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Review Article **Periodontics**

Revolutionizing Dental Care- Evolution, Current Applications, and Future Prospects of Oral Irrigators: A Narrative Review

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Abstract

This narrative review comprehensively evaluates the clinical applications and effectiveness of oral irrigators (water flossers) compared to traditional interdental aids in the management of periodontal and peri-implant diseases. Drawing from an extensive literature search across databases including PubMed, Embase, MEDLINE, and Google Scholar (1971–2025), the review covers historical evolution, current usage patterns, device classification, and future technological advancements in water flossing. Oral irrigators, which utilize pulsating and pressurized water streams, have demonstrated efficacy in plaque removal, reduction of gingival inflammation, and improved access to subgingival and interproximal areas—particularly beneficial for patients with implants, orthodontic appliances, or compromised manual dexterity. Clinical evidence indicates that water flossers are often superior or at least equivalent to dental floss and interdental brushes in reducing bleeding on probing, plaque indices, and inflammatory markers. Furthermore, their synergistic use with antimicrobial agents such as chlorhexidine enhances their therapeutic impact. While water flossers show promise in improving patient compliance and oral hygiene outcomes, certain limitations—such as the risk of transient bacteremia and microbial colonization—warrant further investigation. Innovations like app-controlled devices, biofeedback mechanisms, and AI-driven water flow adjustments represent the future of personalized oral hygiene. Overall, water flossers emerge as effective, patient-friendly tools with broad utility in modern dental care. Continued research and innovation will further solidify their role in promoting periodontal and peri-implant health.

Keywords: Oral irrigator; water flosser (WF); Waterpik®; interdental cleaning; periodontal health; peri-implant disease.

INTRODUCTION

Microbial plaque biofilm accumulation is a well-established primary etiological factor for periodontitis and gingivitis. The classic study by Löe *et al.,* (1965) demonstrated that discontinuing oral hygiene leads to gingivitis within 7 to 21 days in individuals with healthy gingiva. This condition is reversible upon resuming daily self-care, highlighting the importance of consistent biofilm removal [1]. Various studies have long established the significance of daily oral hygiene care in maintaining periodontal health. Systematic reviews, including those by Needleman *et al.,* (2015) [2], Salzer *et al.,* (2015) [3], and Van der Weijden & Slot (2015) [4], have demonstrated the efficacy of mechanical plaque control methods, such as tooth brushing and interdental cleaning, in reducing plaque levels and gingival inflammation. These findings align with the European Federation of Periodontology (EFP) S3-level clinical practice guideline for treating Stage I–III periodontitis, which emphasizes the necessity of individualized self-care regimens to achieve optimal periodontal outcomes [5].

Plaque biofilm primarily accumulates in interdental spaces, which are difficult to access with toothbrush bristles. It is mostly seen on the molar and premolar interproximal surfaces, next on the anterior teeth's proximal surfaces, and finally on the molar and premolar facial surfaces. Lingual surfaces accumulate the least amount of biofilm. Posterior teeth are generally more prone to plaque retention compared to anterior

teeth [6]. In periodontal patients, anatomical changes such as gingival defects and exposed root surfaces further complicate oral hygiene practices, making effective plaque removal even more challenging [7]. Rosa *et al.,* found that even diligent tooth brushing can remove only about 60% of plaque due to the limited reach of bristles into interdental spaces, which remain hotspots for plaque accumulation and the initiation of periodontal disease [8].

Interdental cleaning aids play a crucial role in managing these hard-to-reach areas. Crocombe *et al.,* emphasized the importance of interproximal plaque removal for maintaining oral health [9]. Among various interdental cleaning aids, oral irrigators, also known as water flossers (WFs), have gained recognition as an effective adjunct to traditional methods [10]. Utilizing pulsating water streams, WFs can dislodge plaque and debris from interdental spaces and other anatomically complex areas, such as gingival pockets and exposed root surfaces [11]. Studies have shown that water flossers can effectively remove plaque and debris from periodontal pockets, with their efficacy influenced by the power setting and the type of tip used [12]. This capability makes WFs particularly beneficial for individuals with periodontal disease or difficult-to-reach areas, offering an efficient alternative or complement to traditional oral hygiene methods.

Oral irrigators have demonstrated promise in treating various difficult clinical situations in addition to their effectiveness in treating periodontal diseases. By helping to remove biofilm around implants without endangering sensitive implant surfaces, they are extremely helpful in the management of peri-implant diseases, including peri-implant mucositis and peri-implantitis [13]. Furthermore, orthodontic patients benefit from oral irrigators since fixed appliances can make cleaning more difficult and raise the risk of gingivitis and white spot lesions [14]. Children, those with hand dexterity issues (such as arthritis or other limitations), and post-surgical patients who need gentle, yet efficient plaque treatment are all benefited from WFs [15].

The versatility of oral irrigators underscores their potential as a vital tool in modern oral healthcare. Future research may explore innovations such as integrating antimicrobial agents into irrigators, optimizing pulsation and pressure settings for enhanced efficacy, and developing specialized tips for unique clinical applications. Advancements in personalized oral irrigation technology, such as app-controlled devices and biofeedback systems, could further revolutionize home care, making it easier to use and more efficient. As our knowledge of biofilm dynamics and patient demands continues to advance, oral irrigators will become more and more important in the therapy of periodontal and peri-implant diseases.

This review article concentrates on the clinical usage and efficacy of oral irrigators as supplemental instruments for the treatment of periodontal and peri-implant diseases. This article critically compares the effectiveness of WFs to traditional interdental aids like dental floss and interdental brushes across a range of patient groups, building on research that suggests their function in disrupting biofilms. This study attempts to close the current research gaps and provide a nuanced knowledge of the best usage of oral irrigators in attaining periodontal and peri-implant health by combining results from clinical trials, systematic reviews, and guidelines. The paper also looks at new developments that may reinterpret oral irrigators' function in individualized dental care and the synergistic benefits of mixing them with antibacterial medicines.

STUDY DESIGN AND METHODS

We gathered several research literatures on the efficacy of WF in treating periodontal and peri-implant diseases from 1971 to 2025. This is done by conducting a thorough search across various academic databases, including PubMed, Embase, Medline, and Google Scholar. A particular set of keywords and Medical Subject Headings (MeSH) terms such as "water floss", "periodontal disease", "peri-implant disease", "oral irrigation", and "plaque removal", were used to find studies that evaluated the impact of water flossing on oral health. Also, we have narrowed our search using specific criteria, to ensure that the results were limited to peer-reviewed literature and human clinical studies that specifically addressed WF's effectiveness in improving periodontal and peri-implant health. The main objective of this comprehensive analysis is to collect most important scientific data about the advantages of water floss for maintaining proper oral hygiene, mainly to control plaque, reduce gingival inflammation, and improve periodontal and peri-implant health generally.

Evolution of the Water Flosser [16]

Table 1: Evolution of the Water Flosser

1955	Dr. C.D. Matteson invented the "Hydraulic Dental Syringe", but it failed commercially. (Figure 1)
1962	Aqua Tec, founded by Dr. Gerald Moyer, John Mattingly, and Dr. Thomas Bennett, developed the oral irrigator with a pulsating flow.
1975	Aqua Tec rebranded as WaterPik, introducing the modern water flosser. (Figure 2)
Today	WaterPik, used for over 60 years, retains its design while benefiting from ongoing technological improvements.

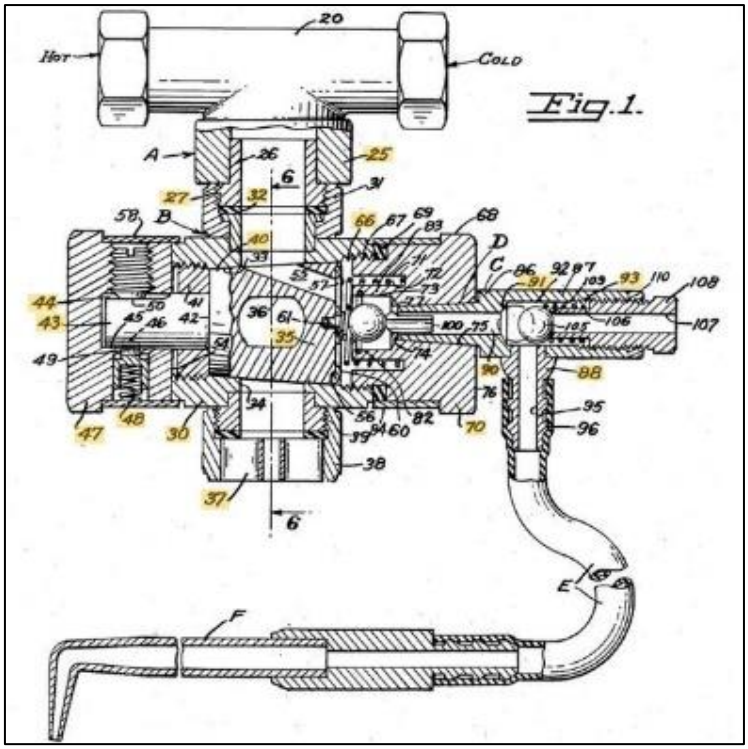

Figure 1: Hydraulic Dental Syringe

Figure 2: An early prototype of water pik

Water Flosser Types [17]

Class 1: Traditional water flossers with a reservoir and nozzle
Class 2: Electric or power-driven models
Class 3: Professional-grade dental flossers
Class 4: Portable, battery or USB-powered flossers
Class 5: Smart technology-enabled flosser

The Biomechanics Behind Water Flossers

WFs use a combination of pulsation and pressure to effectively clean between teeth and below the gumline. Pulsation creates alternating compression and decompression phases, allowing water or a solution to penetrate and flush out bacteria and debris from subgingival areas. This action creates two zones of hydrokinetic activity:

- **Impact zone** – where the solution contacts the gingival margin.
- **Flushing zone** – where the solution reaches subgingivally [11].

In 1971, Bhaskar *et al.,* compared pulsating water jets (such as the Water Pik) with continuous streams using devices developed at the U.S. Army Institute of Dental Research and by the Aquatec Corporation. They found that pulsating jets were more

effective at removing bacteria and debris [18]. Gross *et al.,* (1971) demonstrated that water jets could also deliver disinfectants and antibiotics [19], while Selting *et al.,* (1972) concluded that directing the water jet perpendicular to the tooth increased efficiency with minimal gum damage [20].

The American Academy of Periodontology endorsed WFs in 2001, recognizing their ability to reduce gingival inflammation beyond brushing alone [21]. WFs help decrease periodontal inflammation by lowering pro-inflammatory cytokines (IL-1β and PGE2) [22] and can penetrate periodontal pockets up to 6 mm deep [12]. Studies have shown that they are safe to use, even at high pressure (up to 100 PSI) [23], with a bacteraemia rate comparable to traditional flossing [24]. Additionally, oral irrigators have been found effective for both children [15] and implant patients, reducing bleeding and improving gum health [13].

How to Use a Water Flosser: A Step-by-Step Guide [25]

1. **Fill the Reservoir:** Use lukewarm water or add mouthwash for extra freshness.
2. **Choose and Attach the Tip:** Select the appropriate tip and securely lock it into the handle.
3. **Position in Mouth:** Start at the back teeth, keeping the tip just above the gums while leaning over the sink.
4. **Turn On:** Begin at a low pressure and gradually increase to a comfortable level.
5. **Clean Methodically:** Keep the tip of the flosser at a 90-degree angle to the gum line. Follow the gumline and floss for about two minutes, ensuring all teeth are covered.
6. **Empty the Reservoir:** Discard any leftover water to prevent bacterial growth.

Commercially Available Water Flossers: Types & Features [26]

1. **Countertop:** Feature-rich, with big reservoirs and numerous pressure settings; needs an electrical outlet. (Figure 3)

Figure 3: Aquarius™ Professional Water Flosser

2. **Cordless:** Perfect for travel, this device is small, portable, and runs on batteries. (Figure 4)

Figure 4: Advanced 2.0 Water Flosser

3. **Sonic-Fusion:** A two-in-one electric toothbrush that features an integrated WF for brushing and flossing at the same time (Figure 5)

Figure 5: Sonic-Fusion™ 2.0

4. **Complete Care:** An integrated device that combines a WF and electric toothbrush for comprehensive dental hygiene (Figure 6).

Figure 6: Complete Care 5.0

Comparison of Water Flossers and Traditional Tools on Plaque Removal and Oral Health

Water flossers have been extensively studied in comparison with traditional interdental aids. They have consistently demonstrated superior outcomes in reducing plaque, gingival bleeding, and inflammation. Multiple clinical trials highlight their enhanced effectiveness over floss, interdental brushes, and other aids, particularly in improving overall periodontal health. (Table 2)

Table 2: Comparison of Water Flossers and Traditional Tools on Plaque Removal and Oral Health

Comparison	Studies	Summary Interpretation
WF vs. Dental Floss	Rosema *et al.,* [27], Goyal *et al.,* [28], Magnuson *et al.,* [13], Akram *et al.,* [29], Abdellatif *et al.,* [30], Mancinelli-Lyle *et al.,* [31], Sarlati *et al.,* [32] Sawan *et al.,* [33]	WFs are more effective than floss in reducing gingival bleeding, plaque, and inflammation; better for interdental care.
WF + Manual Toothbrush vs. Floss Alone	Barnes *et al.,* [34]	Combined use of WF and manual brushing is superior in reducing bleeding and gingivitis.
WF vs. Manual Brushing + Floss	Batool *et al.,* [35]	WF achieves greater plaque reduction compared to brushing and flossing together.
WF vs. Interdental Brushes (IDBs)	Goyal *et al.,* [36], Lyle *et al.,* [37]	WFs outperform IDBs in reducing bleeding and plaque removal.
WF vs. Other Interdental Aids	Ng and Lim [38]	WFs enhance overall oral hygiene effectiveness compared to general interdental aids.
WF vs. Tooth Brushing Alone	Xu *et al.,* [39], Cutler *et al.,* [21], Al-Mubarak *et al.,* [40]	WFs significantly improve gingival health, reduce inflammation, and decrease pro-inflammatory markers (e.g., PGE2, IL-1β).
Vs- versus, WF-Water flosser		

Enhanced Efficacy of Water Flossing with Chemical Agents

Water flossers can serve as effective delivery systems for chemical agents, enhancing their therapeutic potential. Studies have shown that using antimicrobials like chlorhexidine, ozonated water, and herbal extracts through oral irrigators results in superior plaque control and gingival inflammation reduction compared to mouth rinsing alone. This approach offers targeted subgingival delivery, making it a valuable adjunct in both home care and periodontal maintenance. (Table 3)

Table 3: Enhanced Efficacy of Water Flossing with Chemical Agents

Author	Intervention	Interpretation
Niklaus *et al.,* [41]	CHX as a mouth rinse vs. CHX as an oral irrigant	Applying CHX using a fractionated jet irrigator is more efficient than rinsing.
Niklaus *et al.,* [42]	Evaluated various concentrations of CHX in oral irrigators	Plaque development can be prevented by using chlorhexidine once a day with the irrigator.
Flemming *et al.,* [43]	CHX as a mouth rinse vs. CHX as an oral irrigator	Oral irrigation with CHX provides improved effects on gingivitis compared to rinsing alone.
Parsons *et al.,* [44]	Sanguinaria extract as mouth rinse vs. oral irrigator	Supragingival irrigation with sanguinaria extract is a useful addition to home care for plaque and gingivitis control.
Pandya *et al.,* [45]	CHX vs. ozonated water vs. saline in oral irrigators	Ozonated water and CHX are effective subgingival irrigants; saline is less effective.
Ciancio *et al.,* [46]	Antimicrobial agents delivered via oral irrigator	Use of antimicrobials in oral irrigators significantly reduces bleeding, plaque, and microbial load.
Walsh *et al.,* [47]	CHX in oral irrigators	CHX irrigation twice daily effectively reduces inflammation, plaque accumulation, and probing depth.
CHX – Chlorhexidine; vs – versus		

Water Flossers and Implant Care

Biofilm buildup is the major cause of peri-implantitis, a condition marked by inflammation and extended bone loss surrounding dental implants. WFs are becoming useful instruments for removing biofilm, which is essential for preserving the health of the peri-implant. Conventional instruments like floss and interdental brushes may not be as successful in difficult-to-reach places like subgingival areas and the small crevices between implants and prostheses. These areas can be reached by the pulsing and pressurized streams of water from WFs. According to research from Tufts University, the Waterpik® WF proved superior to conventional flossing when it came to cleaning the area surrounding dental implants. This result emphasizes how WFs help in managing peri-implant conditions by guaranteeing better biofilm management [13].

Furthermore, Felo *et al.,* emphasized that specialized subgingival tips, like the Pik Pocket® Tip, offer a secure and efficient way to reduce bleeding and irritation surrounding implants. By delivering precise irrigation into the peri-implant spaces, these tips improve the elimination of debris [48]. To increase the effectiveness of antimicrobials like chlorhexidine, WFs can also be used as a vehicle for their direct delivery into

the peri-implant pockets. In addition to improving plaque management, the mild yet efficient cleaning method guarantees that the peri-implant tissues sustain the least amount of damage. Magnuson *et al.,* showed that utilizing WFs daily improves bleeding indices and reduces plaque without harming the implant or the tissues around it [13]. According to Tütüncüoğlu *et al.,* oral irrigators showed decreased bleeding scores and were shown to be similar to interdental brushes in treating peri-implant mucositis [49]. Additionally, Daniel Bunk *et al.,* discovered that the use of an oral irrigator with 0.06% chlorhexidine (CHX), mechanical biofilm removal, and oral hygiene instruction significantly reduced mucositis surrounding the implant after 12 weeks [50].

WFs are an important supplement to implant maintenance procedures because of their capacity to manage biofilm, lower inflammation, and support tissue health. They can lower the risk of peri-implantitis and prolong the success of dental implants when used consistently in conjunction with proficient periodontal care [21].

Patient Compliance

WFs significantly enhance patient compliance in periodontal, implant, orthodontic, prosthetic, and pediatric care, as well as for individuals with manual dexterity challenges. They provide an easy, efficient, and effective method for reducing plaque, controlling inflammation, and improving overall oral hygiene. Flemming *et al.,* reported high compliance rates with dental water jets in a six-month study [51]. Research also indicates that for orthodontic patients, the use of a dental water jet significantly reduces plaque biofilm and inflammation. Similarly, Al Moharib *et al.,* found that oral irrigation devices effectively decrease plaque accumulation, gingival inflammation, and bleeding on probing in orthodontic patients [52]. Hurst *et al.,* further demonstrated that oral irrigators significantly reduced the total aerobic flora, particularly the lactobacillus count, in orthodontic users [53]. Additionally, Mubarak *et al.,*concluded that combining scaling and root planing with subgingival water irrigation twice daily can promote periodontal health in diabetic patients [37].

Safety is just as important as effectiveness when recommending a product or device to patients. Preliminary research has validated the safety of the Waterpik dental water jet, with no serious adverse effects reported by researchers or patients in any studies.

Overall, WFs provide a safe, effective, and patient-friendly solution for enhancing oral hygiene across various patient groups. By reducing plaque and bacterial load, they play a pivotal role in preventing peri-implantitis, enhancing periodontal health, and maintaining hygiene during orthodontic treatment and prosthetic care. Ultimately, their use contributes to better long-term oral health outcomes.

LIMITATIONS

Sanders *et al.,* concluded that supragingival pulsating jet irrigation with metronidazole provided limited benefits, with most groups returning to baseline levels by day 84 [54]. Similarly, Shiloah *et al.,* reported that a single irrigation of periodontal pockets—whether performed before or after scaling and root planing—had minimal impact on periodontal healing [55].

One challenge associated with power-driven WFs is the difficulty in preventing bacterial colonization and the transmission of contaminated water-jet droplets, particularly concerning *Streptococcus mutans*, a primary caries-associated pathogen. Studies have shown that neither using mouthwash in the device nor following recommended cleaning protocols effectively eradicates *S. mutans* from the flosser. Additionally, replacing an old nozzle with a new one does not eliminate the risk of cross-contamination, as the new nozzle's water jet may still spread bacteria from within the device. To minimize this risk, each should use their own device rather than sharing within a household [56].

Another consideration is that dental irrigators can cause transient bacteremia, particularly in individuals with periodontal disease and poor oral hygiene. This may be a significant concern for individuals at risk of infective endocarditis [57].

DISCUSSION

Effective plaque management is essential to preserve good oral health, but interdental spaces frequently continue to be a covert battlefield for the growth of biofilm. These areas are difficult to reach by conventional oral hygiene tools like toothbrushes and floss, particularly around orthodontic appliances and implants. The bacterial burden further increases and this enduring biofilm may eventually cause gingival inflammation, attachment loss, implant failure, and tooth movement. Therefore, mastering plaque control is not just about cleanliness—it's the foundation of long-term oral health.

The efficiency of oral irrigators in improving oral hygiene and averting periodontal and peri-implant disorders has been emphasized by several researchers. Numerous studies have shown that WFs are just as effective as or even more effective than conventional techniques in removing plaque. Furthermore, WFs offer a less aggressive method of removing plaque, which makes them especially appropriate for people who have sensitive gums, orthodontic appliances, or issues with manual dexterity.

There is evidence that these devices are successful in removing plaque from regions that are frequently challenging to clean with traditional approaches, such as the gum line and interdental spaces. Notably, studies have demonstrated that WFs may

significantly improve plaque management after just a single usage, providing a practical and effective option for people who have trouble with flossing procedures [26-40]. Additionally, Chaves *et al.,* found that a dental water jet considerably reduced biofilm-induced irritation [50].

WFs have been demonstrated to improve gingival health in addition to their ability to remove plaque. They lessen gingival bleeding and inflammation, which are typical signs of periodontal disease, by successfully removing bacterial biofilms from interdental spaces. The notion that WFs promote a better gingival environment is supported by research showing that their usage lowers pro-inflammatory cytokines [21, 37]. Additionally, WFs have shown an even higher reduction in microbial load when used in conjunction with antimicrobial treatments like chlorhexidine or essential oils, improving gingival health results [41-47].

To promote implant and periodontal treatment, WFs are essential. In areas where conventional flossing techniques frequently fail, they have shown especially good results when it comes to cleaning around dental implants. They are therefore a vital tool for implant patients, aiding in the prevention of peri-implant conditions including peri-implantitis and peri-implant mucositis [21, 26, 48-50]. Additionally, for individuals with periodontitis, when manual cleaning methods might not be enough, the WF's capacity to penetrate deeper into periodontal pockets improves hygiene management [22]. WFs assist people in getting orthodontic treatment and keep their teeth clean around their brackets and wires, which lowers gingival irritation and plaque buildup [14, 40, 50, 51].

Any dental hygiene tool's performance depends on patient compliance, and WFs have been demonstrated to improve compliance, particularly for those who have trouble with conventional flossing methods. Studies show that since WFs are comfortable, easy to use, and effective at lowering gingival inflammation and plaque, patients are more inclined to use them regularly [49]. Because it leads to improved long-term oral health outcomes, this enhanced compliance is especially important for people managing chronic oral disorders including periodontal disease and dental implants.

All of the research points to the potential advantages of WFs as an effective addition to conventional oral care practices that promote better periodontal health. WFs and traditional mechanical plaque management techniques have been evaluated in several studies to identify the best oral care regimen. WFs have continuously shown their effectiveness in preserving the best possible dental health throughout these studies [26-40]. This was further corroborated by Frascella et al., who demonstrated that the Braun Oral-B OxyJet (MD15) Oral Irrigator is safe and efficient in lowering plaque and enhancing gingival health when used in conjunction with manual brushing [59].

Future Perspective

With ongoing research and technical developments in oral healthcare WFs are becoming significant in the management of periodontal disease. WFs are expected to be a major functional and structural improvements as technology advances, allowing for more individualized and effective oral hygiene treatments. Specialized plaque removal systems specifically for people with orthodontic appliance, dental restorations, or other particular oral problems could be among the very next advancements. Furthermore, the incorporation of smart technology into WFs may enable real-time monitoring of dental health, providing personalized suggestions and modifications to maximize patient care. The Waterpik™ Water Flossing app is one such innovative app that offers flossing regimens with guidance to increase efficacy [60].

The eXempt Cares app, that incorporates a 5-million-pixel HD endoscope into conventional WFs, is another noteworthy advancement [61]. This helps users to visually inspect their teeth and gums while flossing, allowing for real-time imaging to more accurately identify concealed plaque and debris. This technique increases the efficiency of WFs by improving visibility in hard-to-reach areas, thus helping in better management of periodontal and peri-implant diseases.

Future advancements in WF technology might include AI-driven systems that can evaluate the health of the gums and teeth, allowing to modify the water flow intensity according to user demands, and give real-time feedback on flossing technique. Furthermore, the creation of automatic self-cleaning and sterilization capabilities not only improve hygiene but also extend the longevity of the device, guaranteeing more safer and more efficient oral health care.

In order to give real-time dental health information, future WFs may also have wireless connections, that enable them to sync with smartphone apps or wearable health trackers. Thus, enable to track variations in plaque levels, gum health, and adherence to cleanliness to provide this information to consumers. Furthermore, by learning from each flossing session, machine learning algorithms may allow WFs to adjust to the specific needs of each patient, providing tailored advice to improve the oral hygiene.

There is growing demand in WF in market due to increase in consumer knowledge and acceptance of WFs, thus propelling more advancements in oral hygiene technology. WFs are positioned to become crucial tool in the prevention and treatment of periodontal and peri-implant disorders as more people look for effective as well as user-friendly choices for preserving oral health. WF technological advancements might revolutionize the

treatment of periodontal disease by increasing their efficacy and making them easier to include in everyday oral hygiene regimens.

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