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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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Editor: Claude G. Matasa, Dr. Chem. Eng., Dr. Techn. Sci., Professor of Oral Bio-Materials

CE 0510

Happy Birthday, Claude!

Professor Claude Matasa will be 75 years young this April. Young, because instead of relaxing under South Florida's sun, he is as active as ever. At his Ortho-Cycle's team invitation, which provided me additional information, I'll try to recapitulate his many scientific contributions to the field of materia technica in the dental specialty of orthodontics and dentofacial orthopedics.

Biomaterials deserve today an increasing awareness: there have been major advances in artificial replacement of body parts. Actually, dentistry was one of the first areas for this to occur as teeth have been repaired or replaced for many centuries. As the time passes, however, more dental materials have come into question; i.e., mercury based tooth restorations, ceramic brackets, nickel leaching attachments, some plastics, etc. This has been stimulated by potenþial iatrogenic sequelae and a very active risk management response from the trial lawyers. In medicine, we are aware of the major lawsuits stimulated by replacement of body parts and subsequent complaints. This has become "big business" for the most powerful lobby in Washington and a very real basis for concern.

Professor Matasa has been a pioneer, one of the first to study this problem. His CV speaks for itself, and indicates a strong dedication to the scientific assessment of biomaterials. His contributions have been significant. To me, some are worthy of international recognition. That he has been able to produce his prodigious contributions, in the face of political persecution and imprisonment in Romania during the Communist domination, makes his work all the more amazing.

Professor Matasa's total commitment to his research, to his analysis of biomaterials, his personal sacrifice, despite having to leave his homeland is little short of incredible. Going to a new country, learning a new language, becoming financially viable under tremendous handicaps, and becoming an outstanding leader in the field is quite remarkable and speaks not only to his knowledge and work ethic, but his motivation to find answers to questions that affect everybody, i.e., the use of artificial materials to help or replace body parts.

I have indeed been fortunate to know and work with Professor Matasa for over 15 years. As editor, adviser and teacher, his knowledge and research helped me evaluate contributions in the field. How fortunate we are to have the leading scientist in this field to help us! His unique training and background as an engineer have helped materially to provide substantive bases for orthopedic materia technica.

He 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 electro- polishing 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 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 manufacturer letters sent to Professor Matasa, with grudging recognition of his avant garde discoveries.

Professors T.M. Graber and C G Matasa

Professor Matasa was the first to call attention to the flaws encountered in bracket manufacturing. Mesh-based brackets are assembled manually, often leading to misfits. While most manufacturers subject these to statistical inspection, checking only a few of a lot and releasing the rest, Professor Matasa has implemented the examination of each attachment. The description has helped manufacturers to improve their products. Getting deeper in the attachment's study, he found simpler methods to evaluate brackets' slot width and functions. While any optical slot width measurement cannot go deeper than the bracket's edge, his mechanical method also takes into account the slots' interior. To link friction to bracket shape, he has used both do-it-yourself methods, as well as Atomic Force Microscopy. Thus, he has related friction to the pressure exerted by the ligature, which in turn is a function of the bracket's shape.

His study of the basic orthodontic appliances has continued, using metallographic and micro-hardness analyses, allowing him to disclose phase structures and to measure the metal's strength. Using his chemistry knowledge, he tested the attachments' corrosion susceptibilities. Corrosion does not just interfere with the attachment's performance, but also leads to the release of harmful ions in the patient's body. As the known testing methods involve standard, unitary samples, demand that cannot be fulfilled using brackets, he has designed do-it-yourself tests such as measuring the hydrogen these release under acid attack, or the reactive gel entrapment of the leached ions. This is a significant aid to practicing clinicians.

Far from restricting his research only on metal attachments, he has tested their aesthetic coatings such as those based upon titanium nitride and gold, as well the impact resistance of the ceramic brackets using a method borrowed from industry. This allowed him not only to disclose the fragile ones but also the most impact-resisting shapes. As one of the most important conditions for all attachments is to be properly bonded, he has focused his research on how to improve both the adhesives and the bonding pads, as well as on simpler (do-it-yourself methods) methods to approximate or even measure their suitability. In the laboratory, the accepted testing method involves universal testing machines worth over $30,000! Professor Matasa developed ingenious "do-it-yourself methods", helping the orthodontists to cope with the laws, patient's health, etc.

As he has demonstrated using scanning electronic microscopy, there is a lack of affinity between water-loving surfaces (enamel and stainless steel) and the water-hating, resin-based adhesives and sealants. To improve bonding, he was the first to be documented as using the silanation and the etching of metal-based attachments. Today, many modern pads are etched, silanated or both. His is also the first use of surfactants to improve bond strength as these enhance the resin's penetration into the water-loving substrates. Interestingly, while some of the manufacturers initially resented Professor Matasa's company's competition, some frankly acknowledge his contribution to the field and his support to their attempts to come up with better devices. I have enjoyed reading their comments.

Regarding polymeric devices, he demonstrated the cytotoxicity of polyurethane ligatures and called the profession's attention to the adhesive's aerobic and anaerobic attack by microorganisms, until then an unknown reason for late debondings and attacks of the enamel. Following the addition of biocides to the adhesive, alone and with a team of U. Illinois' Dental College researchers, such attacks were significantly reduced without deterring the composite's performance. A commercial product is now in study by Bisco International, a company who wants to deserve its slogan *"Bringing science to the art of dentistry"*

Testing the leaching of ligatures, adhesives, sealants, restoratives have led him to a new method, reactive gel entrapment, which allows selection of the less leaching surgical latex gloves. Releasing specific proteins, the latter can even lead to fatal anaphylactic shocks. Refining his test by using manganometry, he stirred the interest of the main dental testing laboratory in the US, i. e. Clinical Research Associates of Provo, UT, led by the eminent Dr. Gordon Christensen.

Listing above the variety of research performed by Professor Matasa, one cannot but wonder about what a persistent and knowledgeable person can do singlehandledly, without a sophisticated lab, highly specialized personnel or grants...

Recently, he teamed up with Romania's top chemist, professor A. T. Balaban, former Vice President of the Romanian Academy, in a theoretical speculation that may have a major impact on the future of the in-situ curable polymers currently used in medicine. In their view, the exceptional mechanical strength of the bis GMA-derived adhesives is due to the reinforcement action of molecular rods. These elongated and rigid monomer molecules act at as reinforcement at the atomic scale, working as nanofibers in composites where the matrix is the diluting, linear monomer molecules. This is, in my mind, is the latest and most important contribution, as it breaks a myth and introduces a brand new category of possible substitutes for bis GMA. As bis GMA, a derivative from a phenol, is toxic, cytotoxic, mutagenic, carcinogenic and oestrogenic, its replacement with less harmful products such as natural derivatives, rich in molecular rods, may lead to stronger but less harmful polymeric devices.

Professor Matasa's activity isn't limited to publishing his research and reviews in specialty journals. He launched almost twenty years ago *"Phoenix without Ashes"*, aptly renamed in 1994 *"The Orthodontic Materials Insider"*, a publication he has personally fostered for the good of the profession. This, alone, shines like a scientific beacon for the orthodontic community.

Professor Matasa, these excerpts alone show how many contributions you have made to the development of the science and art of our specialty. It is a real advantage for the Orthodontic Department of the University of Illinois, as well as our research staff, to have you as a distinguished member of the faculty. I have many more letters of praise for your work, and numerous comments by our orthodontic residents at the University of Illinois on their gratitude for being your students. You have made applied scientists of them!

Finally, I am most indebted to you, as its former Chief-Editor, for your signal services as an outstanding referee and consultant for the *American Journal of Orthodontics and Dentofacial Orthopedics*, the foremost, most widely read publication in the field. Having you as a member of the Romanian Academy of Medical Sciences redounds to the credit of Romania and this prestigious organization and of course to the University of Illinois!

As you know, you have lectured all over the world, and this redounds to the credit of your original country, your education in România, your scientific contributions you have made since then, and continue to make. I have many more examples of your prowess in the bio-material field—like your chapters in my orthodontic textbook, published by Elsevier (the most widely read and used orthodontic text in the world, published in 4 languages; the most recent 4th edition will be released in May, 2005, at the AAO meeting in San Francisco. The recently published book by Quintessence on Risk Management in Orthodontics has your outstanding chapter that will assist countless practitioners in preventing iatrogenic results during their therapeutic manipulations. Your continuing to serve as a referee for the World Journal of Orthodontics, of which I am the Editor, as well as for other scientific Journal around the world provides, additional evidence of your noble effort...

T. M. Graber
DMD, MSD PhD, MD, Odont.Dr. DSc. ScD, FRCS, Professor

Happy Birthday, Dr. Matasa!

Ortho-Cycle Company exists and has reached almost 30 years, because of Dr. Claude Matasa's innovative ideas and endless efforts. In turn, we all are behind him, supporting and assisting him in his research, taking care of the details and continuity while he makes us proud for representing us.

We are grateful for the years he practically lived in the company, for the countless days and nights spent at the computer, in the laboratory or on the road making us known.

We also thank him for keeping alive The Insider, our news letter (and perhaps the most known product) as well as for helping us to receive the highest certifications a recycling can get, i.e. ISO:9001:2000; 13485:2003 and CE Mark...

Ortho-Cycle's people

ADVANCED ORTHODONTICS

12/29/04

Dr.Claude Matassa
Ortho-Cycle Co.
2026 Scott St.
Hollywood Fla.33020

Dear Claude,

Over the last twenty five years that I have been involved in the manufacture of brackets you have been the most helpful person in the industry. Your knowledge of brackets and materials is unmatched by anyone. There hasn't been one problem that you have not solved for me. The success of Advanced Orthodontics has been in large part due to your helpful advice.

You are due a more lengthy letter of appreciation than this, but now I take this opportunity to thank you for you help and friendship.

Sincerely,

Larry Hermann D.D.S.
Pres.

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JANUARY 21,2005

To whom it may concern,

I have known professor Claude Matasa for more than twenty years and consider him to be the most prolific and knowledgeable scientist in the field of Oral Biomaterials as it relates to the dental specialty of Orthodontics. His free publication known as The Orthodontic Insider has served to educate manufacturers like myself and provide, at no cost, valuable competitive comparisons on materials and physical properties of parts used in the industry.

I personally have on numerous occasions consulted professor Matasa as to the feasibility of producing certain orthodontic products and procedures and found him to be totally forthcoming as to needed chemical or physical properties. In 1993 Pyramid Orthodontics began to design and produce an orthodontic bracket appliance that would be nickel free to avoid allergies and avoid the galvanic action, which erodes brackets with dissimilar metals that are brazed together. Professor Matasa helped test the metals and provided expert feedback to facilitate the production of a finished part

There are few people and even fewer professionals willing to offer valuable information to possible competitors with no request for reimbursement save a chance to report research findings to the industry at large. My hat is off to this generous mentor.

Sincerely,

Rodney Schmitt
President

On your 75th birthday!

Claude is it possible? I hear that you will be 75 years old in April. It seems only yesterday when, some 30 years ago, I was introduced to *"that charming and slightly eccentric Romanian, who knows more about orthodontics than most orthodontists"*.

Well, Claude, we did get older and wiser over these years. Both you and I have seen many parts and corners of this Earth and have been privileged to visit and speak to many learned groups and societies. I know that we are richer for the experiences and can only hope that we have also contributed to those who have listened to us.

It is almost strange how much our individual interests and beliefs overlapped over the years. I readily admit that I asked and received your advice on numerous occasions. I admit that I have used you, used you as a ready and usually instant reference on many subjects. Often, when I needed a quick answer to nearly anything related to materials, to physical or chemical properties of things, to interaction and effects of different substances – you were there and usually had the pertinent information right on the tip of your tongue. And you were neither shy nor selfish in giving this information to me.

I recall several instances when I myself or some one around me speculated on behavior and outcomes of doing new procedures or using new apparatus. Your uncanny ability to recall who had already tried the same thing, and where and under what condition, was often eye opening. For instance, I remember one time, when the muse had seemingly visited me and I thought that I had had a brilliant idea of how to make a small surface magnetic poles, presumably to be able to move dental units in a preprogrammed direction by applying a thin coating of an 'oriented magnet'. It took you a short time to convince me that the idea could not work. It seemed that I forgot that exerted force is a function of the magnet's mass. Oh, well, it sounded interesting at the time.

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.

Your work is equally recognized in the United States and abroad. I have personally witnessed numerous well known presenters in the field of orthodontics, who during their lectures or upon questioning have stated that *"this has been shown by Prof. Matasa in his publications"*. This is one more piece of evidence that your name, your work and your views are widely respected. They should be, for you take credit for an incredible amount of published work. There is hardly a recognized orthodontic or dental material journal that has not published some of your contributions. It is my gut feeling that you are not entirely finished with your work and that we will be lucky to read more of your contributions to our literature.

That brings me to the inevitable question to ponder: *quo vadis, Claudius?* What else can we expect out of your work and your life? Somehow, you sneaked on us 75 years. I predict that this will not stop, or even slow you down. It may achieve the opposite effect, one that Churchill used when he reached a similar age milestone: "So much to do and so little time to do it!" This writer certainly hopes that the time will not run out on you any time soon. I wish you many, many happy returns, always hoping that our paths will continue to cross on numerous occasions and on many parallels and meridians of our Earth!

Fondly yours,

Mladen [Miki] Kuftinec, StomD, DMD, ScD
Professor & Director of Orthodontics
New York University College of Dentistry

To have great composites, we'll have to look ...down

The chemistry below may be hard to swallow, but we bet, it will touch you!

Warning:

- **If you eat things just because they look or taste good**
- **If you are using your instruments without paying atten tion to their composition,**
- **If you are putting in your patient's mouth restoratives, adhesives, etc. without caring about the accompanying in structions or MS DS,**
- **If you disregard what's in the recently released book "Risk Management in Orthodontics: Expert's guide to malprac tice", Quintessence, 2004...**

...then what follows may cause you indigestion!

In contrast, if you are interested in the health of your patients, in the future of your profession and in the way its tools will develop, the following may help you. If you hate to read it, show it at least to your composite provider.

Ask him to challenge what follows, and remind him that he is actually selling you a "me too" product that slightly differs from what was sold almost half a century ago. Ask him if he is investing in this direction in order to provide you with better products, whose existence is almost here and just need a push, attention and, unfortunately, enough financing...

Introduction

Today's workhorse of most of the polymers formed *in situ* in medicine is based upon the half-a-century old bis GMA. As shown in our last issue,[1] although toxic, cytotoxic, mutagenic, carcinogenic and oestrogenic, this monomer is still widely used due to the superior mechanical strength of its polymers. [2, 3] As far as we know, nobody has given an explanation for this unusual property: Our theory is that what makes bis GMA strong is the particular structure of its bis phenol A moiety. Elongated and rigid, it acts in polymers as reinforcement.

Widely used today, macroscopic fiber or rod reinforcement is thousands of years old. The oldest known surviving sample of reinforced concrete was found in the former Yugoslavia and was thought to have been laid in 5,600 BC. Egyptians used it in around 2,500 BC and the Romans from 300 BC. It took, however, over two thousand years (until the Paris Exhibition of 1855) for the world to realize what the addition of a frame of steel rods to concrete can bring.

Modern strong, inert woven and non-woven fibrous materials are incorporated into a multitude of matrices to improve their physical properties. Typical reinforcements are asbestos, boron, carbon, metal glass and ceramic fibers, flock, graphite, jute, sisal and whiskers, as well as chopped paper, macerated fabrics and synthetic fibers. The difference between reinforcement (fibers) and filler is visible in wood. In the macadamia nut shell, the strongest known, this reinforcement remains invisible, taking place at the molecular level.

While the cotton wool is very soft, the cellulose crystals (same chemical formula) are stronger than steel.[4] The difference lays at the molecular level, the latter being a molecular or nano-composite $(1\ nm < size < 100\ nm)$. A molecular composite is a miscible blend of rigid rod- and flexible-coil polymers where the rigid reinforcing polymer is dispersed at the molecular level in the flexible coil matrix. These materials present advantages over conventional fiber reinforced composites due to the absence of the fiber-matrix interface.

"There's Plenty of Room at the Bottom"

In 1959, the future Nobel Laureate in Physics Richard Feynman gave a speech with the above title at the annual meeting of the American Physical Society at the California Institute of Technology (Caltech). This speech is considered by most nanotechnology researchers to be the inspiration for their work, an invitation to enter a new field of physics, i.e. nanotechnology and atom rearrangement. On January 21, 2000 President Clinton said: *"My 2001 budget supports a major new National Nanotechnology Initiative, worth $500 million. … the ability to manipulate matter at the atomic and molecular level. Imagine the possibilities: materials with ten times the strength of steel and only a small fraction of the weight - shrinking all the information housed at the Library of Congress into a device the size of a sugar cube — detecting cancerous tumors when they are only a few cells in size. Some of our research goals may take 20 or more years to achieve, but that is precisely why there is an important role for the federal government."*

Today, the National Nanotechnology Initiative (NNI) is a Federal R&D program established to coordinate the multi-agency efforts in nanoscale science, engineering, and technology. It comprises 22 federal agencies, 11 of which have an R&D budget for nanotechnology. Other Federal organizations contribute with studies, applications of the results from those agencies performing R&D, and other collaborations.

While the initiative has a strong impact on many medical fields, in what follows we will show a not yet described advance that should reflect on the everyday life of any physician that restores, bonds or seals.

Serendipity?

Discouraged with the properties of the time's available polymers, Rafael Bowen came up in the fifties with a new monomer, bis GMA.[5]. To fulfill the needs, it had to cure fast and give a strong polymer. Epoxies gave a good bond, but they cured slowly and needed as kicker larger amounts of amines, polyamides or anhydrides, which are toxic. In addition, these were not moisture resistant. Methacrylates, and especially polymethyl methacrylate, were resistant to water, but shrank too much. As a result, he tried to convert the best epoxy resin of the time into a methacrylate. In what is called today *"Bowen's resin"*, he got the sought-after mechanical properties. In an age where half of the products existing ten years ago have been replaced, bis GMA still reigns supreme. In composites, adhesives, veneers, the basic resins remain the same, the differences residing in the nature and size of the filler, or in polymerization initiators and the method of cure.

As the definition of serendipity entails pure luck in discovering things you were not looking for, and bis GMA was not his single, major finding, Rafael Bowen's discovery does not qualify. However, by starting from the strongest epoxy resin which was available at the time,[6, 7] Fig. 1, he may have, maybe unknowingly, introduced in his bis GMA, Fig. 2, a special molecular structure (highlighted blue), that of a short molecular rod.

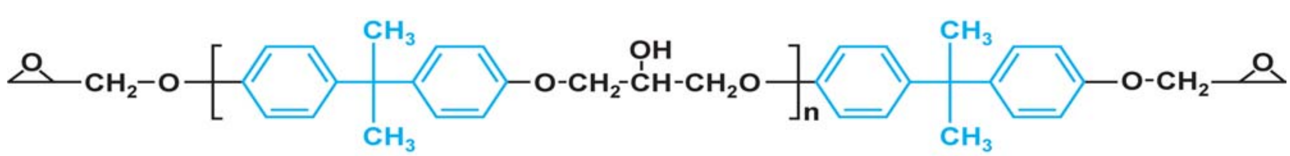

Fig. 1. Bis GMA's precursor: an epoxy, diglycidyl ether of bisphenol A(DGEBA)

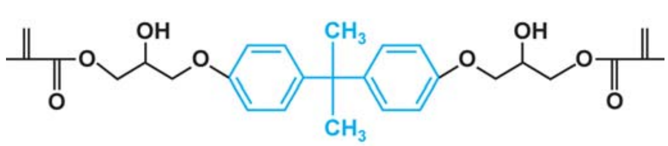

Fig. 2. 2,2-Bis[4-(2-hydroxy-3-methacryloxyprop-1-oxy)phenyl]propane (Bis GMA)

Molecular rods

It is known today that in most polymers, molecules are linked in fully flexible chains that are likened to boiled spaghetti, Fig. 3. Quite seldom, however, some molecules are stiffer due to internal movement hindrances: such rigid, rod-like monomer molecules may bring unusual strength to the polymer.

Fig.3. SEM image of top edges of thin sheets of polystyrene and polymethylmethacrylate

If rigid rods that interface well with a flexible-coil matrix polymer are properly dispersed, these will act as reinforcements. As a result, the mechanical properties of the whole are effectively enhanced at both the macro and the micro scale. Following the spaghetti model, everybody can demonstrate this at the macro scale. For the purpose, we have tried to move two piles of boiled spaghetti: in one of these we have added some 20% fragments of dry spaghetti rods, Fig 4. Trying to move the piles, the reinforced one opposed more resistance and left behind fewer residues.

The elements that make up a polymer and the way these

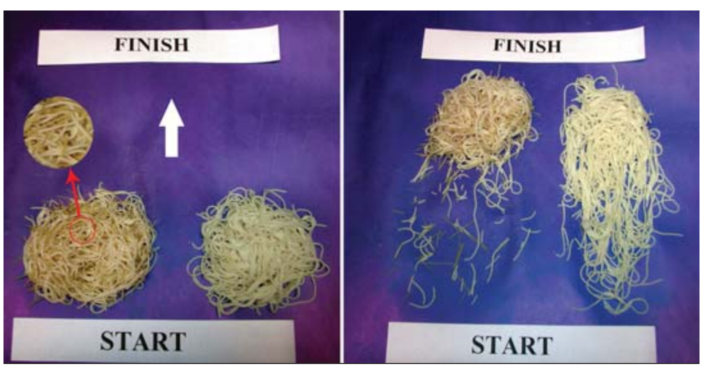

Fig. 4. An addition of dry spaghetti fragments (left piles) toughens a pile of boiled ones

elements are joined together determine the different characteristics and properties of a polymer. Some polymers have loose and flexible bonds, like silicone rubber which is resilient and elastic, while others have more rigid bonds with highly organized chains such as the poly methyl methacrylate which is hard, but brittle.

As the molecular rods are large, elongated molecules that cannot be bent and compressed, [8] these act as reinforcement. Their linearity is explained by a severe movement restriction of the atoms which are joined through covalent bonds. In Fig. 5 is shown the structure of the bis GMA's moiety: the bending of the main chain cannot take place due to the hindrance effect exerted by the two methyl groups which are marked with a different shade.

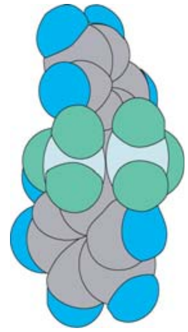

Fig. 5. Space filled model of the bis phenol A moiety. The movement-hindering methyl groups are colored differently and the OH groups are not shown

In 1971 Du Pont launched Kevlar™, a polyaromatic amide (short, Aramid), which is the strongest synthetic material known (five times stronger than steel at equal weight). Its structure is shown in Fig. 6, with its molecular rod marked green.

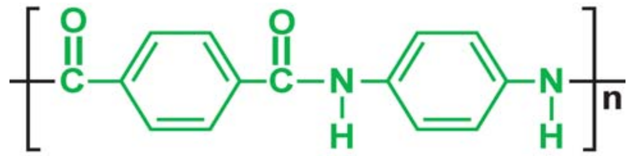

Fig. 6. Poly p(phenylene terephthalamide unit (Kevlar™)

While the aromatic (benzene) cycles are separated, the amide function joining them does not allow the bending of the molecule (as the bond between the carbonyl carbon and the nitrogen, or oxygen). Both functions include partial double bonds which restrict rotation . The same reason makes the peptide molecule (a short protein) to have a planar, rigid structure.

Other polymers, such as the polycarbonates, Fig. 7 (widely used for CDs as well as for the Invisalign™ retainers) and the polysulfones, Fig. 8, have in their structure the same bis phenol A moiety as bis GMA. As their rods are by far shorter, these are weaker than Kevlar™, but stronger than the other polymers, Table I.

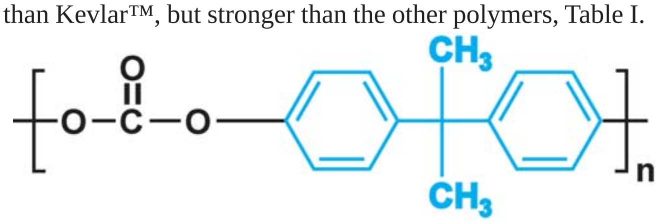

Fig. 7. Polycarbonate unit: observe similitude to bis GMA (the molecular rod is highlighted blue)

Yield Strength of Selected Engineering Thermoplastics kg/cm² (after Dow Chemicals)	
Polystyrene	270
Acrylic	340
Nylon 6.6	460
Polyurethane	490
Polycarbonate*	630
Polysulfone*	710

* Molecular rod structure

Table I

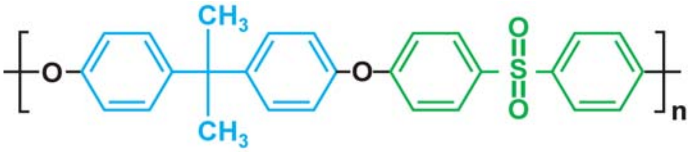

Fig. 8. Polysulfone unit: observe similitude to bis GMA

Searching the literature, we found that the many monomers suggested to replace bis GMA do not have its molecular rod structure, i.e. their chains form random coils similar to boiled spaghetti, as already shown. In contrast, the progress made during the last two decades in the field of strong fibers has led to other molecular rods structures, as shown in Fig.9 and 10, where the units of Vectran™ (Celanese) and Zylon™ (Toyobo) are shown. Vectran™ by Celanese, is considered almost as strong as Kevlar™, and is a copolymer of p-hydroxybenzoic acid and 6-hydroxy-2-naphthoic acid. The presence of three aromatic rings in one single repeating unit makes the polymer chain highly rigid incorporating a perfectly linear rod-like molecule. In Zylon, the repeating unit in the chain is the rigid rod of poly (p-phenylene-2,6 benzobisoxazole).

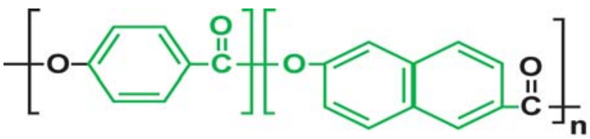

Fig.9. Repeating copolymer unit in Vectran (Celanese)

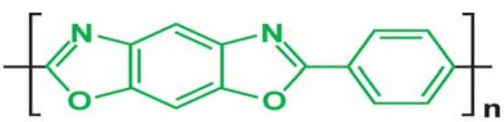

Fig 10. Repeating unit of Zylon (Toyobo)

Sources of rigid monomers are around the corner. These can be selected not to derive from phenols or contain aromatic (benzene) cycles, but from the more nature-related, saturated cyclic compounds. Such is the monomer shown in Fig. 11, which is made from nontoxic ingredients,[9] or the linear diol shown in Fig. 12, the synthesis of which has been equally reported.[10] The conversion of such molecular rods into copolymerizable methacrylates can be successfully performed today by standard chemical procedures.

The best provider for molecular rods: nature

The bulk of the mechanical loads in natural materials are carried by polymer fibers such as cellulose (wood and plants), collagen (animals), chitin (insects, crustaceans) and silks. The fibers are bonded together by various organic substances, sometimes in combination with minerals such as calcium carbonate (mollusk shells) and hydroxyapatite (bone). Even if we don't see them, the fibers/rods are there, at a molecular level. Liquid crystal polymers such as the tobacco mosaic virus, and spider silk are made of relatively rigid molecules. Most of the materials of a living organism are composite materials and many of them are nano-composites. In humans, important examples are the collagen fibers in skin and tendon. The polypeptide molecules form tightly coiled helices which behave like rigid rods.

Fig.11 Long and planar polycyclic monomer in which R can be a methacrylic moiety.

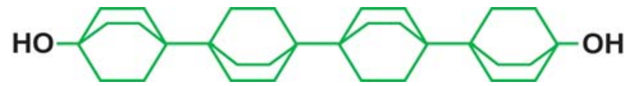

Fig. 12. A polycyclic saturated diol, longer than bis phenol A: 1,1':4',1":4",1"'-Quaterbicyclo[2.2.2]octane-4-4"' diol

Nature's strength is its ability to combine different materials with different properties in such a way that they are tailor-made for the individual applications. Sooner or later, we will be able to copy it. Using nanocomposite materials out of natural components will offer a great opportunity for advanced biomedical materials since they are not only *biodegradable* but also *biocompatible*. Nano-fibrils are currently extracted from natural plant materials and are subsequently combined with various polymers to form nano-bio-composites.

Conclusion

While the human attempts to design structures with rod-like polymers are still primitive, these are steadily making inroads in fields such as electronics (biosensors, switches, nanomotors). Dentistry should keep abreast: The time when it transferred products directly from industry into the patient's mouth should have been since long past.

If we are not yet able to tailor molecules according to all our needs, we should at least use the research already performed in other fields by directing it toward better products.

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A quarter century ago, Buchman tested brackets subjected to different refurbishing processes: measuring their magnetic properties (the Curie point) he found that only Ortho-Cycle's did not have the metal's microstructure altered[3]. After twenty years, an accurate measurement of the dimensional changes involved in the last process showed these to be insignificant only when electro-polishing was replaced by burnishing[4]. As our many competitors do not posses our technology, they damage the attachments in a way you can check:

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- **-Their active, self-engaging ones have their elastic spring annealed,**
- **-Stainless steel attachments became "sensitized", i.e. weak and corrosion susceptible**
- **-The bracket's dimensions were altered, as electropolishing removes metal: the slot is enlarged and the bases loses grip.**

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established and implemented a quality system
in conformity with the requirements in

ISO 13485:2003
Medical devices - Quality management systems - Requirements for regulatory purposes

This certificate is valid until
2006 02 12
provided that surveillance confirms continued fulfillment of the requirements.

Roy I. Holland
Head, NIOM CERTIFICATION

EC-CERTIFICATE

- No. 0230 -

It is hereby declared that, on the basis of our examination under the requirements of Council Directive 93/42/EEC, Annex V, adequate confidence has been provided that

Ortho-Cycle Co., Inc.
2026 Scott St., Hollywood, Florida 33029-2417, U.S.A.

has instituted a quality system in conformity with the requirements in Annex V, clause 3.2, of Council Directive 93/42/EEC for the products/product groups specified on the attached schedule and is for these products/product groups hereby granted the right to affix the CE marking of conformity, accompanied by the notified body identification number of NIOM, 0510.

Audit report no: C-0356/11/01

This EC-CERTIFICATE is valid until 2006 12 13 provided that surveillance confirms continued conformity with the requirements of Council Directive 93/42/EEC.

Roy I. Holland
Head of NIOM CERTIFICATION

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