

**TABLE 47-1** Increased Understanding of the Benefits of a Dental Water Jet

Understanding of Periodontal Diseases (Approximate Years)	Significant Developments and Research in Dental Water Jet (DWJ) Technology
<p><b>Nonspecific Plaque Era (1965)</b></p> <p>Plaque was considered to be a homogenous, toxic substance that caused gingivitis. Gingivitis could progress slowly to periodontitis. Amount of plaque and length of time plaque attached to tooth were paramount factors in disease. All plaque was considered essentially the same, and all plaque was considered bad.<sup>62</sup></p>	<p>DWJ initially introduced to dental community in early 1960s. Clinical and laboratory studies showed the following:</p> <ul style="list-style-type: none"> <li>• DWJ is a significant aid to oral hygiene procedures.<sup>8</sup></li> <li>• DWJ can decrease plaque formation.<sup>39,42</sup></li> <li>• Use of DWJ significantly reduces gingivitis<sup>20</sup> and calculus formation as adjunct to tooth brushing.<sup>59</sup></li> <li>• These devices do not produce bacteremia.<sup>40,79</sup></li> </ul>
<p><b>Specific Plaque Hypothesis Era (1975)</b></p> <p>Supragingival and subgingival plaque shown to be different. Supragingival plaque begins first, then with time can grow apically and evolve into subgingival plaque, which can cause bone destruction around a tooth.<sup>69</sup></p> <p>Elevation of specific bacterial species associated with specific periodontal diseases. Periodontal pathogens are located subgingivally.<sup>65</sup></p>	<p>Clinical studies in the 1970s through 1990s continued to show significant clinical reductions in bleeding, inflammation, and plaque formation using DWJ and marginal irrigation with water, chlorhexidine gluconate, and essential oils.*</p> <p>Studies show that DWJ irrigation with a jet tip can reach subgingival areas inhabited by periodontal pathogens.<sup>12,24,29,30</sup></p>
<p><b>Host Bacteria Interrelationship Era (1985) and Era of Periodontal Medicine (Present)</b></p> <p>Diabetes and other systemic diseases shown to make patient more susceptible to periodontal diseases.<sup>41</sup></p>	<p>There is an improvement in clinical parameters in diabetic patients using DWJ and reduced inflammatory mediators over traditional routine oral hygiene regimens.<sup>1</sup></p> <p>Moderate-to-severe periodontitis increases systemic inflammation, which is associated with cardiovascular disease and gram-negative bacteria in periodontal pockets (biofilms) have been associated with arthromas.<sup>35</sup></p> <p>In 2009, at a consensus meeting, the <i>American Journal of Cardiology</i> and <i>Journal of Periodontology</i> issued guidelines for patients with atherosclerotic cardiovascular disease who have untreated or uncontrolled periodontitis that stated these patients should be treated with a focus on <i>reducing and controlling the bacterial accumulations and eliminating inflammation</i>.<sup>35</sup></p> <p>Clinical benefits of oral irrigation found to be related to reduction of proinflammatory mediators in serum (i.e., reduces systemic inflammation).<sup>26</sup></p> <p>Efficiency of DWJ irrigation at removing biofilm ex vivo and in vivo shown in scanning electron microscopy studies.<sup>42</sup></p> <p>DWJ irrigation (along with toothbrushing) is an effective alternative to dental floss for the reduction of bleeding, gingivitis, and plaque and in some cases, may provide superior results for reducing bleeding and gingivitis.<sup>7,73</sup></p>

### Home/Self-Applied Irrigation

The body of evidence on the dental water jet (also called oral irrigator and water flosser) consistently has been shown to significantly reduce gingivitis, bleeding on probing, and periodontal pathogens.\* These oral health improvements have been demonstrated with the use of either water or an antimicrobial agent. Emerging evidence indicates the dental water jet effectively removes biofilm<sup>39,42</sup> and is as effective as dental floss when added to toothbrushing.<sup>8,73,77</sup> Table 47-1 compares the understanding of periodontal disease to significant developments in dental water jet technology.

### Mechanism of Action of Irrigation

The mechanism of action of irrigation occurs through the direct application of a pulsed stream of water or other solution. Studies have found pulsation and pressure to be critical components of an irrigation device.<sup>9,10,76</sup> Pulsating devices have been shown to be three times as effective as a continuous-stream irrigating syringe.<sup>76</sup> Pulsation provides for a compression and decompression phase that may account for expedient clearing of bacteria from the pocket.<sup>9</sup> A pulsating device allows for control of the pressure rate. The

majority of studies on home irrigation that have demonstrated clinical efficacy have been done using a dental water jet with 1200 pulsations per minute set on a medium to a high pressure setting (50 to 90 psi)<sup>9,10,76</sup> (Figures 47-10 and 47-11). Dental water jets with varying pulsation and pressure are available, but like other self-care products, research from one product brand should not be extrapolated to other brands since they may have used a different pressure setting and pulsation rate.

A pulsation rate of 1200 per minute has been shown to create two zones of hydrokinetic activity<sup>24</sup>: the impact zone, in which the solution initially contacts, and the flushing zone, in which the solution reaches into the subgingival sulcus<sup>43</sup> (Figure 47-12). The outcome of hydrokinetic activity is subgingival penetration.

Home irrigation has been demonstrated to penetrate subgingivally with both a jet tip<sup>30</sup> (Figure 47-13) and a soft, site-specific, subgingival tip<sup>14</sup> (Pik Pocket subgingival irrigation tip, Water Pik, Inc., Fort Collins, CO) (Figure 47-14). Supragingival irrigation is irrigation with a jet tip placed above the gingival margin resulting in penetration of a solution into the subgingival sulcus to approximately 50% (Video clips 47-3 and 47-4).<sup>12,30</sup>

**TABLE 47-2** Reduction of Inflammation and Plaque Biofilm

Study	Duration	N	Agent Used	% Bleeding Reduction	% Gingivitis Reduction	% Plaque Biofilm Reduction
Al-Mubarak et al <sup>1</sup>	3 months	50	Water	43.8	66.9	64.9
Barnes et al <sup>8</sup>	4 weeks	105	Water	36.2-59.2	10.8-15.1	8.8-17.3
Brownstein et al <sup>16</sup>	8 weeks	44	CHX (0.06%)	52-59	25.4-31.1*	14.3-19*
			Water	NR		NR
Burch et al <sup>17</sup>	2 months	47	Water	57.1-76.6	NR	52-55.7
Chaves et al <sup>20</sup>	6 months	105	CHX (0.04%)	54	26	35
			Water	50	26	16
Ciancio et al <sup>21</sup>	6 weeks	61	Essential oils <sup>†</sup>	27.6	54-55.7	23-24
			Water and alcohol 5%	13.6-31.2	59.8-61.9	9/6-13.3
Cutler et al <sup>26</sup>	2 weeks	52	Water	56	50	40
Flemmig et al <sup>34</sup>	6 months	175	CHX (0.06%)	35.4	42.5	53.2
			Water	24	23.1	0.1
Flemmig et al <sup>33</sup>	6 months	60	Acetylsalicylic acid 3%		8.9	55.6
			Water	50	29.2	0
Felo et al <sup>31</sup>	3 months	24	CHX (0.06%)	62	45	29
Fine et al <sup>32</sup>	6 weeks	50	Essential oils <sup>†</sup>	14.8-21.7	NR	36.8-37.7
			Water	7.5-10.6	NR	15.5-18.4
Jolkovsky et al <sup>50</sup>	3 months	58	CHX (0.4%)	NR	33.1	51.6
			Water	NR	18.6	25.6
Lobene et al <sup>59</sup>	5 months	155	Water	NR	52.9	7.9
Newman et al <sup>64</sup>	6 months	155	Water	22.8	17.8	6.1
			Water and zinc sulfate (0.57%)	8.8	6.5	9.2
Rosema et al <sup>73</sup>	30 days	104	Water	17%	NR	?
Sharma et al <sup>77</sup>	4 weeks	128	Water	84.5	NR	38.9
Walsh et al <sup>86</sup>	8 weeks	8	CHX (0.2%)	NR	45	77
			Quinine salt	NR	14	0

CHX, Chlorhexidine; NR, not reported.

\*Percentages were reported for differences between CHX and water irrigation groups.

<sup>†</sup>Reported the range for prophylaxis and nonprophylaxis groups.

Data from Ciancio SG: *Compendium Contin Educ Dent* 30:7-14, 2009.

The jet tip is generally used for full-mouth irrigation. Recently, other types of supragingival tips enhanced with soft, tapered bristles (Figure 47-15) have been introduced and shown to be effective in increasing the removal of plaque.<sup>42,73,77</sup> Irrigation with the soft, site-specific tip is called *subgingival irrigation*. This refers to the placement of the tip, which is placed slightly below the gingival margin (Figure 47-16). The subgingival tip is used for the localized irrigation of a specific site such as a deep pocket, furcation, implant, or crown and bridge. Studies with this site-specific, subgingival tip show that it can deliver a solution into a pocket of 6 mm or less up to 90% of its depth.<sup>14</sup> In pockets deeper than 6 mm, the depth of penetration has been shown to be 64%.<sup>14</sup>

### Safety

Concerns regarding the safety of oral irrigation with regard to soft tissue damage and penetration of bacteria into the pocket have been voiced; although no scientific evidence exists to support these claims. Several investigators have evaluated the soft tissue and found no trauma or adverse reaction from using a pulsating oral irrigator. Researchers have found that irrigation reduces the amount of bacteria in the gingival crevice or periodontal pocket.\* Specifically, Cobb et al<sup>24</sup> and Drisko et al<sup>29</sup> found that bacteria was reduced up to 6 mm.

\*References 16, 20, 21, 24, 29, 34, 49, 50, and 66.

### Clinical Outcomes of Irrigation

Table 47-2 highlights the body of evidence on the dental water jet. Evaluated outcomes include removal of plaque biofilm and reductions in calculus, gingivitis, bleeding on probing, probing depth, periodontal pathogens, and inflammatory mediators.\* Home irrigation has been studied and found safe and effective for those with gingivitis,<sup>†</sup> implants,<sup>31</sup> crown and bridge,<sup>56</sup> orthodontics,<sup>17,49,77</sup> intermaxillary fixation,<sup>72</sup> and diabetes<sup>1</sup>; patients who are noncompliant with dental floss<sup>7,73</sup>; and in periodontal maintenance.<sup>‡</sup>

Early studies found that irrigation with water leads to a reduction in calculus<sup>46,59</sup>; up to as much as 50% over brushing alone.<sup>59</sup> A study conducted with the scanning electron microscope found that a 3-second pulsating lavage at a 60 psi with either a jet tip or small brush tip removed 99% of plaque biofilm<sup>42</sup> (Figures 47-17 and 47-18). A single-use study that compared irrigation to string floss in addition each in addition to manual brushing found irrigation to be 29% more effective at whole mouth plaque removal.<sup>39</sup>

As early as the 1960s, it was shown that oral irrigation with water added to toothbrushing reduced gingivitis by 52% compared

\*References 1, 4, 8, 13, 16, 17, 20, 21, 26, 31-34, 46, 47, 49, 56, 59, 64, 72, 77, 86, and 87.

<sup>†</sup>References 16, 20, 21, 34, and 59.

<sup>‡</sup>References 26, 32, 33, 50, 64, and 86.

### BOX 47-2 Indications, Precautions, and Contraindications for Use of Mechanized Instruments

#### Indications

- Supragingival debridement of dental calculus and extrinsic stain
- Subgingival debridement of calculus, oral biofilm, root surface constituents, and periodontal pathogens
- Removal of orthodontic cement
- Gingival and periodontal conditions and diseases
- Surgical interventions
- Margination (reduces amalgam overhangs)

#### Precautions

- Unshielded pacemakers
- Infectious diseases: human immunodeficiency virus, hepatitis, tuberculosis (active stages)
- Demineralized tooth surface
- Exposed dentin (especially associated with sensitivity)
- Restorative materials (porcelain, amalgam, gold, composite)
- Titanium implant abutments unless using special insert, e.g., Quixonic SofTip Prophy Tips
- Children (primary teeth)
- Immunosuppression from disease or chemotherapy
- Uncontrolled diabetes mellitus

#### Contraindications

- Chronic pulmonary disease: asthma, emphysema, cystic fibrosis, pneumonia
- Cardiovascular disease with secondary pulmonary disease
- Swallowing difficulty (dysphagia)

From Darby ML, Walsh MM: *Dental hygiene*, ed 3, Saunders, St Louis, 2010.



**Figure 47-9** Modified pen grasp with tip. (Courtesy Hu-Friedy, Chicago.)

to a 30% reduction for toothbrushing alone.<sup>59</sup> Throughout the years, other researchers have found concurring results with the use of plain water.<sup>§</sup> The use of an antimicrobial agent, such as diluted chlorhexidine (Table 47-3), or an essential oil, generally enhances reductions in gingivitis and bleeding.\*

Emerging evidence indicates that home irrigation may play a role in modulating the host response, particularly the inflammatory mediators associated with clinical attachment loss and alveolar bone loss.<sup>1,26</sup> This evidence lends support to the safety of irrigation, as well as its potential for helping periodontal maintenance patients maintain stability.

<sup>§</sup>References 1, 8, 20, 26, 34, 46, 47, 59, 64, and 77.

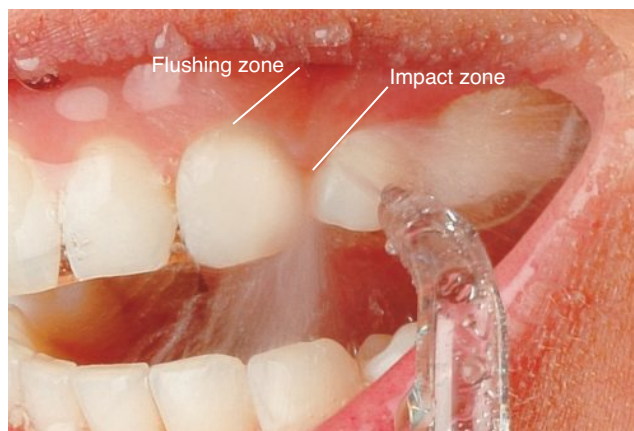
\*References 4, 16, 20, 21, 31-34, 50, and 86.



**Figure 47-10** A dental water jet with 1200 ppm and a pressure setting that ranges from 20 to 90 psi. (Courtesy Water Pik, Inc., Fort Collins, CO.)



**Figure 47-11** A cordless dental water jet, which also has 1200 ppm. (Courtesy Water Pik, Inc., Fort Collins, CO.)



**Figure 47-12** Pulsation creates two zones of hydrokinetic activity: the impact zone and the flushing zone. (Courtesy Water Pik, Inc., Fort Collins, CO.)





**Figure 47-13** Jet tip. (Courtesy Water Pik, Inc., Fort Collins, CO.)



**Figure 47-14** Site-specific tip. (Courtesy Water Pik, Inc., Fort Collins, CO.)



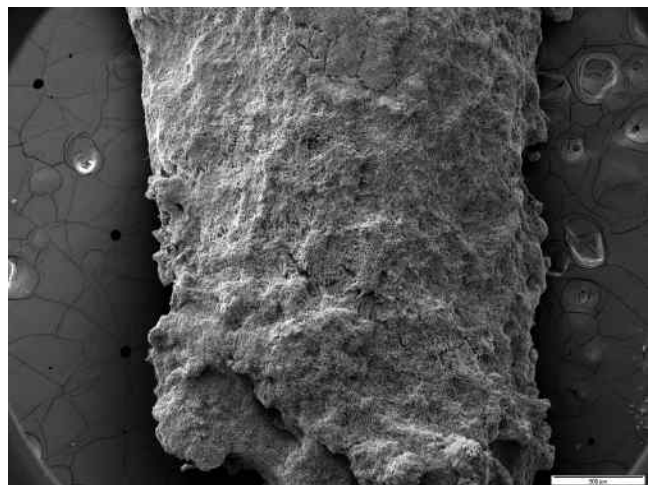
**Figure 47-15** Tip with soft tapered bristles. (Courtesy Water Pik, Inc., Fort Collins, CO.)



**Figure 47-16** The Pik Pocket tip is gently placed slightly subgingivally. (Courtesy Water Pik, Inc., Fort Collins, CO.)



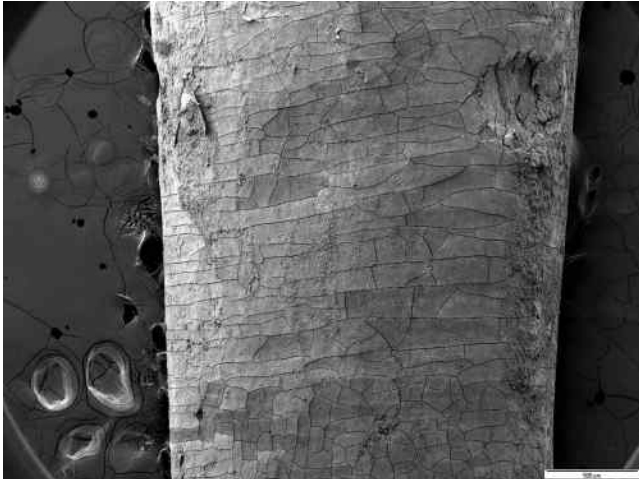
**Figure 47-17** The use of the Pik Pocket tip around an implant. (Courtesy Water Pik, Inc., Fort Collins, CO.)



**Figure 47-18** Control tooth with no irrigation. (Courtesy Water Pik, Inc., Fort Collins, CO.)

**TABLE 47-3** Chlorhexidine Dilutions (Based on 0.12% Concentration) Shown Effective in Clinical Trials

Concentrations	Amount of Water	Amount of Chlorhexidine
0.02% <sup>3,86</sup>	5 parts	1 part
0.04% <sup>20,50</sup>	3 parts	1 part
0.06% <sup>16,31,34,66</sup>	1 part	1 part

**Figure 47-19** Tooth after a 3-second pulsating lavage with a jet tip at medium pressure. (Courtesy Water Pik, Inc., Fort Collins, CO.)

### Individuals with Special Considerations

Some clinical trials have focused on groups with special oral or medical health needs. Both children and adults undergoing orthodontic therapy have shown significant benefits from using a dental water jet.<sup>17,77</sup> A new, small brush tip that cleans and irrigates simultaneously has been shown to remove 3.76 times more plaque than brushing and flossing with a floss threader.<sup>77</sup> For individuals with implants, a soft, site-specific subgingival tip used with 0.06% chlorhexidine improved oral health better than rinsing with 0.12% chlorhexidine<sup>31</sup> (Figure 47-19). For those with special medical considerations, home irrigation has been studied and shown safe and effective in a group of individuals with either type 1 or type 2 diabetes.<sup>1</sup>

### Conclusion

Power scalers have emerged from adjuncts for removing heavy supragingival calculus to a tool that may be used for all aspects of scaling: deplaquing, supragingival scaling, and subgingival scaling. The clinical outcomes achieved are similar to those for hand instrumentation. The advantages gained from using power instruments are potentially greater access subgingivally and in furcation areas and increased efficiency in time needed for scaling.

Home irrigation is safe and effective for a wide variety of patients, including those in periodontal maintenance; those with calculus buildup, gingivitis, orthodontic appliances, maxillary fixation, crown and bridge, implants, and diabetes; and those who are noncompliant with floss. Clinical outcomes include the reduction of plaque, calculus, gingivitis, bleeding on probing, probing depth, periodontal pathogens, and inflammatory mediators.

### Suggested Readings

- Arabaci T, Cicek Y, Canakci CF: Sonic and ultrasonic scalers in periodontal treatment: a review. *Int J Dent Hygiene* 5:2, 2007.
- Ciancio SG: The dental water jet: a product ahead of its time. *Compend Contin Educ Dent* 30(special 1):7, 2009.
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### References



References for this chapter are found on the companion website [www.expertconsult.com](http://www.expertconsult.com).