



# THE ORTHODONTIC MATERIALS INSIDER



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A quarterly dedicated to orthodontic professionals, and to the renewal of their habits and tools by ORTHO-CYCLE, A COMPANY THROUGH WHICH YOU CAN RECONDITION, BUY AND SELL ORTHODONTIC APPLIANCES.

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## Accelerated aging, a dream?

In contrast with orthodontics, industry uses a standard that provides an acceptable assessment of a material's deterioration over time at different temperatures. The generalized use of this standard in orthodontics would allow not only comparing the results of related research but also accurately predicting the behavior and useful life of orthodontic armamentaria.

An exhaustive search in March 2008 for articles published in both the *American Journal of Orthodontics and Dentofacial Orthopedics (AJODO)* and the *Angle Orthodontist (AO)* for the word *aging* revealed, for the first publication, 147 responses with 6 having it in the title, while in the second, 132 and 3. For the words *accelerated* and *aging* in the title, there were 16 and 14, respectively. While in the second journal there was a title including both words (*accelerated* and *aging*) in the first there was none. In dental journals, this syntagm is found quite often. In contrast, the word *aging* in article titles of English-language medical periodicals as found in MedLine was found to be 20,787, and having both words, 2,782.

The above demonstrates a hiatus between orthodontics and other medical specialties and a real chasm when compared with industry. While ceramics are hardly affected, metals and polymers—as well as their combination and additives—can be severely altered in the biological environment of the mouth, which is surprisingly harsh. This can lead to rapid or gradual breakdown of many materials. Ignoring abrasion, flexure, exposure to continuous or cyclic stress, and biologic mechanisms (evolved over millennia specifically to rid the living organism of invading foreign substances), orthodontic materials should be tested for resistance to water for 2 years at 37°C. As these conditions are difficult to meet, researchers are substituting them with ones that seem selected at random.

Taking as an example the aging of bond strength, the exposures described in recent articles in the *AJODO* and *AO* vary from 1 day at 37°C (room temperature)<sup>1-3</sup> to 1 day at 37°C and 25 days at room temperature,<sup>4</sup> to 1 week and 1 month at 35°C,<sup>5</sup> to 2 weeks at temperatures from 5°C to 55°C,<sup>6</sup> to 1

month at room temperature<sup>7</sup> to 2 months at 37°C,<sup>8</sup> and for 1, 15, 30, and 100 days at room temperature.<sup>9</sup> Even the media in which the samples were immersed varied from fresh water<sup>5,6,9</sup> to deionized<sup>3</sup> water to saline<sup>8</sup> to absolute ethanol.<sup>10</sup>

With the exception of the last article which tries a *sui generis* aging environment, none of them comes even close to the normal exposure of the orthodontic systems or products, nor even tries to simulate it through accelerated aging.

In contrast, industry uses the standard (see below) of the American Society for Testing and Materials (now ASTM International), which was initially developed to estimate the accelerated aging time needed for medical devices,<sup>11</sup> that is, materials, sterile barrier systems, and packaging systems as defined by the American National Standards Institute (ANSI).<sup>12</sup> While specific dental and orthodontic materials are not addressed<sup>13</sup> (as in many other instances), they can be properly tested using this method.

### Theoretical Basis

In 1903, Svante Arrhenius won the Nobel Prize in Chemistry by demonstrating that the speed of a reaction is proportional to the concentration of the reagents and to a rate constant that is exponentially related to temperature. The standard states that an increase in temperature will shorten the normal accelerated aging time ( $T_A$ ) by dividing its value by an accelerated aging factor (AAF):

$$AAF = Q_{10}^{\frac{T_A - T_M}{10}} \quad (1)$$

In the later,  $Q_{10}$  is the rate of the chemical reactions involved in aging for a 10°C increase in temperature,  $T_A$  is the accelerated aging temperature, and  $T_M$  the room (or mouth) temperature.  $Q_{10}$  varies between 1.8 and 3, its conservative value being 2 (the higher its value, the longer the exposure time, Fig 1).

As an example, a polymer exposed for 3.7 weeks to 60°C will age as much as if stored at room temperature for 42.2 weeks. In other words, in less than a month it will age as

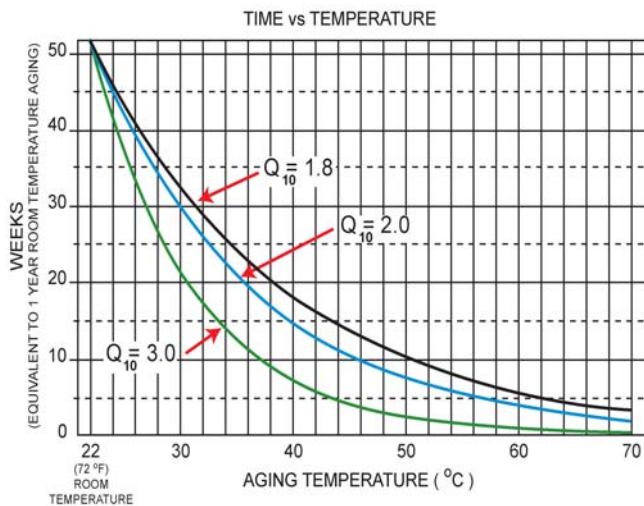


Fig. 1. Aging as a function of time and temperature

much as in 10 months. A simplified version of this equation, known as the “10-degree rule,” states that a 10°C increase (or decrease) in temperature results in doubling (or halving) the rate of a chemical reaction”.<sup>11</sup>

If the body temperature is 37°C, the elevated temperature to which the sample will be tested for aging is 100°C. Substituting these values in the equation leads to the following value of the exponent (power) to which  $Q_{10}$  is raised:

$$\frac{[T_A - T_M]}{10} \longrightarrow \frac{[100 - 37]}{10} = 6.3 \quad (2)$$

Taking for  $Q_{10}$  the conservative value of 2, the AAF becomes:

$$AAF = 2^{6.3} = 79 \quad (3)$$

To measure the effect of raising the temperature from 37°C to 100°C of a system subjected for 2 years of orthodontic treatment (730 days), the AAT must be corrected with the factor AAF. This leads to  $730/79 = 9.2$  days.

A similar result can be obtained by applying the 10-degree rule, as shown in Table 1 (for each 10°C increase, the aging time halves). In other words, a 2-year exposure in the mouth is equivalent to 10 days in water at 100°C.

Table 1

TEMP (°C)	40	50	60	70	80	90	100
TIME (days)	730	365	182	91	45	22	11

### Conclusions

Arbitrary aging methods or the absence of accelerated aging cannot provide proper information about the materials or systems during orthodontic treatment. A good ex-

ample is the wide variation in the conditions used to simulate decreases in bond strength. Understandably, this situation has prompted the questioning of related protocols.<sup>14</sup>

The studies mentioned avoid or ignore the standard mentioned which is widely accepted in industry and having as a specific target the medical devices’ “loss in integrity that may occur as a result of physical properties of the materials and adhesive or cohesive bonds degrading over time.”<sup>11</sup>

Its application in orthodontics would amount to an exposure of its attachments or systems to 10 days in water at 100°C.

### References

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## Interested in an accelerated aging of your attachment or system?

Ortho-Cycle has the means and the willingness to apply the Standard’s protocols to your attachment/system.

An illustrative example is described in the following article. Contact us, describing the object of your research and the conditions desired (water or water-based solutions, etc.). If feasible, we will be glad to help!

## Sometimes, dreams can come true...

Every clinician expects that the attachments or systems he or she uses during treatment will work as planned; unfortunately, there are all too often unpleasant surprises.

The present research was initiated by the need to investigate if the good bond strength offered by cyanoacrylates<sup>1-3</sup> is not offset by their poor resistance to water. To be acceptable as orthodontic adhesives, these materials must stand for some two years in the oral environment. As this condition is difficult to meet in vitro, accelerated aging was the preferred choice.

Keeping samples in water in a small container for a longer period is difficult even at room temperature. Subjecting them to water at 100°C for 10 days, as shown in the preceding article, requires either the continuous addition of water to the container (a Clifton bath) or the use of additional pressure. The latter can be achieved with the help of a common pressure cooker. Most pressure cookers sold in the United States have an internal pressure setting of about 15 psi (1 bar) over atmospheric pressure. At this pressure (relative to sea-level atmospheric pressure), water boils at 125°C.

Respecting the conditions imposed by the standard<sup>2</sup> discussed in the preceding article (i.e., keeping the samples for weeks under pressure at 100°C) poses problems. Maintaining continuously the container in these conditions in a prolonged absence of supervision may yield faulty experiments or even a fire. Using common kitchen and lab devices, the test can be properly performed.

### Material and methods

Fifty “mini” upper central incisor brackets (Straight Edge, 100 mesh, TP International, Laporte, IN) were bonded to 4 × 4-in ceramic tiles (Home Depot) either as such (glazed) or after treatment for 10 min with 50% hydrofluoric acid. To fit in the cooker, the tiles had their corners clipped.

The adhesives used were SmartBond (Gestenco International, Gothenburg, Sweden; sold by Dentaaurum, Newtown, PA) and the visible light-curable, fluoride-added, single-paste LightBond (Reliance, Itasca, IL). The primers used for the latter were the commercial form of 2-ethyl ( $\alpha$ ) cyanoacrylate (sold as



Fig. 1. Bench bond-strength tester. A controlled, increasing weight (stainless steel balls) pulls a wire attached to bonded brackets' tie-wings: 1. Sample tested., 2. System of pulleys transmitting the force.; 4, 5. Sand-timer system., 6. Scale.



Fig. 2. Pressure cooker with brackets bonded on ceramic tiles

Krazy Glue [KG], Toagosei, Tokyo, and the photo-curable sealant LightBond, (also Reliance).

The brackets were bonded on etched, wet tiles either with the adhesives as such, or over a layer of uncured sealant over a freshly brushed (up to 30 min), thin layer of KG. As sealant/protective layers for the  $\alpha$ -cyanoacrylate, we also tried both the di- and triethylene glycol dimethacrylates (Sartomer Co, Exton, PA), as well as bis GMA (PolySciences, Warrington, PA). Their solubility in water is listed by their manufacturers as “negligible”; indeed, our test had shown that 1 volume of either one in 2,500 volumes of water at room temperature leads to dispersion and not to solution.

The method used was described earlier,<sup>1-3</sup> with the difference that the 10 days' aging was replaced by an accelerated aging according to the standard. Instead of a universal testing machine, a simplified bench bond tester was used. Actually a scale allowing a controlled, discrete addition of weight (Fig 1), it uses stainless steel balls and lead weights. As in previous studies, the force was measured in grams (1kg = 9.8 N). To measure the brackets' tension bond strength, they were attached under their tie-wings by a loop of the tester's wire. To enable the balls to flow evenly, a sand-timer arrangement was used: as soon as the tested bracket detached, the direction of the ball flow was manually changed and the weights of the container and the balls were measured separately.

The ceramic tiles with bonded brackets were immersed in water in a 4-qt aluminum pressure cooker (Presto, Hillsville, VA; Fig 2). Once sealed, the container was placed in a Lindberg/Blue M oil bath (Daigger & Co, Vernon Hills, IL) as shown in Figure 3. Paraffin oil was used as heat transfer fluid. Such oil baths can maintain operating temperatures up to 260°C.



Fig. 3. Pressure cooker in the oil bath



Fig. 4. Insulated oil bath containing pressure cooker  
1. Regulator on the cooker's lid controlling steam escape.  
2. Mercury thermometer. 3 Thermoregulator. 4. Plastic tank.

To reduce chances of malfunctioning or fire (over-heating), the bath's own temperature control was augmented with the Dyna-Sense system (Cole-Parmer, Vernon Hills, IL), which comprises a mercury thermo-regulator connected to a variable-output controller that can cut the bath's power supply. As an extra measure, the tester was placed outdoors and protected against rain by a large, reversed plastic tank (Fig 4).

#### Preliminary Results

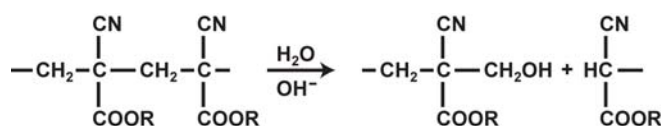
The accelerated aging tests that follow are a repeat of those presented earlier, both in this publication<sup>1</sup>, web site<sup>2</sup> and as a poster at an AAO annual meeting.<sup>3</sup> The tension bond strength of the system brackets/adhesive(LightBond)/KG on wet glazed tiles confirmed the previous data showing before exposure a tension bond strength of around 4 kg (3,840g;  $\Delta\pm 320$ g).

After the accelerated aging, their bond strength actually increased slightly (3,870g,  $\Delta\pm 240$ g), probably due to an improved cross-linking/cure of the polymer. The brackets bonded with SmartBond to wet glazed tiles debonded without stress after an exposure of 10 days at 100°C. Interestingly, both the LightBond photo-curable sealant and adhesive, as well as bis GMA, gel in the presence of liquid KG. In contrast, di- and triethylene glycol dimethacrylate can be temporarily compounded with KG, leading to tensile bond strengths up to 4 kg (40N).

#### Discussion

While cyanoacrylates are known for exceptional bond strength even on smooth surfaces, poly (cyanoacrylates) are unique in having their C-C bond cleaved by hydrolysis<sup>5</sup>; this occurs because the methylene hydrogen in the polymer is highly activated inductively by the electron-withdrawing neighboring groups.

This reaction is catalyzed by water itself and accel-



erated by enzymes; in animal implants, poly (methyl cyanoacrylate) is extensively degraded within 4 to 6 months.<sup>6</sup> This explains why brackets bonded with SmartBond (Gestenco International, which contain 89% to 90% 2-ethyl cyanomethacrylate, 9% to 10% poly (methyl methacrylate), 5% to 10% silica, and 0.1% to 0.5% hydroquinone<sup>7</sup> failed after a few months' exposure.<sup>8-10</sup> Consequently, cyanoacrylates were considered as being "unsuitable for use as a bonding agent in routine orthodontic practice."<sup>10</sup>

The above-quoted research and the present one demonstrate the importance of accelerated aging. In its absence, other authors have concluded that "the adhesive has the potential to be successfully used in the bonding of orthodontic brackets."<sup>11</sup>

If a cyanoacrylate primer is protected against the oral environment by coating or copolymerizing by a supernatant layer of sealant, adhesive, or a compatible monomer (such as di- or triethylene glycol dimethacrylate), it can retain its otherwise remarkable bonding strength even on a less retentive surface (e.g., glazed ceramic tile).

#### Conclusions

Accelerated aging according to a widely accepted standard can be successfully used to compare the bond strength of adhesives and perhaps many other orthodontic systems.

Cyanoacrylates used as adhesives lose in time their bonding strength; as primers, they show a strong affinity vs. substrates such as glazed ceramics (and probably tooth enamel). If protected against hydrolysis by a layer of hydrophobic monomers, as such or in a sealant or adhesive, they can withstand an exposure of 10 days at 100°C as inferred by the already mentioned standard, i.e. with a high probability of enduring the whole orthodontic treatment.

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## Is it “disgusting” to recycle? Few quotes...

☹️ “Recycling: A disgusting procedure where an orthodontist takes bands, brackets, wires, etc., out of one patient’s mouth and “recycles” them to another patient’s mouth” [www.surgicalservicesinternational.com]. **How about your pliers, cutters, scalers, and pushers?**

☹️ “We are a planet of limited resources and we need to figure out a way to keep things reusable and good for the environment. It won’t happen in our lifetimes, but if we followed his advice, generations down the line will be cursing us for not doing anything to help them keep the planet sustainable” [Hillary Rodham Clinton: Personal Responsibility!? FORA.tv, 12-18-2007]. **Will we be immersed in our own garbage? Talk about “disgusting”!**

😊 “He (CGM) also developed a practical recycling process for orthodontic materials that has saved millions of dollars for practitioners and indirectly benefited patients. In the 1980s, the recycling of metallic and ceramic orthodontic biomaterials was in its infancy, and the contribution of heavy metals to environmental pollution was practically ignored. Furthermore, the concept of reusing materials that had been worn by somebody else was repugnant. Ironically, it took the AIDS epidemic to force clinicians and the public alike to pay more attention to sterilization. Indeed, the attachments that survive the rigorous recycling process are less contaminated because for the recycler to remove the adhesive successfully, the carbon-to-carbon bonds in the polymer attached to the bracket must be broken. In the process, all microorganisms are killed” [Bishara SE, U. Iowa. Celebrating twenty years of contributions to the science of orthodontic materials. (According to TM Graber, A. D. 2000, “*The most prolific scientific contributor to AJO-DO*” [Orthod Materials Insider, December 2007, 19(4):1]. **The distortion of a related study from the same university follows.**

😊 “Providing the integrity and bracket specifications of the appliance has been maintained, notwithstanding the debonding process, and physical properties of the bracket have not been altered by the recycling process and/or the sterilization process and that the appliances have been properly sterilized and packaged and the issue of informed consent has been resolved, the use of recycled orthodontic brackets may be incorporated into your orthodontic practice.” [Machen DJ. Am J Orthod Dentofacial Orthop 1993;104:618–9]. **With a lot of “ifs,” it can be done!**

😊 “An FDA finding of substantial equivalence of your device to the legally marketed devices results in the classification of your device and permits your device to proceed to the market” [Dept of Health and Human Resources, FDA to Ortho-Cycle, Nov. 27, 1991]. **No “vive la difference?”**

😊 “This country must make every effort to stem the rising tide of garbage and industrial waste through a more aggressive use of waste minimization and recycling practices.... The waste problem is not going away, and it can no longer be

neglected” [George Bush, Message to Congress, June 23, 1989]. **Every one has to do his share ...**

😊 “Currently, Ortho-Cycle has thousands of clients all over the world—primarily institutions and orthodontic doctors in the United States and Western Europe. While there can be a social stigma of using used orthodontic equipment, it is not one that affects Ortho-Cycle’s bottom line” [www.aboutus.org/OrthoCycle.com]. **Stigma discrimination? Why only discriminate against brackets and not against knives and forks?**

☹️ “Recycled brackets are not statistically different from the new ones. In NBC’s broadcast of March 9, 1998, some of the information was watered down, omitted, in some cases misrepresented” [TA Fisher. E-mail to Ortho-Cycle regarding NBC-TV’s “Dateline” of February 1998 in presentation of his thesis, “An in vitro comparative study of new and recycled orthodontic brackets,” Univ. of Iowa]. **Purpose justifies means? They couldn’t handle the truth!**

☹️ “No statistically significant differences were found between: (a) the total bond failure rate of recycled and new stainless steel brackets, (b) the upper and lower arches, and (c) the anterior and posterior segments. These findings demonstrate that recycling metallic orthodontic brackets can be of benefit to the profession, both economically and ecologically, as long as the orthodontist is aware of the various aspects of the recycling methods, and that patients are informed about the type of bracket that will be used for their treatment” [Melsen B et al, Eur J Orthod, 2004;26:449–54]. **Informed professors are our best customers. They have no ax to grind!**

☹️ “Most orthodontists have probably proceeded on the assumption that the same regulatory controls that govern original bracket manufacturers are being adhered to by reconditioning firms” [DiPasquale TJ (3M/Unitek). Reconditioning and reuse of orthodontic devices, Am J Orthod Dentofacial Orthop 1992;102:187–9]. **In our case, yes!! It would be foolishly bad business to do otherwise.**

☹️ “In conclusion, orthodontic bracket reuse is a practice driven by the desire to reduce costs, but these cost savings may well be illusory. The legal consequences of bracket reuse to the orthodontic industry are not readily quantifiable, but will no doubt be part of the ultimate cost-benefit determination if the practice continues” [DiPasquale TJ (3M/Unitek). Reconditioning and reuse of orthodontic devices. Am J Orthod Dentofacial Orthop 1992;102:285–7]. **Then, why do we still have customers after 30 years of business?**

😊 “Recycled brackets are safe and effective” [Poulton D, AAO president. AAO Bulletin, 1997–1998]. **That’s all, folks! Six words say a mouthful.**

😊 “Global Recycling Network is an electronic information exchange that specializes in the trade of recyclables reclaimed in municipal solid waste (MSW) streams, as well

as the marketing of eco-friendly products” [DiPasquale Enterprises Corp in Global Recycling Network (<http://www.grn.com>)]. **Another DiPasquale? (see above). A fight in the family?**

☹️ “Thomas J. DiPasquale, senior counsel for 3M, has raised the issue of legal liability associated with using recycled orthodontic brackets ... He concludes that the risk of malpractice claims may well offset the cost savings.... Raising the questions of medical risks and ethics is disingenuous. In plain language, it is a red herring, obfuscating the real issue ... Labeling a product ‘single use only’ does not make it so. Labeling orthodontic pliers ‘single use only’ would be a great boost of sales, but would be similarly untruthful” [Rubin RM. Letter to the Editor. *Am J Orthod Dentofacial Orthop* 1993;104:21A]. **Words were given to man to hide his thoughts...**

😊 “By June 1998, all medical devices (except custom-made devices or those used in clinical trials) will have a mark of conformity (CE) stamped on its product or labeled on its packaging by the manufacturers. This CE mark of conformity means the medical device satisfies the essential requirements for it to be fit for its intended purpose, i.e., it is safe to use” [J. Warren Jones. A medico-legal review of some current UK guidelines in orthodontics: a personal view. *J Orthod* 1999;26:307–24]. **Just CE? Besides FDA, Ortho-Cycle also has ISO and EN certifications ...**

☹️ “Cross contamination: Passing bacteria, viruses or AIDS indirectly from one patient to another through the use of improper sterilization procedures, unclean instruments, or ‘single use only’ recycling of orthodontic products ... Recycling: A disgusting procedure where an orthodontist takes bands, brackets, wires, etc., out of one patient’s mouth and ‘single use only’ recycles them to another patient’s mouth” [Masel, [www.bracesinfo.com](http://www.bracesinfo.com)]. **In short: the newer and more expensive, the better ...**

😊 The *Manchester Evening News* reports that the city wants to become Britain’s “greenest” so badly that it is looking to enforce mandatory recycling, with potential fines and criminal prosecution for violators: Recycle or face a £100 fine. Manchester residents could be forced to recycle—or face bin searches and on-the-spot fines of £100. And if people continue to flout the rules they could face criminal prosecution and fines of up to £1,000... Council chiefs are looking at introducing compulsory recycling as part of its bid to become Britain’s greenest city” [<http://earth911.org/blog/2007/10/17/recycle-or-face-100-fine>]. **In UK, fined for not recycling ...**

😊 “The hauler does not pick up trash that contains recyclables, and residents who are not recycling are fined after 3 written warnings” [Connecticut Department of Environmental Protection, Mansfield, CT [www.ct.gov/dep/cwp/view.asp?A=2714&Q=324874](http://www.ct.gov/dep/cwp/view.asp?A=2714&Q=324874)] **It also happens in the US: fined for not recycling ...**

😊 “One other passion I share with you is the idea of protecting the environment, which includes not wasting its

resources. One aspect of this commitment is recycling of the Earth’s finite resources. It has been repeatedly proven that recycling of medical devices not only makes economic sense, but it is necessary in order to preserve natural, as well as human, resources. You have been a pioneer in this field. Many have tried to discredit you for these efforts, but have clearly not succeeded. It is evident that your beliefs have prevailed over the years” [Kuftinec MM. On your 75<sup>th</sup> birthday. *Orthod Materials Insider*, March 2005;17:3]. **The future rewards vision**

😊 “Every time we go into a restaurant, we make precisely the choice to use silverware that has been in hundreds of people’s mouths, separated only by a dishwasher that meets no sterilization standards” [Levy M. Letter to the editor. *Am J Orthod Dentofacial Orthop* 1993;104:22A]. **Let’s use only plasticware!**

😊 “Recycled ceramic brackets have been found to provide shear bond strengths adequate for clinical use. Moreover, they exhibit bond failures mostly at the bracket/adhesive interface, without causing enamel damage” [Martina A et al. Recycling effects on ceramic brackets: a dimensional, weight and shear bond strength analysis. *Eur J Orthod* 1997;19:629–36]. **Ceramics are either broken or good: no in-betweens.**

😊 “The results showed no significant statistical difference between recycled brackets by aluminum oxide and control group. Recycled brackets by 90 and 50m aluminum oxide showed no significant statistical difference” [Tavares SW et al. *Braz J Oral Sci* October/December 2003;2). **Again and again!**

😊 “Neither the FDA rules, nor policy guidelines, nor other case laws specifically provide patients with the right of informed consent before the use of recycled brackets.... Even if a bracket could become detached and the patient could swallow it, this will not result in an injury to the patient” [Bowers SA *Am J Orthod Dentofac Orthop* 1993;103:194].

**AAO’s lawyers talk....**

😊 “There is no evidence that any patient has been injured as a result of wearing recycled brackets. The recycling process to which brackets are subjected involves a combination of intense cleaning and heating which effectively decontaminates and sterilizes brackets” [Alberta Dental Assoc. *Updaters*. February 1997. “Recycled orthodontic brackets”]. **We couldn’t pay them ...**

😊 “If, under strong magnification, the bracket slot appears undistorted, and the bracket base and mesh are still in good shape, I see no reason not to use them at least one more time” [Phillips HW. *JCO Interviews: Phillips on bonding*. Part 2. *J Clin Orthod* 1980;14:462–80]. **Makes sense!**

😊 “This survey shows that interested lay opinion is not totally opposed to the use of recycled brackets, but patients would expect to be told if those brackets had been recycled and they would expect any savings to be passed on to

them” [Oliver RG et al. Patient and parent opinion of the use of recycled orthodontic brackets: an international comparison. *Br J Orthod* 1997; 24:329–32]. **Fair enough!**

😊 “Improved methods for recycling of bonded brackets will cut down the costs further” [JCO Interviews: Dr. Bjorn U. Zachrisson on iatrogenic damage in orthodontic treatment. Part 2. *J Clin Orthod* 1978;12:208–20]. **Talking about our burnishing method?**

😊 “The mean gross income level of the orthodontists who recycle the most in UK is \$401–600.000 (metal) and \$201–400.000 (ceramic)” [Keim RG, Gottlieb EL, Nelson AH, Vogels DS. JCO Study of orthodontic diagnosis and treatment procedures. Part II. *J Clin Orthod* 2002;36:627–36]. **To be rich doesn’t have to be wasteful.**

😊 “Reuse of undamaged direct bonding attachments has rapidly gained support in the orthodontic profession. And now Lancer Pacific is the first full-line manufacturer to offer a professional attachment renewal service” [Lancer, Catalog 111, June 1, 1982]. **No success? Try again!**

😊 “A laser is used to surface anneal an orthodontic appliance, such as an orthodontic bracket, for identification purposes and to withstand a number of recycling processes ...” [Roman P, Lancer Orthodontics, US Patent 5,556,276, 1996]. **How thoughtful for this bracket manufacturer to enhance recycling ...**

😊 “The inventive method can, however, also be used with advantage to produce a marking which withstands all of the recycling process cycles to which an orthodontic aid can be subjected within the scope of its service life” [Rohlcke EW, Sernetz F (Dentaurum), US Patent 5,238,402 (1993)]. **Same thanks also to this manufacturer for encouraging recycling ...**

😊 “The Ortho-Cycle method did not alter the mechanical properties of the bracket ... Hardness, theoretical tensile strength and microstructure were similar to those of the control ... Company Esmadent’s process falls in the range of carbide precipitation leading to a decrease in corrosion resistance” [Buchman DJL. *Am J Orthod Dentofac Orthop* 1980;77:656] **Stainless steel is not “steel-strong”!**

😊 “What happens to your garbage after it goes into the big noisy truck that wakes you up in the middle of the night? First they crunch it (your garbage) into little pieces, and then the truck takes it to the city dump. There they burn it, bury it, or just leave it to rot. Think that’s disgusting? Well you can do something. We all can. How, you ask? Start recycling!” [<http://thinkquest.org>] **We did it: how about you?**

😊 “Recycling permits cost reduction” [Gorelick L. Bonding, the state of the art: a national survey. *J Clin Orthod* 1979;13:39–53]. **The first orthodontist’s contribution to bracket recycling ...**

😊 “Recycling produces a bracket indistinguishable from a new one” [Vlock RS. In-office bracket recondi-

tioning. *J Clin Orthod* 1981;15:635–7]. **The first orthodontist’s contribution to metal-bracket recycling ...**

😊 “In addition to metal brackets, other studies considered the reuse of ceramic attachments the recycling of which was claimed to provide substantial savings” [Lew KK, Djeng SK. Recycling ceramic brackets. *J Clin Orthod* 1990;24:44–7]. **The first orthodontist’s contribution to ceramic-bracket recycling ...**

😊 “The changes induced by recycling were dramatically less than the variability allowed in the manufacture of the new brackets” ... “The changes induced by recycling were dramatically less than the variability allowed in the manufacture of the new brackets” [Haller MW, Penn State Univ./Harrisburg, in: Are reconditioned attachments worse than the new ones? *Orthod Materials Insider* 1998;11(1):2–3]. **More reliable intrabrand (new vs. used) than interbrand (all new) !**

😊 “Rebonding had no significant effect on reduction of SBS (shear bond strength). Tungsten carbide burs are suitable for removing remaining composite from brackets and enamel surfaces and finally, chemically recycled brackets had a clinically acceptable SBS” [Heravi F, Naseh R. A comparative study between bond strength of rebonded and recycled orthodontic brackets. *Dent Res J* 2006;2:1–6]. **Unexpected? We knew this since long ...**

😊 “Can be of great aid to the profession, both economically and ecologically” [Buchman DJL. Effects of recycling on metallic direct-bond orthodontic brackets. *Am J Orthod Dentofac Orthop* 1980;77:656–66]. **Double take!**

😊 “Bracket recycling, by either chemical or heat treatment methods, when compared to non-treated brackets, shows no significant difference in corrosion potential” [Harriot SE. The corrosion susceptibility of the metallic orthodontic bracket/wire interface. Louisville KY: Thesis. Univ. of Louisville, 1994]. **No lawyers involved!**

😊 “The fact that almost 90 per cent of questionnaires were returned suggests a high degree of interest in the subject of recycling at present. Commercial recycling of metallic orthodontic brackets appears to be a widespread practice amongst British orthodontists. Results of the present survey suggest that approximately half of British orthodontists recycle metal brackets and that recycling is more popular amongst specialist practitioners than hospital based consultants” [Coley-Smith A, Rock WP. Bracket recycling—who does what? *Br J Orthod* 1999;26:135–9]. **Only half of them?**

😞 “Reuse of orthodontic products is a continuing problem. It has been estimated that as many as one US orthodontist in three ‘recycles’” [Masel, [www.bracesinfo.com/comparants4.html#recyc](http://www.bracesinfo.com/comparants4.html#recyc)]. **Only a third?**

😊 “For the average clinician, the repeated use of delicate appliances demonstrates that with proper reconditioning, it is possible not only to save, but also to achieve a performance similar to that of the new ones” [Buchwald A.

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A three-cycle in vivo evaluation of reconditioned direct-bonding brackets" [Am J Orthod Dentofac Orthop 1989;95:352]. **Unexpected?!!! We have known this for decades ...**

☺ "He (CG Matasa) has developed an elevated but practical recycling process for orthodontic appurtenances that has saved millions of dollars for practitioners (and patients) in the cost of their armamentaria. By replacing adhesive's charring with its dissolution, and metal electropolishing with a method used by manufacturers, burnishing, he has allowed his company, Ortho-Cycle, to be both ISO and CE certified by the prestigious Scandinavian Institute for Dental Materials.

Aside from its economic effect, the recycling of stainless steel devices reduces the amount of harmful chromium and nickel ions which, if dumped, pollute our groundwater. Today, even the intrusive and comparatively difficult-to-sterilize pacemakers and catheters are often recycled. I have personally read the manufacturers' letters sent to Professor Matasa, with grudging recognition of his avant-garde discoveries" [Graber TM. Happy Birthday, Claude. *Orthod Materials Inside.*, March 2005, vol. 17 (1):1]. **What a loss to the profession...**

☺ "The only safe way for bracket reconditioning is to remove the adhesive chemically (Ortho-Cycle system)" [Tenti FV. Atlas of Orthodontic Appliances, Fixed and Removable. Genoa, Italy: Caravel, 1986:305]. **No more stainless steel's destructive "sensitization"!**

☺ "As expected, orthodontic suppliers were not about to watch this upstart cut into their sales. They countered with everything from labeling their brackets 'Single Use Only' to outright lawsuits, when in 1996 Ormco/Sybron sued for patent infringement. The Orthodontic Manufacturers Association (OMA) had six years earlier also brought pressure to bear with a Fight Back segment on NBC-TV attempting to frighten the public away from accepting recycled brackets, but the AAO reported receiving few consumer calls....

Not only were they deemed safe and effective, but Ortho-Cycle was given a CE Mark by the prestigious Scandinavian Institute of Dental Materials. Today the company stands at the forefront of bracket reconditioning with more customers than ever, despite stiff competition" [Wahl N. *Orthod Materials Insider* 2006;18(3):3-4]. **And the rest is history ...**

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		<p>2026 Scott Street Hollywood, Florida 33020 Phone: 954-920-9074 Toll Free: 800-82-CYCLE Website: <a href="http://www.OrthoCycle.com">www.OrthoCycle.com</a></p>	<p><b>10% Off</b> Purchase or Recycling <i>Offer expires on May 1<sup>st</sup> 2008.</i></p>
<p><b>To the readers of our newsletter:</b> Place your order before May 1<sup>st</sup>, 2008 and attach this coupon, or copy, to our order form: you will get 10% discount on either sales and/or recycling. At your request, we can deliver it at the 108<sup>th</sup> AAO Annual Meeting in DENVER, CO. <b>See us at booth #320</b></p>			
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