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CASE SERIES

Microscope-controlled glass bead blasting: a new technique

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Objective: The aim of periodontal therapy is the healing of periodontal inflammation; the protection of the attachment and the alveolar bone; and the regeneration of the periodontal structures. In the therapy of periodontitis, supra- and subgingival scaling and root planing plays a main role. The procedure described combines perfect root cleaning without scaling and root planing and minimal invasive periodontal surgery without a scalpel.

Material and methods: Glass beads of 90 µm were used with the kinetic preparation unit PrepStart® under a pressure of 0.5–5 bar. This technique was practised only under visual control using the OPMI® PRO Magis microscope. Seven examinations were carried out at baseline after 3, 6, 12, 18, 24, and 36 months.

Results: Time shows a statistically significant influence on all of the considered target variables ($P < 0.0001$ for all). As the according estimate is negative, probing depth decreases over time. The major decrease seems to be during the first 6 months. Considering probing depth, plaque on the main effect root shows significant influence (again, $P < 0.0001$ for all). Observations with high probing depth at the beginning were faster than those with low probing depth. The same characteristic appears by attachment level. Patients with more loss of attachment show more gain.

Conclusions: Using microscope-controlled glass bead blasting results in a perfectly clean root surface using visual control (magnification 20×). Microscope-controlled glass bead blasting is therefore a good alternative to periodontal surgery.

Keywords: periodontal therapy, microscope, periodontitis

Introduction

Using a microscope in dental therapy is not new. In combination with glass bead blasting, very good results are shown in periodontology. The advantage is that this microinvasive procedure cleans root surfaces without damaging them. Microsurgical treatment is possible without incisions or flap surgery, because it is done directly within the inflamed pocket. So the patient benefits from excellent results, and the approach is nearly painless with nearly no postoperative problems.

The treatment starts with an initial examination of the patient.[3–5] After diagnosis, the general treatment options are discussed with the patient and the dental hygienist can start by cleaning the root surfaces. The dental hygienist removes biofilm and supra-and subgingival calculus with ultrasonic instruments (no scaling and root planing) and polishes all tooth surfaces. It is absolutely impossible to see all the roughness and deposits in the crevices without the microscope, not to mention to remove them.

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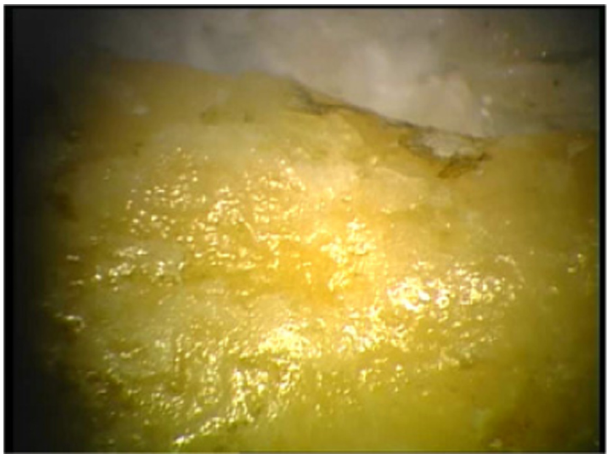

Figure 1 High-pressure glass bead blasting cleans root surfaces under direct undisturbed view, irrespective of the anatomy, without causing any visible damage (magnification ×20).

Figure 2 OPMI® PRO Magis microscope (Zeiss).

Figure 3 PrepStart® unit (Danville Engineering).

The dentist begins his or her work immediately because visual access to the pocket is needed and, after a few days, healing and shrinkage would not allow the dentist to work under visual control. A microscope is used with a magnification ×15–20. The air jet opens the pocket, and the irregular root surface can be cleaned under visual control with the glass bead blasting unit. As there is always the risk of air emphysema, compression of the tissue is needed, especially around molars. If bulky deposits are visible at a microscope magnification ×15–20, they can also be removed by ultrasound. Then the biofilm and all discoloration are removed and all root surfaces are cleaned with glass bead blasting without any injuries to the other structures. If needed, materials such as Emdogain® (Straumann, Basel, Switzerland) or Bio-Oss® (Geistlich, Wolhusen, Switzerland) can be used to fill infrabony pockets.[10–19] As direct vision is not always possible, there are different mirrors to provide indirect vision.

All pockets are cleaned in 1–2 days to reduce the bacterial load. Glass bead blasting serves to remove all deposits, clean surfaces without visibly injuring them, debride inflamed junctional epithelium, and eliminate intrapocket bacteria.[20]

The benefits compared with traditional periodontal treatment are that this procedure is minimally invasive, it allows controlled manipulation under direct vision, it involves no incisions or flaps, it is almost painless, sutures are not necessary after compression, there is no swelling or bleeding, and there are minimal aftercare measures.

The disadvantage of using this procedure is that all manipulations must be done under the microscope to ensure continual visual control.

Material and methods

The procedure began with periodontal status and was followed by a conservative and surgical pocket treatment with microscope-controlled glass bead blasting. Patients were revaluated after 3 or 6 months. If re-evaluation showed pockets deeper than 3 mm, the procedure was repeated. The author used 90 μ glass beads with the kinetic preparation unit PrepStart® (Danville Engineering, Danville, CA, USA) under a pressure of 0.5–5 bar and practised this technique only under visual control using his preferred microscope OPMI® PRO Magis by Zeiss (Germany).[22]

Protecting the soft tissue from air insufflations is important. Only very sensitive patients need anesthetic for the procedure, because the structures are possibly numbed by the air jet.

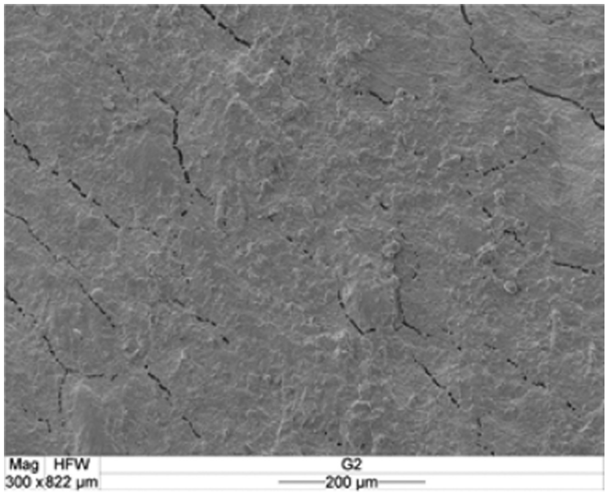

Figure 4 Half-tooth, untreated.

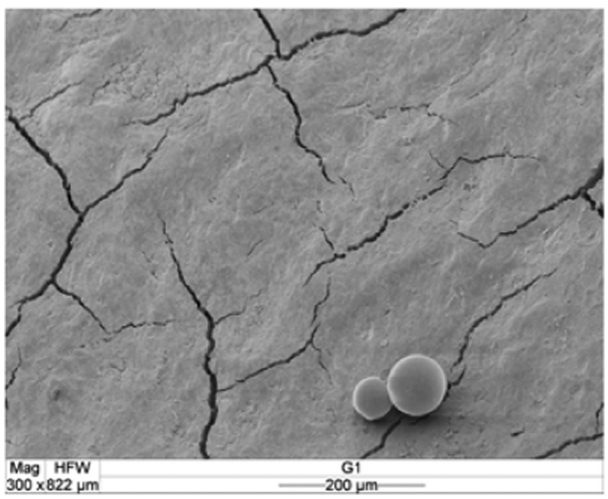

Figure 5 Same half-tooth, blasted with 5 bar for 20 seconds.

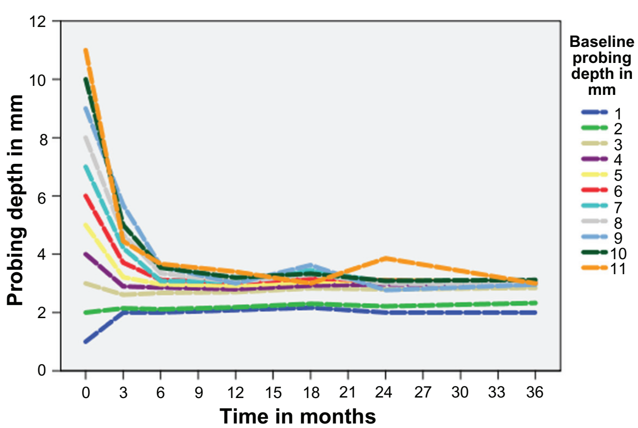

Figure 6 Observations with high probing depth at the beginning decreases very quickly, whereas observations with low probing depths at the beginning stay similar over the whole time period. After 6 months, all probing depths level off to values between 2 and 4.

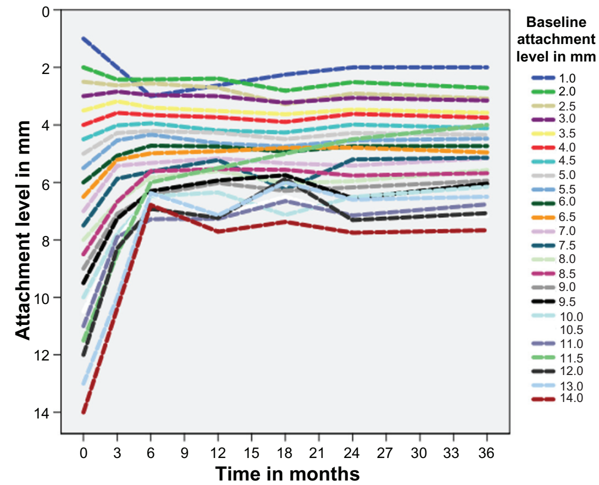

Figure 7 Related characteristics appear for attachment level. The only difference is that the variation between the different attachments levels is higer. After 6 month, all values stay between attachment 1evels of 2 mm and 8 mm. Then, no big changes over time can be seen.

Seven examinations were carried out at baseline after 3, 6, 12, 18, 24, and 36 months. Not all patients were regarded at each time point, so the sample size may have differed.

Observations with high probing depth at the beginning were faster than those with low probing depth. The same characteristics appeared by attachment level; patients with more loss of attachment showed more gain.

The ethical guidelines of the World Health Organization, the Declaration of Helsinki, and the Austrian Law of Dentists were followed.

Statistical analysis

Descriptive statistics (mean, median, standard deviation, minimum, maximum, and frequencies) for all collected variables at baseline and after 36 months are presented. The influence of the teeth roots on the target variables (probing depth, attachment level, bleeding on probing, plaque, Emdogain, Bio-Oss, periodontal tunnel flap surgery, OP, and GV over time) were determined using generalized linear mixed models with the fix factors root and time, and random factors patients and teeth nested in root, and localizations as repeated measures were calculated. Additionally, pair-wise comparisons of the different roots were performed. Plots over time were drawn. Analysis was performed using SAS 9.1 (SAS Institute Inc., Cary, NC, USA). All P-values <0.00625 were considered statistically significant. The critical boundary of 0.00625 results from the correction for multiplicity according to Bonferroni, due to the number of tests (eights tests were performed, $0.05/8 = 0.00625$).

Table 1 Attachment level and probing depth at baseline and 36 months

Variable	n	Mean	Median	SD	Minimum	Maximum	Missing
CPD_0	4406	3.65	3.00	1.61	1.00	11.00	64
AL_0	4374	4.79	4.00	2.24	1.00	14.00	96
CPD_36	3871	2.81	3.00	0.55	1.00	7.00	599
AL_36	3839	4.10	4.00	1.33	2.00	9.00	631

Abbreviations:

Results

Twenty-four patients participated in the study; in each patient, one to 32 teeth were treated with glass beads. Changes to the probing depth and the attachment level for all patients were with glass beads. All in all, 4470 measuring points on 500 teeth were observed. There were 290 front teeth and single-rooted premolars, and 61 double-rooted premolars and molars. Patients were observed over a time period of 36 months. There was one dropout after 12 months. Additionally, four teeth were extracted in other patients. Not all observed teeth of a patient and not all observed localizations of a tooth were measured at each time point. Further descriptive results are given in Table 1 and Table 2.

Time shows a statistically significant influence on all of the considered target variables ($P < 0.0001$ for all). As the according estimate is negative, probing depth decreases over time. The major decrease seems to be during the first 6 months.

Considering probing depth, plaque on the main effect root shows significant influence (again, $P < 0.0001$ for all). Those pair-wise comparisons that show significant results all have negative estimates. Therefore, single-rooted premolars and premolars have significantly lower probing depth and less plaque than molars. Additionally, double-rooted premolars have significantly lower probing depth and less plaque than molars. All other pair-wise comparisons in these variables showed no significant results.

Attachment level, bleeding on probing, OP, Emdogain, and Bio-Oss showed no significant influence ($P = 0.3$ attachment level, $P = 0.4$ bleeding on probing, $P = 0.5$ OP, $P = 0.1$ Emdogain, $P = 0.2$ Bio-Oss). Detailed results can be seen in Table 3.

Table 2 Description of the variables at baseline and 36 months

Baseline	BOP	Plaque	OP	GV	EM	BIO
0	2982	3356	4347	4252	3939	4382
1	1424	1050	59	154	467	24
Missing	64	64	64	64	64	64
36 months	**BOP**	**Plaque**	**OP**	**GV**	**EMD**	**BIO**
0	3832	3816	3871	3867	3794	3871
1	39	55	0	4	77	0
Missing	599	599	599	599	599	599

Abbreviations: BIO, Bio-Oss; BOP, bleeding on probing; EMD, Emdogain; GV, ((Author to define)); OP, ((Author to define)).

Discussion

The results show an overall significant reduction of periodontal probing depth from 3.65 mm to 2.81 mm 3 years after microscope-controlled glass bead blasting and a gain of 0.7 mm in clinical attachment level. Bleeding on probing and the plaque score were reduced from 29.5% to 0.85% and from 21.9% to 1.2%, respectively, after 3 years. Most of the improvements in periodontal probing depth and clinical attachment level were seen in the first 6 months after treatment and were followed by stable periodontal conditions thereafter. This indicates that therapy with glass bead blasting is successful and leads to stable clinical results over a time span of 3 years.

All teeth showed improved clinical parameters; however, single-rooted teeth responded significantly better to treatment than did multirooted teeth. This is consistent with the existing periodontal literature[27,28] in which single-rooted teeth showed better treatment results.

Working with the microscope has shown that untreated pockets of chronic periodontitis with a depth of more than 3 mm are always associated with hard deposits.[23–26]

Manual scalers and curettes should be used very carefully because they harm the root surfaces. Extracted teeth scalers shape the root rather than clean it.[24] Ultrasonic scalers do less harm to the root surfaces, but perfect cleaning is not possible, as they glide over crevices.[24–26]

So the idea is to treat root surfaces with the glass blasting unit by Danville Engineering at varying pressures (0.5–5 bar) under direct vision controlled by a microscope ×15–20. Surface scanning electron microscopy in general showed that all root surfaces were smooth. Pressure of 0.5–5 bar and longer exposure produced even smoother root surfaces and did not injure or harm the teeth.[22]

Inflammatory lesions caused by air insufflations were not seen. Caution should, however, still be exercised when performing this method.

Table 3 Comparison of different root groups (root 1: single-rooted teeth, root 2: premolars, root 3: molars)

	Variable	Groups	Estimate	SE	df	t-value	*P*-value
Probing depth	Intercept		3.4163	0.07552	23	45.24	<0.0001
	Root	**1 vs 3**	−0.3787	0.05336	37	−7.10	**<0.0001**
	Root	**2 vs 3**	−0.2294	0.06955	37	−3.30	**0.0022**
	Root	**1 vs 2**	−0.1493	0.06441	37	−2.32	0.0261
	Time		−0.01606	0.000527	19E3	−30.44	**<0.0001**
Attachment level	Intercept		4.4736	0.2256	23	19.83	<0.0001
	Root	**1 vs 3**	−0.1745	0.1536	37	−1.14	0.2633
	Root	**2 vs 3**	−0.2910	0.1939	37	−1.50	0.1420
	Root	**1 vs 2**	0.1165	0.1783	37	0.65	0.5176
	Time		−0.01297	0.000721	18E3	−17.99	<0.0001
BOP	Intercept		−1.6731	0.3215	23	−5.20	**<0.0001**
	Root	**1 vs 3**	−0.1813	0.1586	38	−1.14	0.2600
	Root	**2 vs 3**	0.04574	0.2377	38	0.19	0.8484
	Root	**1 vs 2**	−0.2271	0.2238	38	−1.01	0.3168
	Time		−0.1891	0.01561	19E3	−12.11	**<0.0001**
Plaque	Intercept		−1.9895	0.4341	23	−4.58	0.0001
	Root	**1 vs 3**	−0.6831	0.1400	37	−4.88	**<0.0001**
	Root	**2 vs 3**	−1.0702	0.2256	37	−4.74	**<0.0001**
	Root	**1 vs 2**	0.3871	0.2156	37	1.80	0.0808
	Time		−0.1120	0.006357	19E3	−17.62	**<0.0001**
OP	Intercept		−9.5664	1.3492	24	−7.09	<0.0001
	Root	**1 vs 3**	−1.3844	1.2230	39	−1.13	0.2647
	Root	**2 vs 3**	−1.3199	1.7270	39	−0.76	0.4494
	Root	**1 vs 2**	−0.06451	1.6454	39	−0.04	0.9689
	Time		−0.2918	0.01532	19E3	−19.05	**<0.0001**
GV	Intercept		−3.2549	0.3771	23	−8.63	<0.0001
	Root	**1 vs 3**	−1.9039	0.3614	37	−5.27	**<0.0001**
	Root	**2 vs 3**	−0.5104	0.4892	37	−1.04	0.3035
	Root	**1 vs 2**	−1.3934	0.5194	37	−2.68	0.0109
	Time		−0.1562	0.02402	19E3	−6.50	**<0.0001**
EMD	Intercept		−3.7853	0.5181	23	−7.31	<0.0001
	Root	**1 vs 3**	−0.7301	0.3340	37	−2.19	0.0352
	Root	**2 vs 3**	−0.5101	0.4378	37	−1.17	0.2513
	Root	**1 vs 2**	−0.2200	0.4124	37	−0.53	0.5970
	Time		−0.06140	0.003479	19E3	−17.65	**<0.0001**
BIO	Intercept		−6.2930	0.7496	23	−8.39	<0.0001
	Root	**1 vs 3**	−1.0743	0.5728	37	−1.88	0.0684
	Root	**2 vs 3**	−0.9089	0.8856	37	−1.03	0.3112
	Root	**1 vs 2**	−0.1654	0.8546	37	−0.19	0.8476
	Time		−0.09904	0.01257	19E3	−7.88	**<0.0001**

Abbreviations: BIO, Bio-Oss; BOP, bleeding on probing; EMD, Emdogain; GV, ((Author to define)); OP, ((Author to define)).

Table 4 Probing depth at baseline and 3, 6, 12, 18, 24, and 36 months

	CPD0	CPD3	CPD6	CPD12	CPD18	CPD24	CPD36
Min.	1	1	1	1	2	1	1
Median	3	3	3	3	3	3	3
Mean	3.652	2.964	2.721	2.783	2.781	2.821	2.813
Max.	11	8	8	7	7	7	7
NAs	423	3258	2028	2782	3257	2413	951
SD	1.61	1.03	0.67	0.61	0.58	0.67	0.55

Table 5 Attachment level at baseline and 3, 6, 12, 18, 24 and 36 months

	AL0	AL3	AL6	AL12	AL18	AL24	AL36
Min.	1	2	1	1	1	1	2
Median	4	4	4	4	4	4	4
Mean	4.783	4.393	4.166	4.45	4.095	4.176	4.095
Max.	14	12	12	10	10.5	10	9
NAs	447	3398	2060	2792	3284	2429	989
SD	2.24	1.98	1.51	1.53	1.27	1.52	1.33

Table 6 Bleeding on probing, plaque score, EMD, and BIO at baseline and 3, 6, 12, 18, 24, and 36 months

	BOP0	Plaque0	OP0	GV0	EMD0	BIO0
0	3252	3620	4616	4519	4208	4652
%	67.33%	74.95%	95.57%	93.56%	87.12%	96.31%
1	1424	1056	60	156	469	24
%	29.48%	21.86%	1.24%	3.23%	9.71%	0.50%
NAs	154	154	154	155	153	154
%	3.19%	3.19%	3.19%	3.21%	3.17%	3.19%
	BOP3	**Plaque3**	**OP3**	**GV3**	**EMD3**	**BIO3**
0	1704	1708	1958	1960	1896	1930
%	35.28%	35.36%	40.54%	40.58%	39.25%	39.96%
1	18	14	38	36	100	66
%	0.37%	0.29%	0.79%	0.75%	2.07%	1.37%
NAs	3108	3108	2834	2834	2834	2834
%	64.35%	64.35%	58.67%	58.67%	58.67%	58.67%
	BOP6	**Plaque6**	**OP6**	**GV6**	**EMD6**	**BIO6**
0	2912	2799	2928	2913	2930	2913
%	60.29%	57.95%	60.62%	60.31%	60.66%	60.31%
1	18	131	10	25	8	25
%	0.37%	2.71%	0.21%	0.52%	0.17%	0.52%
NAs	1900	1900	1892	1892	1892	1892
%	39.34%	39.34%	39.17%	39.17%	39.17%	39.17%
	BOP12	**Plaque12**	**OP12**	**GV12**	**EMD12**	**BIO12**
0	2270	2185	2694	2682	2652	2692
%	47.00%	45.24%	55.78%	55.53%	54.91%	55.73%
1	75	160	0	12	46	2
%	1.55%	3.31%	0.00%	0.25%	0.95%	0.04%
NAs	2485	2485	2136	2136	2132	2136
%	51.45%	51.45%	44.22%	44.22%	44.14%	44.22%
	BOP18	**Plaque18**	**OP18**	**GV18**	**EMD18**	**BIO18**
0	2065	2058	2014	2010	1989	2014
%	42.75%	42.61%	41.70%	41.61%	41.18%	41.70%
1	11	18	0	4	25	0
%	0.23%	0.37%	0.00%	0.08%	0.52%	0.00%
NAs	2754	2754	2816	2816	2816	2816
%	57.02%	57.02%	58.30%	58.30%	58.30%	58.30%
	BOP24	**Plaque24**	**OP24**	**GV24**	**EMD24**	**BIO24**
0	2637	2622	2742	2742	2591	2734
%	54.60%	54.29%	56.77%	56.77%	53.64%	56.60%
1	69	84	0	0	151	8
%	1.43%	1.74%	0.00%	0.00%	3.13%	0.17%
NAs	2124	2124	2088	2088	2088	2088
%	43.98%	43.98%	43.23%	43.23%	43.23%	43.23%
	BOP36	**Plaque36**	**OP36**	**GV36**	**EMD36**	**BIO36**
0	4346	4327	4546	4542	4465	4546
%	89.98%	89.59%	94.12%	94.04%	92.44%	94.12%

(*Continued*)

Table 6 (*Continued*)

	BOP36	Plaque36	OP36	GV36	EMD36	BIO36
1	41	60	0	4	81	0
%	0.85%	1.24%	0.00%	0.08%	1.68%	0.00%
NAs	443	443	284	284	284	284
%	9.17%	9.17%	5.88%	5.88%	5.88%	5.88%

Abbreviations: BIO, Bio-Oss; BOP, bleeding on probing; EMD, Emdogain; GV, ((Author to define)); OP, ((Author to define)).

Microscope-controlled glass bead blasting removes biofilm, deposits, and granulation tissue and creates optimal conditions for tissue regeneration. The treatment of incisors, canines, and premolars carries a very good prognosis, because these teeth are single or double rooted and easily accessible.

The prognosis for molars is equally good for the external and internal facets of molar roots. Furcation has mostly defied treatment in the past, as cleaning the teeth was not visually controllable and was largely left to chance. But direct visual control has its limitations. When furcations fold inward into the dome, the height of the gingival cuff usually impairs or altogether prevents direct vision, even when using glass beads. This factor limits the applicability of the procedure. In this case, one incision tunnel flap surgery was done.

With microscope-controlled glass bead blasting, the distal molar facets, which have so far escaped visual control during conservative therapy, have become amenable to perfect cleaning supra- and subgingival. Visual control is, however, bound to be indirect and places major demands on the skills of the dental assistants. Buccal, palatal, and mesial facets, by contrast, can usually be seen easily.

The air jet of the unit bombards the tooth surfaces with glass beads and blows these into the sulcus. Whether or not some glass beads may stay in the sulcus is not clear. This is still an unresolved question.

The author has successfully used this procedure, which has revolutionized paradigms of periodontal treatment.

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Disclosure

The authors report no conflicts of interest in this work.

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