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ORTHO-CYCLE, A COMPANY THROUGH WHICH YOU CAN RECONDITION,
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Editor: Claude G. Matasa, Dr. Chem. Eng., Dr. Techn. Sci., Professor of Oral Bio-Materials

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Even when stars die, their glow persists …

Thomas M. Graber
1917-2007

To the world of dentistry, Tom Graber was an orthodontist, teacher, editor, author, and leader. But to those of us who knew him as a friend, he was a very humble and caring human being. Witness the unlikely spiritual connection between a world-famous ortho-dontist who fought against the Germans and their satellite countries during World War II, and a chemical engineer born in one of the later (Romania) who was only 13 at the time.

It has started more than 20 years ago, when Prof E. Tenti of Italy wanted to have his book, Atlas of Orthodontic Appliances, introduced by the editor of the American Journal of Orthodontics, now the American J. Orthodontics and Dentofacial Orthopedics' (AJO-DO), Prof. T. M. "Tom" Graber. As the book was to be distributed in the US and Canada through Ortho-Cycle Co., I advised against it, believing that this would have been in conflict with Tom's interest (he had a similar book due to be released at about the same time). To my surprise, Tom not only agreed to do it, but he even stressed that the book "fulfilled a long overdue need."

Encouraged by his generosity, I sent Tom a Letter to the Editor entitled "Not all appliances are created equal" (1988) and a few issues of my newsletter, the Orthodontic Materials Insider (*www.OrthodonticMaterials.com*), then Phoenix without Ashes. To my delight, he published it in (AJO-DO), along with my article "Adhesion and Its Ten Commandments" (1989). After these, he accepted several other articles, both in the AJO-DO and the World Journal of Orthodontics (WJO), of which he became editor in 2000.

This activity was crowned later by his choosing me as his coauthor for "Angle, the Innovator, Mechanical Genius, and Clinician" (2000). Electing me as a consultant and referee for the AJO-DO, he also entrusted me with the chapters on orthodontic biomaterials in the last 2 editions of the most-read textbook of the profession, "Orthodontics: Current Principles and Techniques. " Aside from being kind enough to write articles for my Insider (among which I treasure the one written for my 75th birthday, see the March 2005 issue), he asked me to write a chapter in his book "Risk Management in Orthodontics" and introduced and recommended a related book in a field of major concern to him, i.e. the risks presented by orthodontic biomaterials.

Teaching at the same university in Chicago, I had a chance to exchange views and share with him problems, among which was, later, our common affliction: cancer. While his obituaries (such as that in AJO-DO 2007; 132: 272-73) properly reflect his outstanding scientific and educational contributions, they do not reveal how human and compassionate he was. In an attempt to remedy this, I am taking the unusual step of publishing the last 12 months of his e-mail correspondence with me.

C. G. Matasa

Topic: My sending of the 12 cartoons that we are shaking the Muslim world (Published in Denmark, Jyllands Posten)

Subj:	**Re: Clash of civilizations?**
Date:	2/2/2006 9:59:18 PM Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Sad--sad, we should not caricature religious personages or images---regardless. Tom

---

Topic: Appeal for help in publishing my book, Risks in Orthodontic Biomaterials. (Despite Tom's vigorous "pitch" to 2 book publishers, the proposal was rejected by both, presumably on the grounds that they might be sued for libel by the manufacturers.)

Subj:	**Re: Conversation with Prof. T M Graber**
Date:	5/11/2006 4:51:40 PM Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Claude sad, sad, sad! Publishing is in the doldrums now. I don't know where to turn. I tried! Mosby. Don't be too depressed perhaps they can work out something. There are legal implications whenever you present material such as yours possible suits by manufacturers, etc. I don't know the whole story but I think it is the people "upstairs" that put this hold on the project. He was very upbeat about it in Las Vegas. Cheers! Thanks for all you are doing for orthodontics.
Tom

Topic: Help in cancer cure

Subj:	**Sad news!**
Date:	9/21/2006 6:28:18 PM Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Claude;
I saw Dr. Evans today and she told me about your cancer. As a fellow "sufferer", I can only too well appreciate the problem and pray that you can keep up your spirits, getting the right therapy! My esophageal problem required surgery, chemo and radiation. If you have any questions about the best place to go, I can tell you about Cleveland Clinic. I had superb care there and still go for check-ups. I would refer you to my doctor. I had care also at Evanston Hospital but far inferior! Please let me know if I can help! Stay the course. Call me at home, if you want to talk about it. Phone 847-XXX-XXXX, Fax 847-XXX-XXXX, As ever, your friend, Tom

---

Topic: Help in cancer cure

Subj:	**(no subject)**
Date:	9/25/2006 5:22:19 PM Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Dear Claude;
Thanks for your most comprehensive e-mail! I do hope the combined radiation and chemotherapy will not be too hard to take. My adenocarcinoma was at the junction of the esophagus and stomach, so they had to radiate in 5 directions to focus on it so they said 5 days a week for 6 weeks. I felt that radiation seeds would have been more direct and less damaging to the lungs, heart, etc. I ended up having Cleveland Clinic people control the treatment, and respect them highly. If you decide you want a further consultation, I will contact Dr. Greg Zuccaro at Cleveland Clinic for you. Right now, there is no evidence of CA for me but who knows? Lots of damage to my lungs, which are slowly getting better. You don't want the cure to be worse than the disease. Do keep me in touch. I quite understand your writings now. Little did you think you might suffer from the tools and materials you use. I have read up a lot on esophageal cancer and its treatment. Be sure you have no gastro-intestinal reflux disease GERD. I, of course, take a medication each day to ward off the effect of acid reflux. Let me know if I can help! Cheers!
Tom

Topic: Appeal for help in publishing my book "Risks in Orthodontic Biomaterials"

Subj:	**Orthodontic Biomaterials**
Date:	10/2/2006 12:42:58 PM Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Claude, the envelope arrived today from UPS about 2 hours ago. I am sickened by the in-efficiency around school. My stationery, calling cards, etc clearly show you had the correct address! If you recall, I tried Quintessence earlier and they demurred. I can try again. The manuscript still needs editing. I did a little at the beginning, but had to turn to manuscripts waiting for publication in the WJO. Send all correspondence to my home! (2895 Sheridan Place, Evanston, IL, 60201)
Shall I call Tomoko again????? (Quintessence?)
More important, how are you feeling? Are you still on chemotherapy and radiation? Have they checked with an endoscope? My growth was removed surgically by endoscopic surgery.
Look forward to your response to above. Get well! Tom

Topic: Cancer

Subj:	**Re: Your book proposal**
Date:	11/14/2006 10:31:18 PM Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Dear Claude;

Let me think of the best alternative over the weekend. I am swamped now with the accreditation visit, journal deadlines and my lectures to Saudi Arabia via the web tomorrow, etc. I am hopeful we can find a suitable resolution of the problem. I hope you are conquering your cancer without all the damage from radiation and chemotherapy, which I had. I'll tell you about it when we will see each other. Radiation seeds might be preferable.

Happy Thanksgivig.

Tom

Topic: Exchange of greetings

Subj:	**Re: Happy Holidays & New Year!**
Date:	12/27/2006 12:05:47 AM Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

HAVE A SUPER HOLIDAY! THANKS FOR ALL YOU ARE DOING FOR ORTHODONTICS! I AM PROUD OF YOU!

TOM GRABER

Topic: Cancer

Subj:	**Re: TM Graber's address**
Date:	1/5/2007 12:19:16 PM Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Thanks, Claude. I hope you are beating the cancer problem! We miss you!

Tom

Topic: My lab research

Subj:	**Re: Cyanoacrylates**
Date:	01/23/2007 11:43:49 Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Most interesting! Hope you are coping with your therapy. I am fighting respiratory crud, laryngitis, etc. Winter in Chicago…. Ugh! Stay the course! I like the picture. Your lab looks like my desk!

Tom

Topic: Cancer

Subj:	**Re: Good news**
Date:	02/23/2007 12:11:26 Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Claude, I AM DELIGHTED WITH THE NEWS! GOOD LUCK AND I PRAY FUTURE REPORTS ARE THE SAME!

My personal problems are that I now have lung cancer, etc apparently from original adenocarcinoma 3 1/2 years ago. Really not treatable at this age and stage.

C'est la Guerre! Tom

Topic: Cancer and editing my book

Subj:	**Re: Mailing**
Date:	03/01/2007 17:39:56 Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Claude,

Thanks for your kind words. I have enjoyed working with you. I would love to help but I am not even able to keep up with my duties as Editor now. My energy is totally wiped out and it takes great effort to read proof, much less to write anything. I read it and you have my permission to put my name on it, if it helps you... I will sign it, etc, after reading it, if I can still sign my name.

My speed going downward is accelerating. Stay well! Tom

Topic: Cancer and scientific paper

Subj:	**Re: Mailing**
Date:	03/08/2007 23:08:32 Eastern Standard Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Claude, I really feel depressed about not getting to read your paper.
My cancer has me down and I go in for surgery in 10 days.
Prognosis on cancer, poor!
Sorry!
Tom

Topic: Article on my cancer in the “Insider”, April 2007

Subj:	**Re: Report cancer**
Date:	03/13/2007 23:04:37 Eastern Daylight Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
File:	**March,2007WJOEditorial.doc** (27648 bytes) DL Time (49333 bps): < 1 minute
Sent from the Internet (Details)	

I have carefully gone over the article and made a half dozen or so language changes.
Good luck! I wish I could say the same about "cure."
Unfortunately, advanced adenocarcinoma of lung, etc.

Tom

Topic: My book on “Risks in Orthodontic Biomaterials”

Subj:	**Re: Report cancer**
Date:	03/14/2007 11:41:34 Eastern Daylight Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Thanks for the info, Claude what is your Fax number, so I can send the one copy I went over, with minor editing?

Tom

Topic: My book and cancer

Subj:	**Re: Report cancer**
Date:	03/14/2007 17:09:28 Eastern Daylight Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Dear Claude,
What is your FAX number so I can send you a copy of my edited version. I am more or less incapacitated, but I'd like to send the copy with minor language editing. Stay well.
I am so delighted that you "beat the rap!"
Cheers,

Tom

Topic: My appreciations on his last editorial

Subj:	**Re: Report cancer**
Date:	03/14/2007 21:30:54 Eastern Daylight Time
From:	tmgraber@comcast.net
To:	Matasa@aol.com
Sent from the Internet (Details)	

Fortunately, the last thing to go is my brain.
Cheers,

Tom

Proper debonding saves money and the environment

Introduction

Used but undamaged attachments constitute a valuable asset; all it takes is for the clinician to recycle them (by his own means or by pro others) or to sell them for cash. (Ortho-Cycle renews and finds buyers for 30 years,[1] cashing in on the fact that the value of many of these, when new, exceed $10.)

In what follows, we refer only to stainless steel appliances: by dumping these as common refuse, one generates nickel and chromium ions in his drinking water. The chlorides present in the water and soil depassivate the alloy, which then disintegrates into its components becoming soluble, adding to the multiple contaminations we are all subjected to. The amount of nickel freed this way may be minor, but it has been found to be enough to generate contact dermatitis.[2]

To protect the patient and help the clinician, in the last issue of this newsletter we examined the stresses involved in bracket debonding and attempted to model the mechanical debonding with the help of the Velcro™ fastener.[3] In the first article we described 11 patented debonding instruments, while in the second we showed that the lowest effective debonding force is achieved at the adhesive-enamel interface by peeling or cleavage. Till special adhesives and harmless and appropriate solvents become available, mechanical debonding will reign supreme, continuing to subject both teeth and attachments to forces strong enough to generate enamel damage. In what follows, we will show the effect of the different debonding methods on the integrity of the recovered bracket, evidencing the best methods and tools.

Why and when do brackets become damaged?

After 30 years of continually examining an incredible variety of debonded brackets, we can determine the most probable type of mechanical deterioration (breakage, distortion, deformation, or dislocation of parts; Fig 1). The closer to the enamel the applied force (unshaded area A), the less is the chance for the attachment's deterioration.

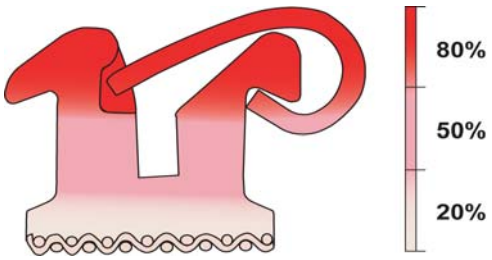


Fig. 1. Chance for damage vs. the force's application

If the attachment is sturdy enough and peeling is applied, the bracket detaches with increased chances for unscathed recovery. The best case is when the adhesive layer takes the brunt of the force and detaches from the enamel along with the bracket. The worst cases reveal slight bending of the base or breakage of the pad, as shown in Figure 2, A.

Applying the force within the area at a higher level, B, significantly increases the chances for damage. Applied mesiodistally (in twin brackets), it bends the base and closes the gap between tie wings. Applied occlusogingivally, it closes the slot. While in the first case, the proper use of sharp-edged pliers might eventually restore both the tie wings and the base's curvature, distortion of the slot is unacceptable. (Ortho-Cycle does not "repair" brackets, but just separates the defective ones as damaged).

The heavily shaded area in Figure 1, C, is the most sensitive as it addresses the self-ligating systems and/or closes the slot over the arch wire, entrapping thus the latter.

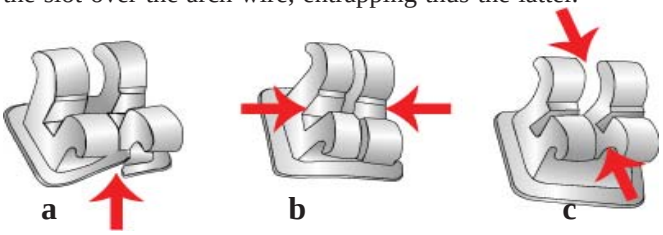


Fig.2 Possible consequences of squeezing the bracket in the A (a) and B areas (b & c), Fig. 1.

Who renders the attachments reusable?

The cooperation of three participants; i.e.: the manufacturer, the user (clinician), and the recycler, be it the clinician or a specialized commercial company.

1. Manufacturer's share in the bracket's fitness for reuse

While some suppliers claim that their attachments should be considered an investment that can be reused time and again, most of them are against reuse ("for one use only".) Cases in point are Unitek/3M's Clarity ceramic bracket and the Lift-Off Debonding Instrument (LODI). Debonding instructions[4] first recommend destruction of the bracket, which is facilitated by the transverse channel under its base (Fig 3).

The second method is no longer sold, along with the "tenaculum" recommended by the inventor (Fig 4).[5] Likewise, an Ormco patent[6] recommends debonding by grabbing the bracket in the B area (Fig 1), an action that damages the slot (Fig 5).

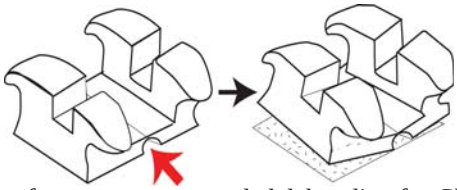


Fig. 3. Manufacturer- recommended debonding for Clarity™

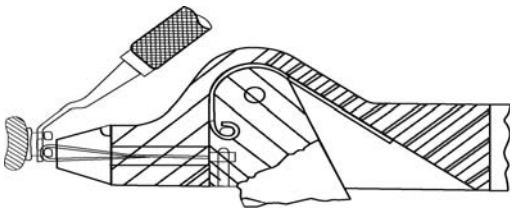


Fig. 4. Original sketch in the LODI patent.[5] Observe the "tenaculum" which helps maintain the initial slot width.

Ironically, the manufacturer of the best brackets inadvertently facilitates their reuse. In order to increase the bracket's strength, the company had to decrease the slot's depth.

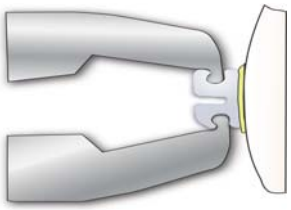


Fig. 5. Grabbing at the slot level leads to the slot's damage

As we showed some 15 years ago in the *American Journal of Orthodontics and Dentofacial Orthopedics* (*AJO-DO*),[7] the attachment's resistance to a torsional force, F, is proportional to the shaded surface in Figure 6 and inversely proportional to the slot's depth (or tie-wing height, marked with a red arrow): where S = strength of the material, L = length of the slot , W = thickness of the bracket tie wing (slot's wall), and H = bracket height. The greater the tie-wing height, the easier it is to distort the slot.

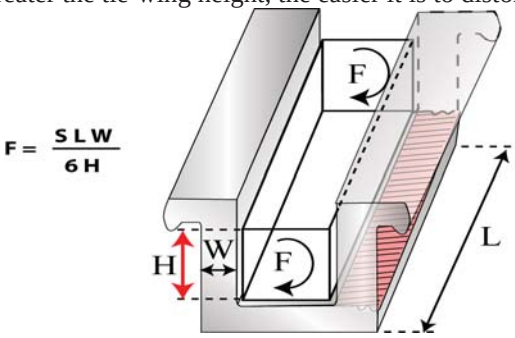


Fig. 6. The chance for slot distortion increases with its depth

Deeper slots or taller tie wings, which were used in the past for piggyback arch-wire arrangements, are of little interest today, as witness the fact that only 1 pertinent article was published in the *AJO-DO*, and this some 10 years ago.[8]

As it can be seen from Figure 7, brackets having deep slots are easily distorted during debonding, in contrast to those in which the arch wire fills the slot. The black arrows indicate less or no deformation, in contrast to the red ones.

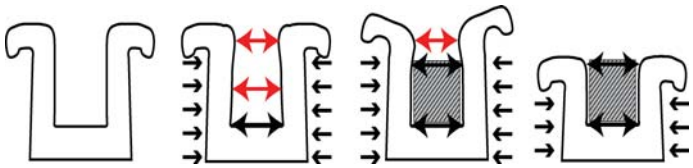


Fig. 7. Slot walls, before and after debonding. a. In the absence of stress; b. Under stress; c & d. Under stress with the arch wire inserted.

The marked depth difference between the several metallic brackets commercially available in 1994 is stressed in Figure 8.[9] For comparison purposes, all have, drawn to scale, an inserted imaginary arch wire.

Today, most brackets hold the inserted arch wire almost flush with the buccal part of their tie wings (Fig 7), thus precluding its entrapment during debonding. Deeper slots can be observed when inserting an .021" x .025" arch wire into the .022 slots of TP's Straight Edge, American Orthodontics' Discovery, RMO's Synergy, or GAC's Accu-Arch or Omni. Inherent in their construction, many bicuspids have deeper slots because of their gingival offset (extension). In the same category are several self-ligating attachments, among which are Orec's Speed, Unitek's Damon (I to III), and Forestadent's Mobil-Lock.

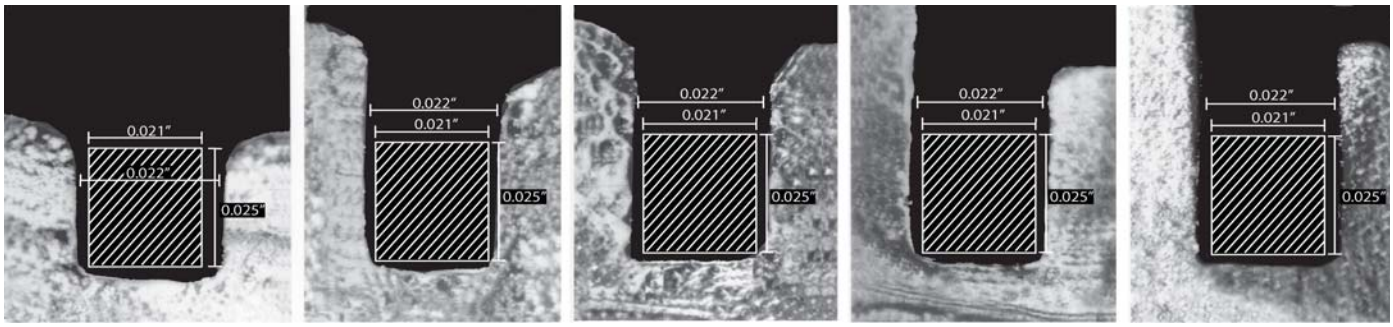
2. Clinician's share in the bracket's fitness for reuse

First, he has to choose a bracket sturdy enough to withstand not only normal wear but also debonding, If magnetic, these are made of a martensitic steel, that is, a strong material. Even so, some, like "A"-Company's Activa™, were so weak that their manufacturer ceases to manufacture them.

Second, he should test if the sited final arch wire will be flush with the attachment's tie wings, and third, he should select an adequate debonding method and the proper tool. Even if all these conditions are obeyed, the properly debonded attachments' further processing may raise problems. After 2 years of exposure to mastication and to a variety of abrasive materials, the attachment's surface becomes scratched and loses its luster, becoming inadequate for reuse. In what follows, we will provide some recommendations based on our long experience.

To best way to save a metallic bracket and leave as little adhesive on the enamel is to grab the bracket as close to the enamel as feasible. Early debonding-instrument inventors such as Northcutt[10] and Cusato[11] have cashed in on this procedure, practically opening the way to bracket recycling. Both instruments use cleavage at the adhesive/enamel interface.

The pliers shown in Figure 9 have a pair of pivoted jaws and handles. According to its inventor, one of the jaws has a raised pad having a resilient surface (plastic) that is placed against the edge of the tooth, and the other jaw has a hard metal insert shaped to provide a chisel portion with a sharp edge for



Ortho Organizers Edgeway Single | **Ortho Organizers Edgeway Mini** | **Glenroe/ Dentsply** | **Unitek Dynalock** | **Dynalock Glance**

Fig. 8. Slot depth of brackets commercially available in 1994.[10] For comparison purposes, an imaginary arch wire is inserted

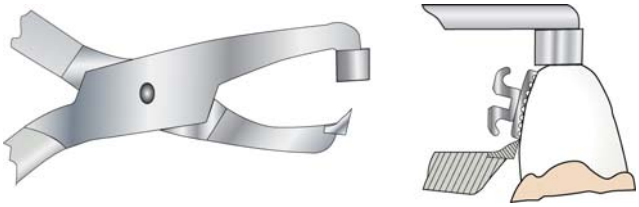


Fig. 9. Northcutt's instrument for debonding

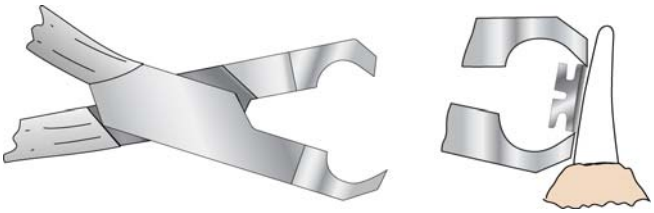


Fig. 10. Cusato's instrument for debonding & scraping[11]

getting in between the tooth and the onlay. When the handles are forced together, the jaws move toward each other and the chisel portion separates the onlay or bracket from the tooth.[12]

Cusato's instrument (Fig 10)[11] provides both prying and scraping jaws. Their sharpened edges are adapted for insertion behind the bracket and into the adhesive. After the bracket is removed, the rest of the adhesive can be scraped from the face of the tooth by the sharp front edges of the jaws of the tool. The pliers can be easily converted into Northcutt's instrument because one of the jaws is provided with a molded plastic, removable cap.

Another widely used debonding instrument (Fig 11, already discussed in Fig. 4) uses peeling; it was designed by Dr. M.A. Armstrong. [5] According to his description, the pistol-like grip has twin abutments projecting in parallel relationship and spaced apart to straddle an orthodontic bracket attached to a tooth and to engage the tooth at opposite sides of the bracket. A swing handle pivoted to the pistol grip carries a pull wire extending between the abutments; such pull wire has a loop for hooking a wing of the orthodontic bracket. The handle can be pulled toward the pistol grip to draw the pull wire toward the pistol grip for pressing the abutments against the tooth and simultaneously pulling the bracket off the tooth. During such pulling, constriction of the arch wire slot in the bracket is prevented by fitting in such slot a spacer hook of a tenaculum.

Although, according to Merriam-Webster's, a tenaculum is just "*a slender sharp-pointed hook attached to a handle*," the inventor has used it to fill the orthodontic slot to "prevent the base of the bracket from being bent by the pulling action, so as to constrict the arch wire slot." (In other words, to render the attachment acceptable for reuse.)

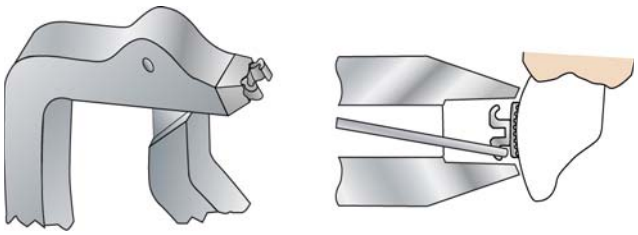


Fig. 11. Armstrong's "Lift Off Debonding Instrument"

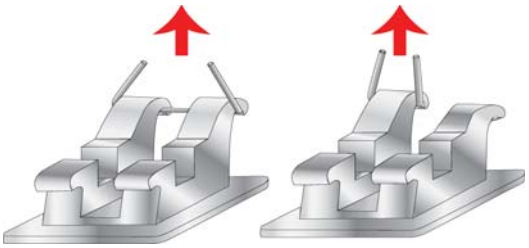


Fig. 12. Pulling only one tie wing leads to distorsion

Along the same lines, the inventor should have specified that for most brackets it is preferable that the tool's pulling wire engage both tie wings, as the stress on only one generates distortion (Fig 12).

Soon after this instrument became commercialized, Ortho-Cycle started to offer to its customers .018" or .022" stainless-steel gauges, along with instructions on how to use them to protect the slot (Fig 13).

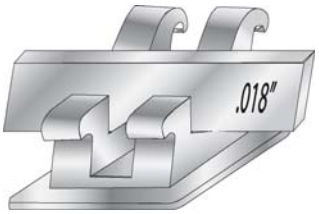


Fig. 13. Inserting an appropriate gauge into the slot protects it against damage

In accordance with the General Agreement on Trade and Tariffs (GATT), the exclusivity of a patent expires 20 years from the date of patent application; consequently, all the above patents are now public. Commercial variations of instruments based on their principles were surveyed in our last issue.[3]

3. Recycler's share in the bracket's fitness for reuse

The real art behind recycling unscathed devices resides in not damaging them. An orthodontic direct-bonding attachment, even if sturdy and properly debonded, may be unsuitable for reuse if it has been exposed to temperatures that generate the alloys' sensitization or to a loss in metal.[13]

-It has lost metal where it counts.

-It was not properly inspected against defects.

-Its adhesive locking system is still clogged.

To test if the attachment parts have been exposed to high heat, one can observe it effect on self-ligating brackets that include a heat-sensitive foil or spring (Fig 14): if its resiliency is lost, the attachment will not work as desired and may incur intergranular corrosion.[13, 14]

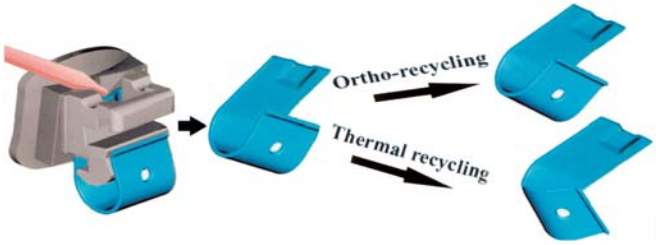


Fig. 14. Improper tempering leads to the attachment's degradation

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After wear and decontamination, stainless-steel attachments lose their initial shine and become oxidized (tarnished), as shown in Fig. 15.

Fig. 15. After wear and decontamination, the attachments have to be brought to their initial shine

If subjected to electro-polishing, a process widely used, metal is unduly removed and the most exposed parts are damaged (the bases lose their grip [Fig 16], the power arms/hooks or ligature wings get thin, etc.). In addition, the strong acid baths used weaken the brazing that keeps multipart attachments together. In contrast, burnishing by high-energy centrifugal tumbling, a process used by all orthodontic manufacturers, thoroughly removes impurities and oxides while compressing/hardening the metal's surface.[14]

The first image in Figure 16, taken from a bracket subjected to subsequent adhesive dissolution and burnishing (Ortho-Cycle's process) amply illustrates the high degree of impurity removal obtained without affecting the metal.

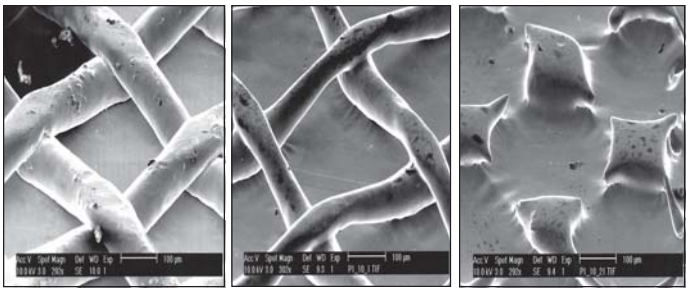

Fig. 16. Electro-polishing leads to a loss of base's grip[15]

Conclusions

Modern direct-bonding brackets are worth several times their weight in gold. Improving design for a better performance, manufacturers provide now properties that make them reusable. Discarding used stainless-steel attachments, knowing that they are an environmental risk, is inexcusable; with a little care, they can be recycled or sold for this purpose. Wasting resources and polluting is far less ethical than reusing attachments that have been processed in accordance with FDA and CE norms.

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