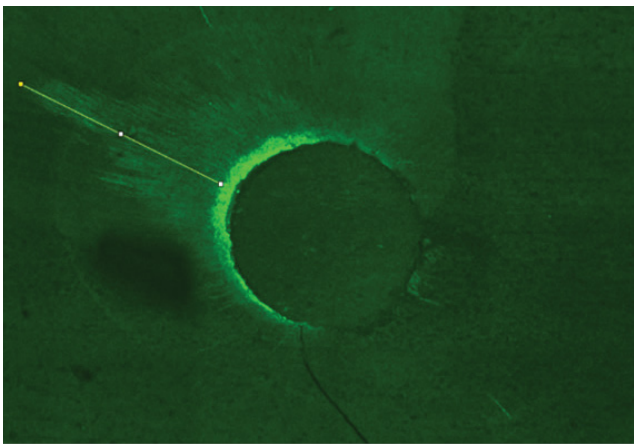


Figure 5
Confocal laser scanning microscope image displaying how the measurement of the dentine tubule penetration was performed.

8 Clinical feedback

The improved consistency of AH Plus® Endodontic Sealer was also confirmed during a user study in patients. A total of 33 experienced AH Plus Jet® users tried the new AH Plus Jet® Endodontic Sealer in a total of 273 patients and 301 teeth. All the users (100%) considered that the new AH Plus Jet® Endodontic Sealer had better or similar perceived sealing performance as the current AH Plus Jet®. In addition, about 76% of the users also agreed that the consistency of the next generation of AH Plus® Endodontic Sealer is improved. In this user study, all users would recommend the new generation of AH Plus Jet® to a colleague. In brief, the next generation of AH Plus® has an improved formulation, and retains the excellent perceived sealing performance [13].

9 Conclusions

In summary, the next generation of AH Plus® Endodontic Sealer presents improvements in comparison to the current version, with all the features needed to provide an excellent handling and sealing performance. In addition, the self-adhesive properties, improved consistency, and very high radiopacity strongly support the reliability of the new generation of sealer. Combined, these properties make AH Plus® Endodontic Sealer suitable for all obturation techniques, carrying on the clinical success legacy of the AH Plus® brand.

10. References

1. Lim M, Jung C, Shin DH, Cho YB, Song M. Calcium silicate-based root canal sealers: a literature review. Restor Dent Endod. 2020;45(3):e35.
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3. IFU [Instructions for use]: AH Plus® Endodontic Sealer.
4. Dimensional stability comparison testing was conducted according to the test method in ADA#57 R2012 5.8, with adapted acceptance criteria. Internal data on file.
5. Review of available information on raw materials, manufacturing processes, chemical characterization tests concludes that the test results meet the requirements of the following ISO 10993 standard series.
6. Internal Test Report, method and sample size according to ISO 6876:2012.
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8. *In-vitro* study based on the “Fluid Filtration Model”, Gustavo De-Deus. Data on file. Method according to De-Deus et al., Journal of Endodontics. 2008;34(3):322-5.
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12. *In-vitro* Study Report, Prof. Mario Alovisi, “Confocal laser scanning evaluation of the intratubular penetration and sealing ability of calcium silicate endodontic sealers compared with epoxy-resin sealer”. External data on file.
13. User Evaluation Report - AH Plus Jet Endodontic Sealer – *in vivo*. Data on file.

For more information regarding referenced data on file,
contact Consumables-Data-Request@dentsplysirona.com.

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