

Design & Innovation Backgrounder



Philips Sonicare AirFloss

Originally launched in 2011, the Sonicare AirFloss has impressed customers and clinicians alike with the way it makes flossing easier and more enjoyable. Using micro-droplet technology, it delivers a rapid burst of air and water droplets that gently removes plaque between the teeth and helps to improve gum health. The breakthrough innovation has since picked up numerous awards, sold more than two million units, and has been updated for spring 2013. But in order to bring the initial product to market, Philips researchers and designers went on a journey that drew on expertise throughout the company.

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Spark of inspiration

The journey began several years ago when Philips designers and researchers were exploring ways to make cleaning teeth a more rewarding experience. Drawing on its strong background in oral healthcare, the company based its work on customer insights it had gathered about how people often see brushing as a chore. It was discovered that people had very positive associations with water jets, which they associated with freshness.

So Philips researchers initially explored how water jet technology could effectively clean teeth. Similar existing solutions on the market use pulsed jets of water, but these had several drawbacks. Because of the large quantities of water they use, the machines were bulky and non-portable, and users reported that they were too messy.

Micro-droplet technology

To inspire them to find a new solution, the team looked at how water jet technologies were already used in other fields. One direction they explored was a shower-like spray, which used pure water droplets at high speeds. But it was an air-assisted device, inspired by the principles of spray paint cans and fuel injectors in cars, that proved to be the most efficient at cleaning teeth. This became the basis for the micro-droplet technology used in the final AirFloss design, which uses compressed air to shoot water droplets at up to 45 miles per hour.

Early prototype tests showed that fast-moving air could push micro-droplets of water over and between the



Initial experimental device used to carry out first clinical tests on safety and efficacy – a foot pedal activated single shots of high-velocity droplet sprays.

teeth to remove harmful plaque more effectively. The pressurized air allowed the device to use much less liquid than water jet solutions in order to be effective. To hone the device, the research team drew on its expertise in fluid dynamics, while clinical tests proved the effectiveness of their innovation, as well as its safety on gums.¹

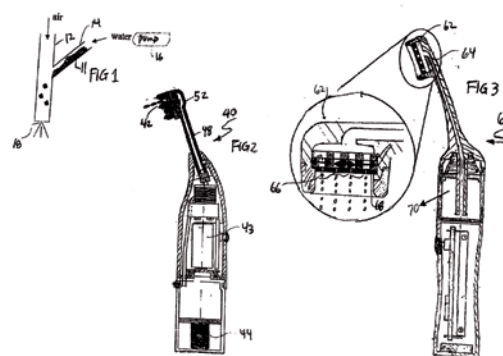
But finding the customer need and the scientific principle behind the innovation was only half the battle. “The challenge then was to make it into a controllable spray using droplets of sufficient size and speed,” explains Principal Scientist at Philips Group Innovation Marko de Jager, who led the research team.

One vision

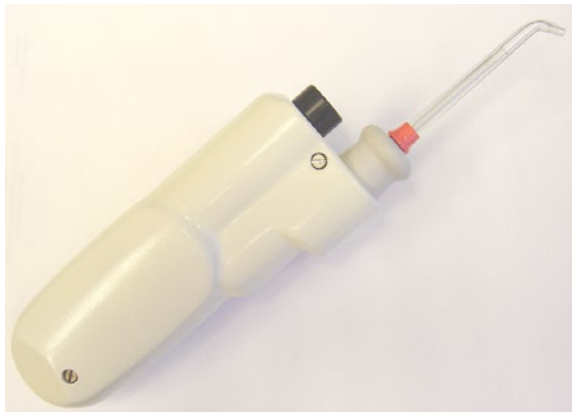
The team found a way to do this using a foot pump that activated single shots of high-pressure spray to clean the teeth. But the technology involved meant that the prototype was essentially a huge box. De Jager and his team knew that in order to make a viable product, it had to be handheld. “We knew it could work, but nothing existed on the market to help us make it smaller,” explains Joep Janssen, who was a Research Scientist at the time. Luckily, Janssen was convinced he could find a solution. He started working on the prototype on Friday afternoons, and made the essential breakthrough. Instead of using a constant spray to clean the teeth, he honed the device down to producing quick bursts. And so the idea of the AirFloss was born. The micro-droplet technology was best suited to produce a revolutionary new oral hygiene device, cleaning exclusively between the teeth (the interdental area).

Interdental cleaning re-invented

Since Philips Sonicare toothbrushes are already extremely effective at cleaning the exposed surfaces of the teeth and only parts of the interdental area, this new device would work in perfect partnership with the Philips Sonicare family. And by cutting down the air and water needed,



US patent submission diagrams (2009)



Early handheld prototype with rechargeable battery and nozzle

Janssen reduced the prototype from a bulky box to a neat handheld device with a rechargeable battery.

With a viable technical solution in hand, the design team took the lead on turning it into a device that customers would intuitively understand how to use.



Early design sketches

Why flossing matters

If bacteria builds up in the mouth it can cause irritation and swelling of gums, and if the plaque it produces is not removed it can eventually harden into calculus and tartar. Flossing regularly helps reduce gum disease (gingivitis) and tooth decay, and can also help minimize bad breath. A Sonicare power toothbrush is able to remove more plaque from these areas than a manual toothbrush, however flossing helps to remove even more of the food, bacteria and plaque that takes hold in the tight spaces between teeth.

Philips Design Consultant Edouard Gebski felt this was the team's biggest challenge: "We were designing a completely new product so we needed to turn the technology into something people could hold, use easily and travel with."

Improving compliance

It also needed to be appealing enough to change people's attitudes to flossing. In a Philips study, the majority of respondents indicated that flossing is "too difficult", "too time consuming" or "difficult to remember". For those who do remember, regular dental floss and interdental brushes are the most effective way to clean between teeth. But although dental professionals inform and train

their patients how to use these solutions, compliance is often low, and some find it difficult to master the correct techniques at home.

Tempting design

"Regularity of flossing is a key issue," explains Gebski, "so the aim was to produce a product that people could build into their daily oral care routine. The Sonicare AirFloss had to be cleaner, easier and faster than other types of



Some of the design prototypes tested in consumer studies

interdental cleaning devices, so all elements of the product had to be simple – charging it, filling it, turning it on and using it."

Because the AirFloss was an entirely new device, even the archetypal shape had to be invented from scratch. "With the miniaturization of components, a product could be developed that fitted into the Sonicare brand, the perfect balance between dental excellence and a consumer lifestyle product," explains Bart Massee, Category Design Lead, Philips Oral Healthcare.



To ensure it was as appealing and easy to use as possible, the design team created a range of shapes, and then tested the prototypes in consumer studies. The “Water Tank” design, which would form the basis for the final AirFloss design, was consistently found to be the most comfortable, easy to use and enticing – a quality necessary to tempt people who do not usually floss.

Easy and effective

Another key innovation was the slim-angled nozzle. The guidance tip on it made it easy to find the spaces between teeth and to place the tip at the appropriate angle for optimal cleaning of the whole mouth in just 60 seconds.

The Sonicare AirFloss launched with a splash in 2011 and has since picked up numerous design awards and sold more than two million units. Building on the expertise of the Sonicare brand through regular clinical trials, the company’s dental team helped to ensure the effectiveness and safety of the AirFloss. And by working closely together – alongside consumers, clinicians and ergonomists – Philips created a truly original product. “Ultimately, it’s those collaborations that make the secret sauce of great innovations,” says Masseur.



Original AirFloss design



New and improved AirFloss

New and improved for 2013

In spring 2013, Philips launched a refined version of the Sonicare AirFloss based on feedback from dental practitioners and patients. The new design has an **auto-burst function** which provides a continuous stream of automatic bursts to clean between the teeth in 30 seconds. It features a **new nozzle** for improved targeting between teeth and reduced splash-back. The nozzles now have tips of different colours that can be easily identified by individual family members, so the device can be shared. It now also includes an **improved reservoir door** with fill-level indicator and an improved **ergonomic design** for better stability, all of which make it even easier to use.

Perfect partner to Sonicare power toothbrushes

Since the technological breakthrough of the first Sonicare power toothbrush, Philips has learned a great deal about the potential power of fluid forces in improving oral health. Thanks to the intense speed at which the bristles vibrate, the Sonicare pushes saliva, water and toothpaste around the mouth to dislodge plaque beyond even where the bristles touch. And where the toothbrush cannot reach, the AirFloss takes over. Using micro-droplet technology, it acts in perfect partnership with the Sonicare brush technology to thoroughly clean between the teeth.

Clinical validation and consumer testing

The reputation of the Sonicare brand is built on its research-based approach to dental and oral care and AirFloss underwent the same rigorous clinical validation. Trials showed that the AirFloss removes five times more plaque biofilm between teeth than brushing with a regular toothbrush and it improves gum health in two weeks, as well as reduces bleeding and gingivitis.

- **Improved compliance:** After three months, 96% of people who were inconsistent flossers used AirFloss for four or more days per week.²
- People also reported that the AirFloss was **gentler on teeth and gums** and made it easier to access the back of the mouth than string floss.³
- **Easy to use:** People reported the AirFloss as easier to use than string floss by 86% of patients surveyed. It was considered easier to use than oral irrigators by three out of four dental practitioners.⁴
- **Effective:** The AirFloss removes five times more plaque than brushing with a manual toothbrush alone.⁵

Design Awards

IDEA International Design
Excellence Award 2012



red dot design award 2012



Spark Product Design Award
2012 - Best of the Best



Good Design Award 2012



Read more

The Science Behind Sonicare AirFloss
Design feature: 'Sonicare AirFloss -
Revolutionary design for oral care'
Philips Sonicare AirFloss web page
Philips press release: 'Philips introduces
Sonicare Airfloss, the latest break-
through innovation in interdental
cleaning' (May 12, 2011)

Videos

'An easier way to floss'
'How microburst technology works'

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- ² A 3-Month In-Home Use Test to Assess Product Usage Using Philips Sonicare AirFloss. S. Krell, A. Kaler, J. Wei
- ³ An Ease of Use Study to Evaluate Philips Sonicare AirFloss, String Floss and the Waterpik Waterflosser (IHUT). S. Krell, A. Kaler, J. Wei.
- ⁴ Survey of US dental professionals, Metrix Lab, USA
- ⁵ Data on file.