

Graphy Shape Memory Aligner (SMA) Demonstrates Structural Stability in Simulated Gastric Conditions

- Distinct Microscopic Degradation Patterns Compared with Thermoformed Aligners

MIAMI, FL, UNITED STATES, November 24, 2025 /EINPresswire.com/ -- "[Graphy Shape Memory Aligner](#)" (SMA)

Demonstrates Structural Stability in Simulated Gastric Conditions"

- Distinct Microscopic Degradation Patterns Compared with Thermoformed Aligners

Concerns over the potential release of microplastics (MPs) and nanoplastics (NPs) from clear aligners during long-term wear or reuse have recently emerged as an important safety issue in oral healthcare. Despite this, little is known about how aligner materials behave under acidic environments such as those caused by acid reflux, vomiting, or consumption of acidic beverages while aligners are being worn.

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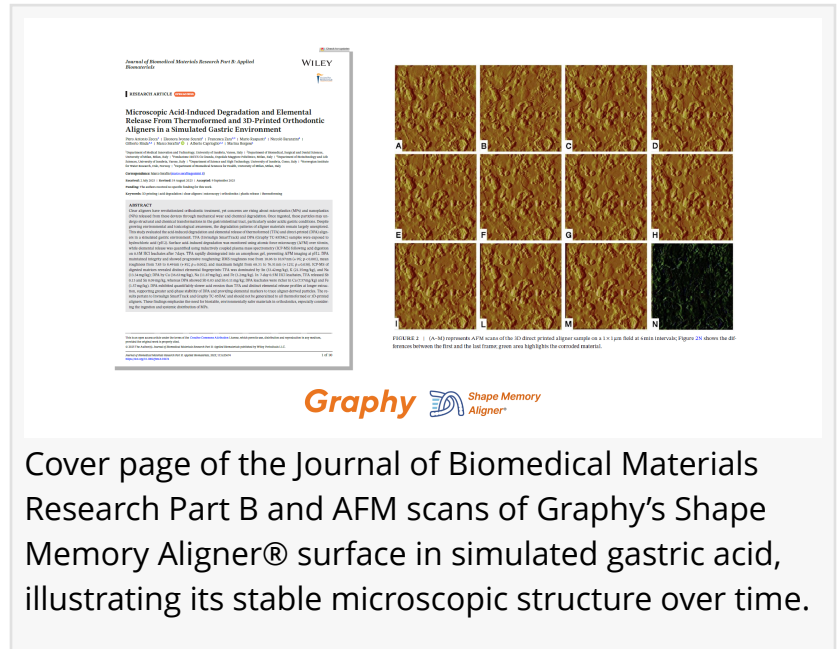
This is the study to quantify micro- and nanoplastic behavior of clear aligners in gastric conditions, positioning SMA as a new benchmark for long-term biostability and material safety.”

Study Authors

A recent study addressed this knowledge gap by conducting a detailed analysis of how clear aligner materials respond to strongly acidic conditions (pH 2), equivalent to gastric acid. The findings highlight clear quantitative differences in structural and chemical stability depending on the material composition and manufacturing process.

The research, published in Journal of Biomedical Materials Research Part B: Applied Biomaterials (IF 4.8, Q1), is titled

"Microscopic Acid-Induced Degradation and Elemental Release from Thermoformed and 3D-



Printed Orthodontic Aligners in a Simulated Gastric Environment.”

[Clear Contrast Under Acidic Conditions: “Dissolution” vs. “Structural Retention”]

Using an Atomic Force Microscope (AFM), the researchers compared a thermoformed aligner (TFA, multilayer polyurethane–copolyester) and the Shape Memory Aligner (SMA, urethane-acrylate-based 3D printed resin) under simulated gastric acid (pH 2 HCl).

The thermoformed material rapidly transformed into a gel-like phase upon acid exposure, losing its surface morphology and exhibiting severe degradation to the point where roughness analysis was impossible. This rapid disintegration indicates a higher likelihood of microplastic particle release.

In contrast, the SMA maintained its structural integrity, showing only gradual and uniform surface roughening over time.

After one hour of exposure, the average roughness (Sa) increased by approximately 8%, and the maximum height (Sz) by about 12%, indicating minimal corrosion and controlled microstructural change.

The researchers attributed this difference to the fundamental variation in chemical architecture and fabrication process, explaining that the shape-memory polymer network of the SMA resists acid-induced breakdown, preserving its structure even under harsh conditions.

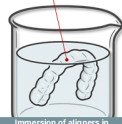
Securing Material Reliability – Proven by SCI-Level Publications

Graphy

SMA, free from microplastic concerns, with objectively proven superior physical and chemical stability.

+ Study Objective: To evaluate the potential for microplastic and ion release under gastric-simulated conditions during prolonged intraoral wear.
Comparison: SMA vs Thermoformed aligners (TFA)

«Sample Types»
- SMA: block (5 x 5 x 0.5 mm)
- TFA: film (0.5mm)



Graphy
Shape Memory Aligner

SMA Maintains Both Dimensional and Chemical Stability

- Even in acidic environments (pH 2), the polymer matrix structure remains intact over time
→ No deformation or signs of chemical degradation
- SMA retains its shape and chemical stability even under extreme acidic conditions
→ Ensures long-term intraoral safety with **no microplastic release**
- Tested under 1,000x larger volume than control group (unfavorable condition)
→ Larger volume slows dissolution, but reveals weaknesses in material stability such as cracking, internal stress, and structural inconsistency

TFA
(Thermoformed Aligner)

Thermoformed Aligners: Risk of Microplastic and Metal Ion Absorption

- Under acidic exposure (pH 2), the surface rapidly degrades and forms a gel-like layer
→ Loss of shape and generation of microplastics
- TFA aligners pose a **risk of internal absorption and accumulation of microplastics and metal ions**

10. Zorica, Rana Anthony, et al. "Microscopic acid-induced degradation and elemental release from thermoformed and 3D-printed orthodontic aligners in a simulated gastric environment." Journal of Biomedical Materials Research Part B: Applied Biomaterials 132(2).
© Journal of Biomedical Materials Research Part B: Applied Biomaterials, a leading peer-reviewed journal specializing in biomaterials, structure analysis, clinical application, and regulatory science.

Scientific summary slide showing that Graphy's Shape Memory Aligner® maintains both dimensional and chemical stability in acidic conditions, unlike thermoformed aligners that risk microplastic and metal ion release.



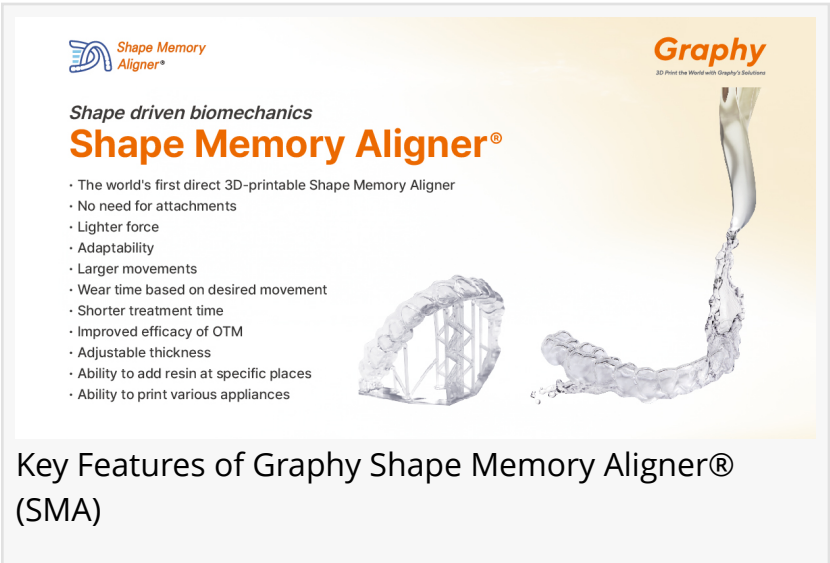
Inside Graphy's Seoul showroom

Graphy  **Shape Memory Aligner®**

Corporate and brand identities of Graphy and the world's first direct 3D-printable Shape Memory Aligner® — a game-changer in digital orthodontics.

[Establishing a New Benchmark for Microplastic Safety]

This study is the first quantitative analysis of micro- and nanoplastic behavior of clear aligners under simulated gastric conditions. The authors emphasized that “even aligners that appear similar may exhibit entirely different structural stability and elemental release patterns depending on their base materials and manufacturing methods.”

The advertisement for Graphy Shape Memory Aligner® (SMA) features a yellow background. At the top left is the 'Shape Memory Aligner®' logo with a blue and orange icon. At the top right is the 'Graphy' logo with the tagline '3D Print the World with Graphy's Solutions'. The main title 'Shape driven biomechanics Shape Memory Aligner®' is prominently displayed. Below it, a list of features includes: 'The world's first direct 3D-printable Shape Memory Aligner', 'No need for attachments', 'Lighter force', 'Adaptability', 'Larger movements', 'Wear time based on desired movement', 'Shorter treatment time', 'Improved efficacy of OTM', 'Adjustable thickness', 'Ability to add resin at specific places', and 'Ability to print various appliances'. To the right of the text are two 3D printed models of dental aligners: one showing a full arch and another showing a side profile. Below the advertisement, the text 'Key Features of Graphy Shape Memory Aligner® (SMA)' is written in a grey box.

Shape Memory Aligner®

Shape driven biomechanics

Shape Memory Aligner®

- The world's first direct 3D-printable Shape Memory Aligner
- No need for attachments
- Lighter force
- Adaptability
- Larger movements
- Wear time based on desired movement
- Shorter treatment time
- Improved efficacy of OTM
- Adjustable thickness
- Ability to add resin at specific places
- Ability to print various appliances

Key Features of Graphy Shape Memory Aligner® (SMA)

The SMA demonstrated acid-phase stability, retaining its morphology and chemical integrity even in strong acidic environments. These findings are directly related to key clinical factors such as long-term safety during wear, reduction in fracture risk, and mitigation of surface degradation, offering a new evidence-based foundation for evaluating the biostability of aligner materials.

With more than 200,000 clinical applications worldwide, SMA technology has already shown superior resistance to micro-corrosion, mechanical durability, and consistent orthodontic force retention compared with conventional thermoformed methods. This study provides fundamental scientific validation for those clinical observations, confirming that SMA materials maintain their integrity not only in clinical use but also in extreme environmental simulations.

Paper Information: <https://doi.org/10.1002/jbm.b.35674>

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