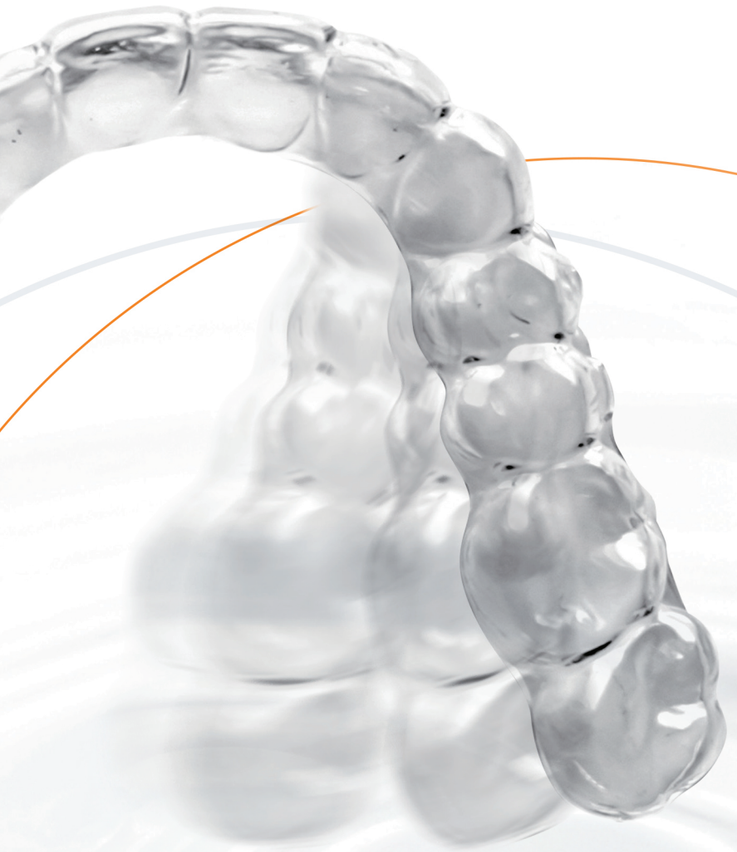
Shape Memory Aligner®

Graphy

World's 1st
Direct Printed Aligner
Shape Memory Aligner®



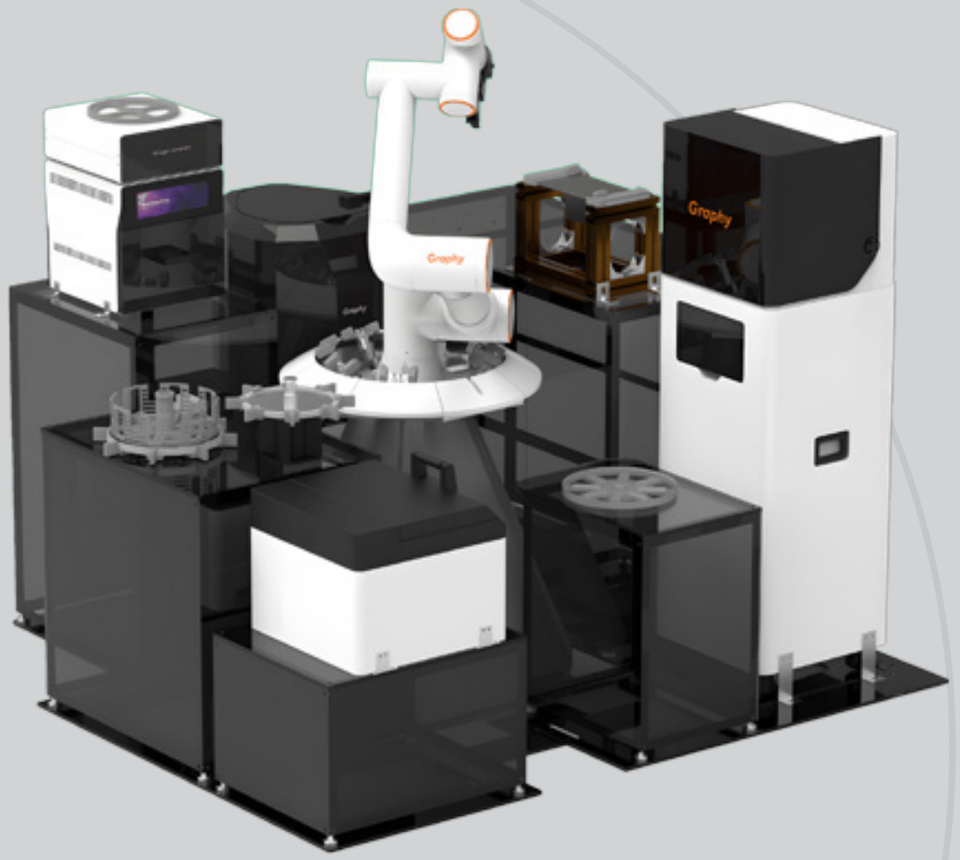
World's first patented technology Shape Memory

DIAR TAJHIZ
ONGOING SMILES

Exclusive Distributor
021-24816

Graphy

3D Print the World with Graphy's Solutions



About Graphy Inc.

Korea's leading manufacturer of 3D printer materials

Graphy Inc.

Is a company that develops and manufactures new materials (photocurable resin) that specializes in 3D printing-based technology, a major element of the 4th industrial revolution, and has optimized knowledge of new material technology and medical convergence technology. With thesuccessful development of Tera-Harz; we are growing into a global company through partnershipswith the world's leading companies in the 3D printer material business field.
Grapy is not going to stop at manufacturing and developing materials, but aims to apply 3D printer technology to real life by supplying various 3D printer application solutions and medical solutions to the market.

Conference & Exhibition

Shape Memory Aligner® Specialists Around the World

What world-class scholars and speakers are saying about Shape Memory Aligner®

Prof. Ravindra Nanda Professor Emeritus
Department of Orthodontics University of Connecticut
Adjunct Professor The Forsyth Institute
Editor-in-Chief Progress in Orthodontics

"What made the big difference in orthodontics especially with the wires and bracket was when we introduce shape memory wires, wires which change their characteristic with the heat as well as when you're going to put up in the mouth then force is going to remain pretty stable over a long period of time. And this is what now Graphy aligner material is going to do."

Prof. Ki Beom Kim, DDS, MSD, PhD
Dr. Lysle Johnston Endowed Chair in Orthodontics
Professor and Program Director
Department of Orthodontics
Center for Advanced Dental Education
Saint Louis University

"I think the Graphy material is an innovative material that can fundamentally overcome the disadvantages and limitations of existing thermoplastic materials, as well as the simplicity of device manufacturing."

Dr. Werner Schupp
Editor in Chief "Journal of Aligner Orthodontics"Quintessence Publishing
Editor for "Manuelle Medizin und Kieferorthopadie"(Springer Verlag)
Advisory Board "Kieferorthopadie" Quintessenz Verlag

"Advantages of 3D aligner printing: Tera Harz Clear is more flexible and has a larger elastic range.
Perfect fit to tooth, almost no gap"

Dr. Kenji Ojima
D.D.SM.D.Sc
Invisalign faculty
Adjunct Professor University of Torino
President of Japan Academy of Aligner Orthodontics

"This material is a verynew future.
There's a better way for new generation aligners on orthodontics

Dr. Bjorn Ludwig
Assistant Professor at the University of Homburg/Saar, Department of Orthodontics
Editor in chief of the Quintessenz publication "Kieferorthopadie"
Co-editor of the Journal of clinical Orthodontics

"I had to print out the aligners the same day, and it worked, because I can print it out in my office. It gives me control, it gives me the power. "

Dr. Yong-Min Jo
Since 2020 Shareholder and Chief Business Development & Innovation Office at Scheu Group:
Scheu Dental, CA Digital, Smile Dental Companies

"The innovative advantage of the new aligner material is the continuous power transmission thanks to its memory effect. Due to this effect, the aligner permanently returns to its original shape, which has a positive effect on the power transmission and rigidity of the aligner."

Dr. Nearchos C. Panayi
Scientific coll. European University Cyprus
Visiting Research Scientist, Clinic of Orthodontics, University of Zurich,
Author "Design It Yourself Orthodontics" book, Quintessence
Associate Editor "Progress in Orthodontics"

"Preliminary results show excellent mechanical properties.
It is clear to see that aligner printing is here to stay. The river cannot reverse. Nevertheless, in order to have a consistence and excellent result, Graphy has created a protocol which needs to be followed beginning from the appropriate aligner design, printing, and most important, UV curing."

Dr. Simon Graf
Smile AG
Inventor and pioneer in CAD/CAM procedures for metal and acrylic 3D printed orthodontic appliances

"The two ways of aligners!
Now direct printed instead of vacuumforming."

Dr. Akim Benattia
Dr. Akim Benattia has served as a former assistant at universities in France and currently holds positions as the General Secretary of the French Aligner Society, as well memberships in The European Aligner Society, the Japan Aligner Academy, and the Deutsche Gesellschaft fur Aligner Orthodontie. Since 2015, he has been an international speaker, presenting in countries such as France, Tunisia, Italy, Spain, Morocco, Taiwan, Ukraine, Greece, Dubai, Latvia, and Austria.

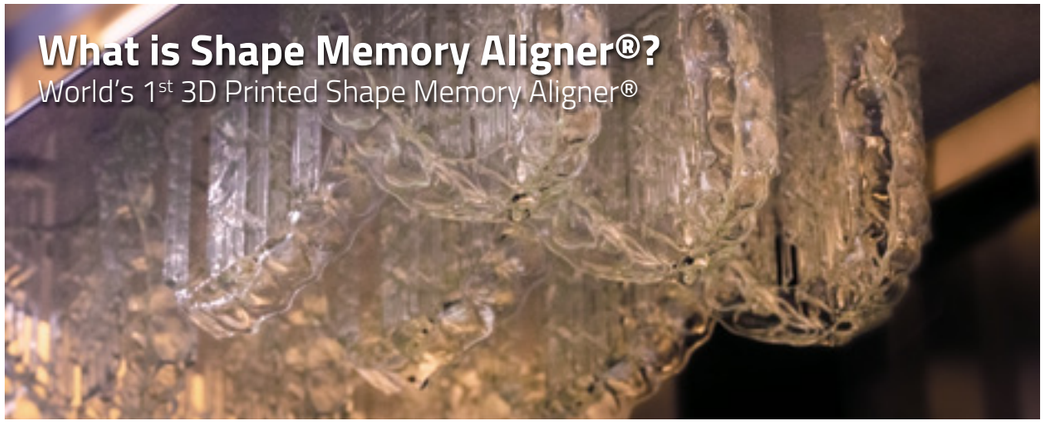
"Advancements in Graphy materials significantly enhance the potential of Clear Aligner Therapy thanks to it's Shape Memory properties"

Dr. Choon Gwack
PNU School of Dentistry DDS PhD
Vice President of the KAO Busan Gyeongnam-Ulsan Division
Vice President of the KSDO
Orthodontic practice director of BarunE Orthodontic Clinic

"Made from shape memory polymers, Shape Memory Aligner®s are moderately elastic at intraoral temperatures and soften at higher temperatures. They have the advantage of being manef~tured without blockout_s for easy insertion, so you can achieve good, predictable alignment with minimal attachments."

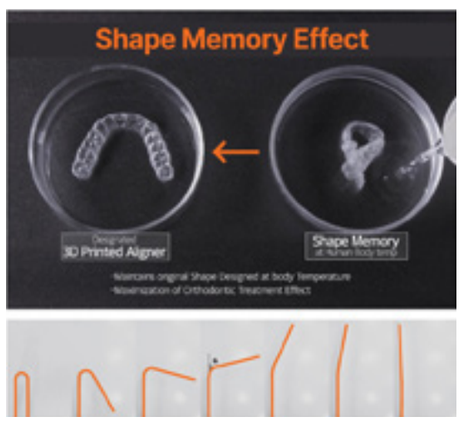
Dr. Young Jin Jeon
Graduate of PNU School of Dentistry, DDS PhD
Invisalign Speaker for Asia-Pacific (APAC)
Assistant Professor of Orthodontics, Case Western Reserve University
Orthodontic Practice Director, Erumi Orthodontic Clinic

"Just as Shape Memory Wire enhanced bracket orthodontics, Shape Memory Direct Aligner will revolutionize clear aligner treatment."

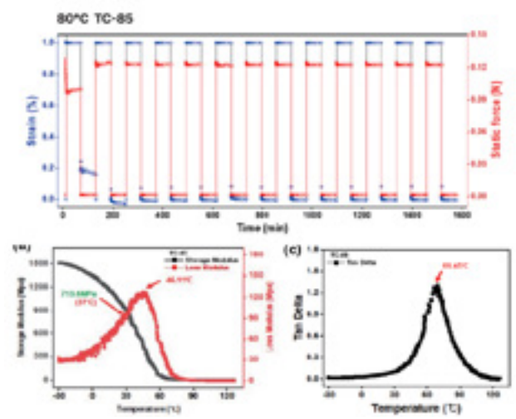


Shape Memory Aligner® is more than just a clear aligner. It's not any typical clear aligner, and it's not just a 3D print. It is the world's first patented product to feature Shape Memory. A state-of-the-art aligner recognized by orthodontic masters around the world.
The Shape Memory Aligner® is a new paradigm in orthodontics, far beyond brackets and other traditional methods. Shape Memory Aligner® is an aligner that uses digital information from a patient's mouth to print directly to a 3D printer, bypassing the step of creating a
tooth model.
Shape Memory Aligner® is a medical device that reduces production time, is suitable for biomechanical movements such as adjusting the thickness of each tooth, which is not possible with conventional thermoforming manufacturing methods, and is harmless to the human body.

Shape Memory Aligner® mechanical property



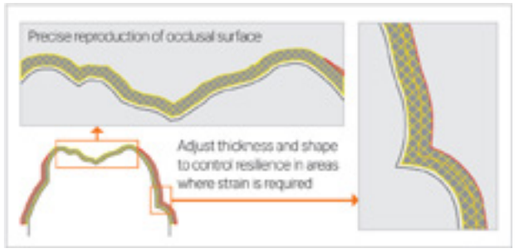
Shape memory effect and shape recovery ratio over time of TC-85



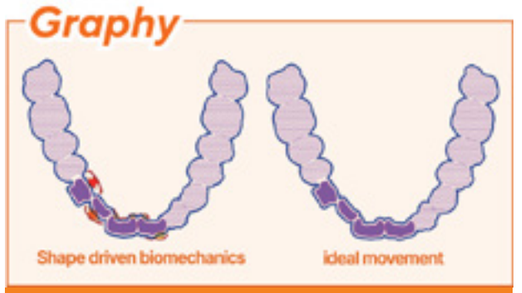
Reference: Lee, S. Y., Kim, H., Kim, H. J., Chung, C. J., Choi, Y. J., Kim, S. J., & Cha, J. Y. (2022). Thermo-mechanical properties of 3D printed photocurable shape memory resin for clear aligners. Scientific Reports, 12(1), 1-10.

Shape Memory Aligner®

Adjustable strain and resilience

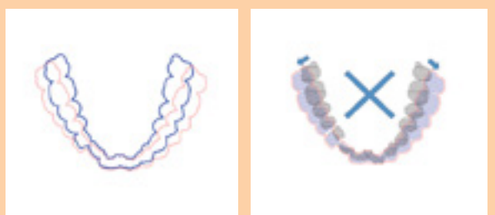


Shape driven biomechanics



However, with the Shape Memory Aligner®, the released forces keep coming back over and over again by the effect of Shape Memory.

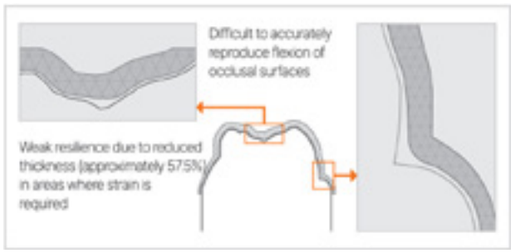
Reference: Koenig, N., Kim, KB. D.D.S., M.S.D., Ph.D. (2022). Comparison of dimensional accuracy between direct-printed and thermoformed aligners. The Korean Journal of Orthodontics, Article In Press. Published online



The deformation of the arch form of the Shape Memory Aligner® does not cause deformation of the entire tooth span.
In addition to the risk of fracture when 3D printing aligners with traditional materials, aligners without shape memory limit the orthodontic ability to return to its original shape when it is deformed

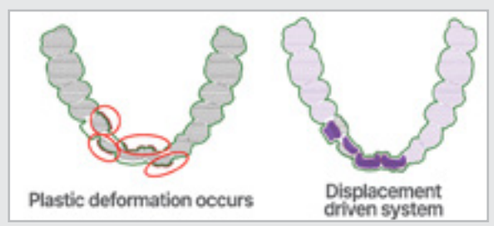
Shape Memory Aligner®

Adjustable strain and resilience



Shape driven biomechanics

This is a displacement driven system and not a force driven system, but Shape driven biomechanics is ideal.



When the center red circle loses strength for the limit of the material's stress, the orthodontic force weakens.

Direct printing allows for strategic thickness control of orthodontic treatment

The thickness of the Shape Memory Aligner® is adjustable part by part, allowing for the fabrication of customized treatment plans for each patient.
On the other hand, conventional clear aligners use thermoformed sheet paper, which is easily deformed. The compression thermoforming makes it difficult to produce aligners of the intended thickness, and it is impossible to adjust the thickness of each tooth to provide orthodontic force to the tooth, resulting in cumulative errors due to multiple steps in the process.

Easy brushing

Healthy teeth and gums, deodorizing bad breath

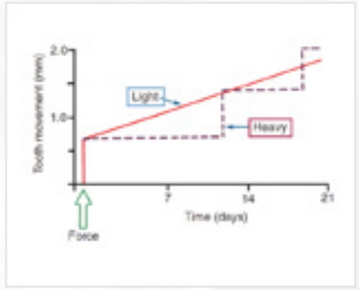
Maximize the effectiveness of orthodontic treatment

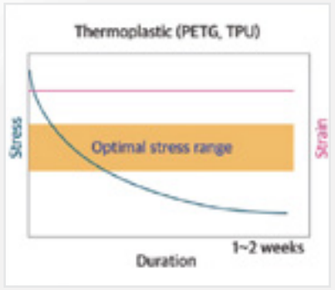
Less stress on the jaw joint

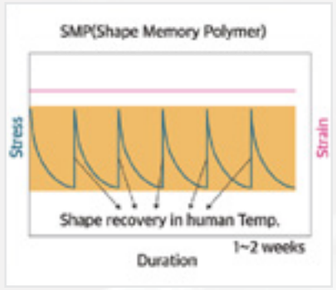
Minimized inconvenience when putting on and taking off, hygienic management through heat disinfection

Minimizing block out for intraoral wearing and removal improves orthodontic power and makes patient more comfortable.
The Shape Memory Aligner® can be heat disinfected by placing it in hot water, so it's always in pristine condition. It's also made of body-friendly materials.

Light & Continuous force







Aligners made of conventional thermoplastic sheets generate an initial heavy force that strains the teeth, causing patient pain, and then rapidly drops below the appropriate force, resulting in an inability to maintain the tooth movement force and achieve the intended orthodontic result.

Due to its innovative technology and material properties, the Shape Memory Aligner® allows for light & continuous force to achieve the intended alignment results. Shape Memory Aligner® induces light and sustained force. Light & Continuous Force induces smooth, continuous tooth movement while activating cells.

Reference : Contemporary Orthodontics. William R. Proffit et al. 6 edition p.263-266

Shape Memory Aligner® patents and medical device safety certifications

Application No.	Patent No.	Title of Patent
10-2018-0099277		RADIATION CURABLE POLYMER COMPOSITION FOR 3D PRINTER
10-2018-0123132		PHOTOCURABLE COMPOSITION FOR 3D PRINTER FOR PRODUCING TRANSPARENT ORTHODONTIC DEVICE
10-2020-0033430		Patient-specific orthodontic device using 3D printing and orthodontic method using the same
10-2020-0172326		Transparent aligner with increased correction power
10-2021-0052197		Post-curing method of 3D printer output and transparent orthodontic device manufactured by the method

World's first "FDA 510k Class II", 'CE Class II'. "MFDS Class 2", "PMDA Class II" Cleared

Shape Memory Aligner® Related articles

Shape Memory Aligner® about 50 relevant SCI-quality international journal articles Collaborations with overseas companies and research institutes and schools are expanding and are now academically recognized.

Orthodontics Platform

DAD

In-house Producuion

- Graphy's 'Direct Aligner Designer (DAD)' is orthodontic simulation software that allows treatment plan establishment, setup, and design work to be performed in one software.
- The automatic separation and alignment function can provide orthodontic simulation results for patients with malocclusion within 5 minutes.

Analysis
Create an orthodontic plan with 2D/3D analysis.

Orthodontic Treatment
Based on the orthodontic theory, controls the movement of teeth.

VerificatiOn
Check and correct teeth movement and occlusion.

Report
Create a treatment plan as a report in various forms.

Production
Adjust the thickness and shape of the Shape Memory Aligner®.

Print
Attach supports to the aligner shells to speed up the 3D printing process.

GraphyTeams

Interactive platform for Shape Memory Aligner

- Graphy provides a custom production service where users do not produce shape memory aligners themselves, but instead request production and have it delivered.
- 'GraphyTeams' allows you to intuitively check reception details, progress status for each patient, delivery status, etc. through a cloud-type database.

Communication

Online reception
Register SMA cases online by attaching > a patient photo, entering information, and leaving comments.

Diagnosis-setup design
It conducts accurate diagnosis and setup design using oral and face scan data.

Verification -Confirmation/ Modification (inspection by Orthodontists)
Customers can directly check/edit files that Graphy has designed online It also provides feedback from Graphy's orthodontists..

Delivery and Payment Database Management/Storage
Customers can check real-time progress, including payment, delivery, and progress status, all through GraphyTeams. It provides efficient management functions through cloud database.

Tera Harz Cure

3rd Generation Nitrogen Curing Machine

World's first UV curing device to achieve polymerization conversion of materials 100%

- 280,000Mj/cm2,1,000MW/cm2(5 minute-curing based), the best material intensity and shade with high-intensity UV energy
- Ability to store 5 curing conditions per material
- The optimal light level for each printed materials(Level 1-5)
- 360° UV irradiation and optimal LED arrangement for best light uniformity
- Safety cooling system based on LED temperature
- Maximum curing size(180mm,360 Turntable)

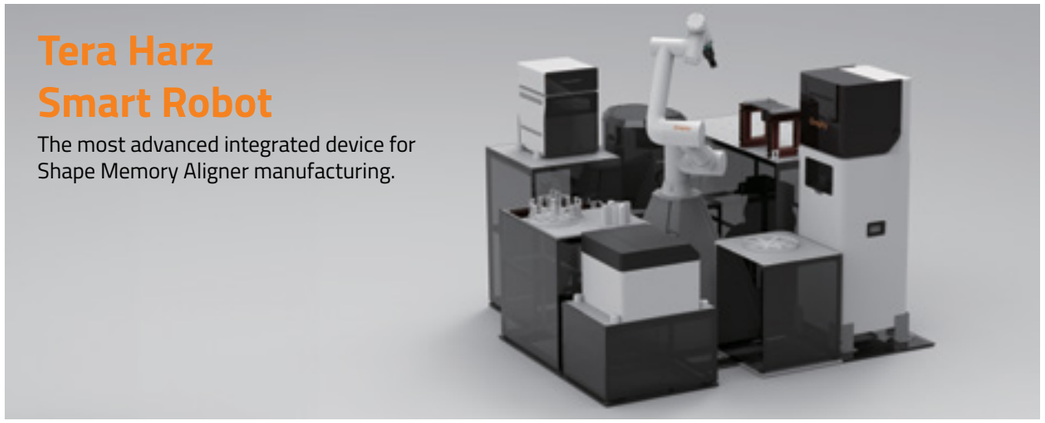
Nitrogen Generation

Minimize Oxygen in the Chamber (artificial image)

Benefits of Nitrogen Curing

Able to obtain the best mechanical properties and optimal shading Minimize oxygen to improve surface quality for C&B, denture fabrications, etc. Perfect final metal crown alignment by improving casting surface quality Nitrogen curing is mandatory for dental and medical field products (for surface tacky and residual polymer removal) Improved economic efficiency and convenience compared to existing nitrogen curing machines connected to a nitrogen tank.

Properties	Description
Display	7.9" TFT Touch LCD
LED Wavelength	405nm
LED Power	200W
UV Energy Density Irradiance of UV (5 minute-curing based)	280,000 mJ/cm2 1,000 mW/cm2
Curing Chamber	0180 x 650mm
Dimension (weight)	275 x 310 x 310mm (8.5kg)



Advantages of Tera Harz Smart Robot

This system is more than just a system. The excellence of the world's first Shape Memory Aligner is more elaborated, possible by introducing a state-of-the-art robot-system for greater excellence and convenience. Shape Memory Aligner is made more efficient with the solution of Graphy's new Tera Harz Smart Robot.

1 Competitive excellency in technology
Deliver consistent quality of product, 24hr operation time and optimized automated reprogramming.

2 Improvement outcomes
Improve the quality of the outcome through sophisticated operation.

3 Economic benefits
Reduce consumables, accelerate the treatment and enhance productivity.

4 Time efficiency
Same day and convenient treatment.

Description	Specification
Product Name	Tera Harz Smart Robot (THSR)
Model Name	R2K2U
Weight(Kg)	20
Application	In-house Aligner Manufacturing (lab/clinic)
Voltage	220V(110V Compatible Module Provided)
Usage	Production Line
After Warranty Service	Video Technical Support
Type	6-axis Vertical Multi-joint
Machine type	Aligner Manufacturing Robot Arm 6 Axis
Aligner Material	Tera Harz Clear
Warranty	1 year

Shape Memory Aligner® Package

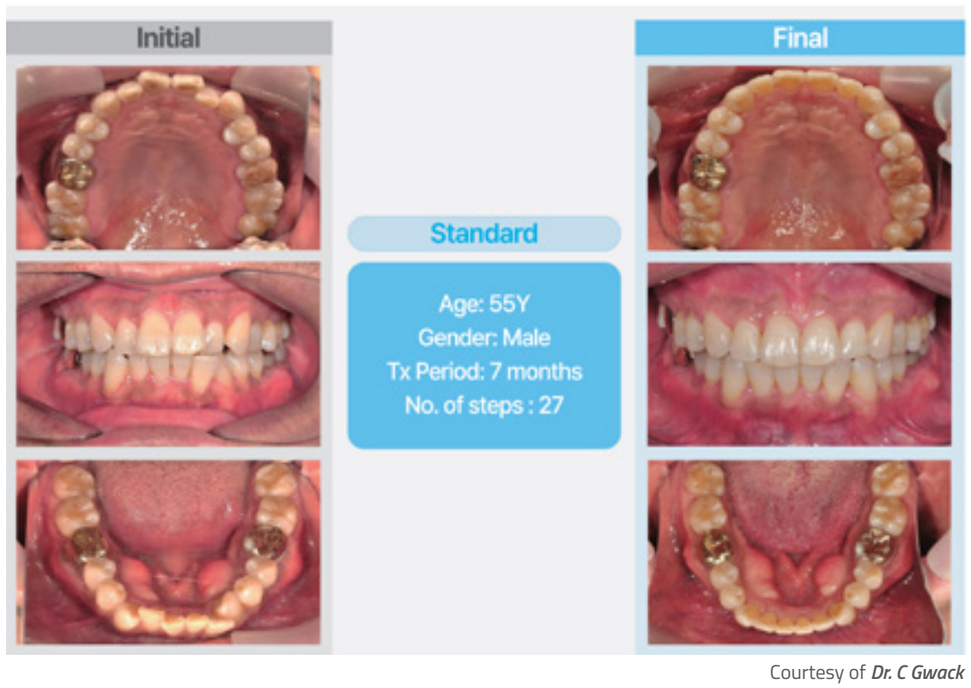
Treatment Option	SMA Lite II	SMA Standard	SMA Advanced
Number of Steps	Up to 16	Up to 30	More than 30
Treatment Period	4~6 Months	7~10 Months	3 Years
Warranty Period	12 Months	2 Years	3 Years
Additional Extension Aligner	N/A	Max. 15 Steps	No limit within warranty period
Scope of Treatment	Normal Orthodontic Treatment	Normal Orthodontic Treatment	Extraction Case, Complex treatment
Treatment Example	■ Anterior A. Crowding: Simple ~ Moderate B. Spacing case C. In/Extrusion: under 1-2mm D. Rotation (under 15 °) E. Relapse case ■ Posterior A. In/Extrusion : less than 1mm B. Distalization	■ Anterior A. Severe Crowding B. 4 anteriors Rotation: under 30° C. In/Extrusion : over 2mm (elastic) ■ Posterior A. Canine – Posterios rotation : under 15° B. In/Extrusion in 2mm (Attachment/Elastic) C. Mesio/Distalization	■ Anterior A. Extraction case - anteriors/ premolar B. Easing skeletal malocclusion C. Rotation : over 30° D. Posterior expansion E. In/Extrusion : over 2mm(Att/ Elastic)

Shape Memory Aligner® Case

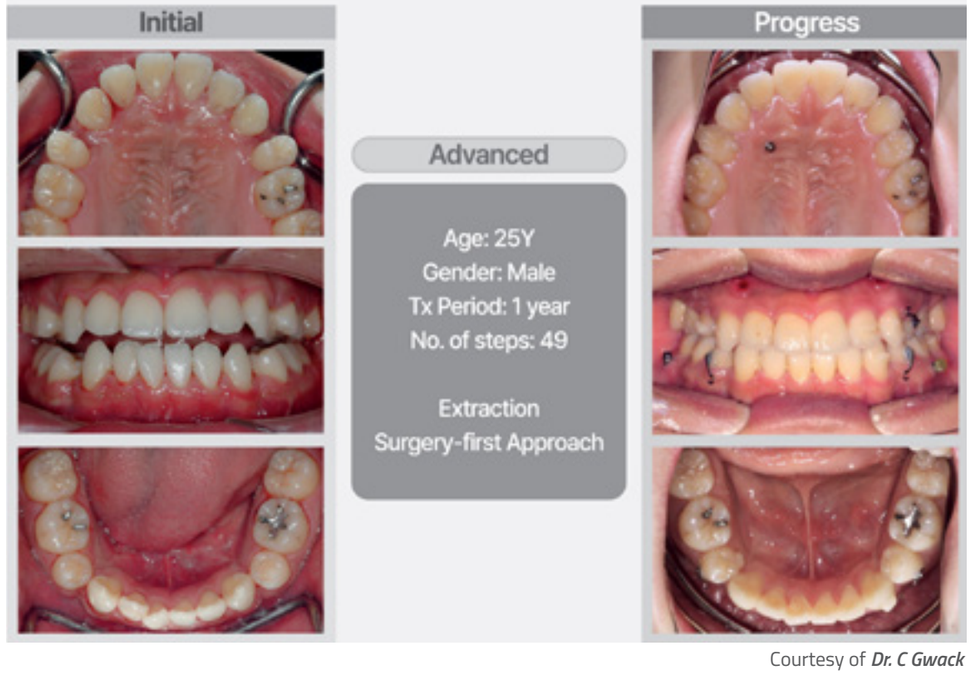
Courtesy of ***Graphy***

Courtesy of ***Graphy***

Shape Memory Aligner® Case



Courtesy of ***Dr. C Gwack***



Courtesy of ***Dr. C Gwack***

Shape Memory Aligner® Case | Advanced

Moderate to severe crowding case

Achieving Excellent Outcomes in Narrow Dental Arch Cases Without Extractions

Courtesy of ***Dr. Kenji Ojima, Japan***

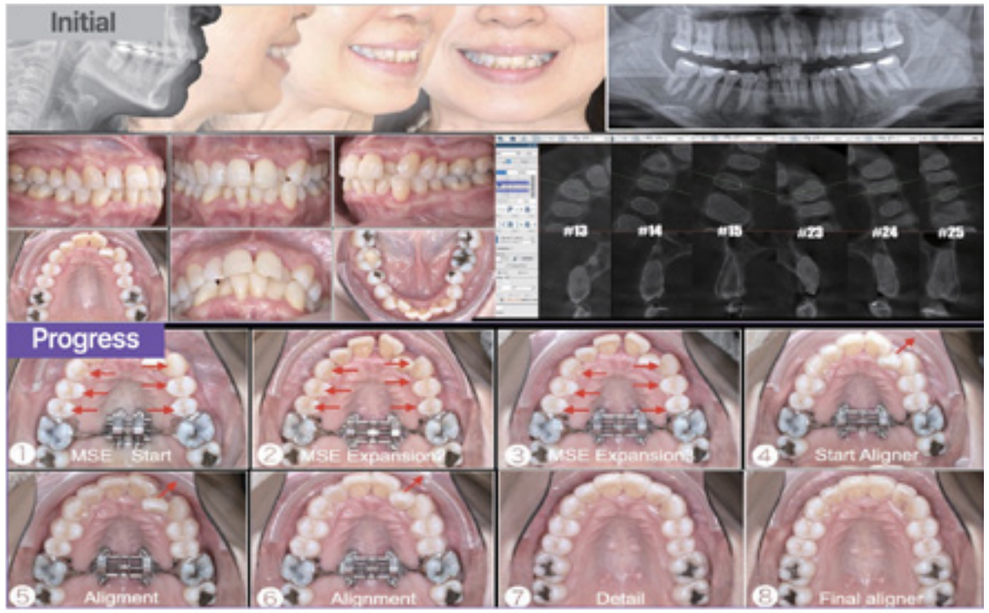
Asymmetric premolar extraction

Outstanding Orthodontic Results in Asymmetry Case by Asymmetric Extraction

Courtesy of ***Dr. Kenji Ojima, Japan***

Shape Memory Aligner® Case | Advanced

MSE [Maxillary skeletal expander] combined case



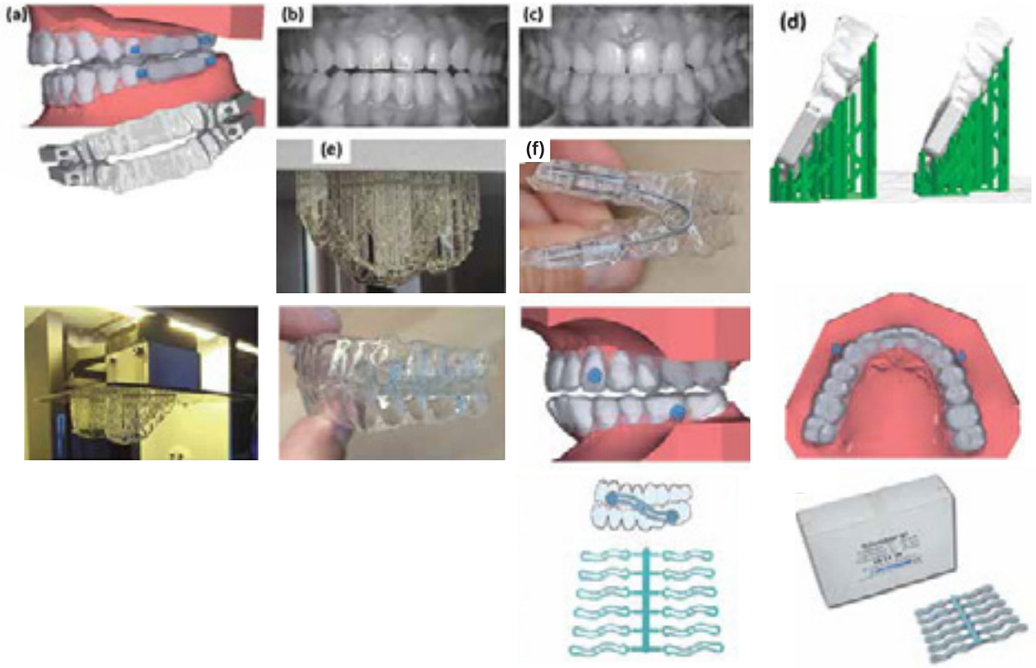
Courtesy of ***Dr. Kenji Ojima, Japan***

Creative Ideas

U2's missing

19Y Female	Initial	Fixed appliance 13 months Tx	Progress	Initial

U2's missing



Bichu, Y. M., Alwafi, A., Liu, X., Andrews, J., Ludwig, B., Bichu, A. Y., & Zou, B. (2023). Advances in orthodontic clear aligner materials. Bioactive Materials, 22, 384-403.

Courtesy of ***Dr. Bjorn Ludwig, Germany***

Initial

9Y Male

Progress #10 (Aligners on)

Growth Modification Approach Twin Block Design

Initial

11 Y Female

Progress #6 (Aligners on)

Courtesy of ***Dr. Simon Graf, Swiss***

Clinical Case Reports

JOURNAL OF CLINICAL ORTHODONTICS

QUINTESSENCE PUBLISHING DEUTSCHLAND

Journal of Aligner Orthodontics

ScientificScholar®
Knowledge is power

Publisher of Scientific Journals