October 7, 2022

Gruppo Europeo Ortodonzia srl
℅ Carlo D`Alessandro
Director, Quality and Regulatory
Donawa Lifescience Consulting srl
Piazza Albania, 10
Rome, 00153
ITALY

Re: K222418
Trade/Device Name: Nuvola
Regulation Number: 21 CFR 872.5470
Regulation Name: Orthodontic Plastic Bracket
Regulatory Class: Class II
Product Code: NXC
Dated: August 5, 2022
Received: August 10, 2022

Dear Carlo D`Alessandro:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. Although this letter refers to your product as a device, please be aware that some cleared products may instead be combination products. The 510(k) Premarket Notification Database located at https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm identifies combination product submissions. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803) for devices or postmarketing safety reporting (21 CFR 4, Subpart B) for combination products (see https://www.fda.gov/combination-products/guidance-regulatory-information/postmarketing-safety-reporting-combination-products); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820) for devices or current good manufacturing practices (21 CFR 4, Subpart A) for combination products; and, if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to https://www.fda.gov/medical-devices/medical-device-safety/medical-device-reporting-mdr-how-report-medical-device-problems.

For comprehensive regulatory information about medical devices and radiation-emitting products, including information about labeling regulations, please see Device Advice (https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance) and CDRH Learn (https://www.fda.gov/training-and-continuing-education/cdrh-learn). Additionally, you may contact the Division of Industry and Consumer Education (DICE) to ask a question about a specific regulatory topic. See the DICE website (https://www.fda.gov/medical-devices/device-advice-comprehensive-regulatory-assistance/contact-us-division-industry-and-consumer-education-dice) for more information or contact DICE by email (DICE@fda.hhs.gov) or phone (1-800-638-2041 or 301-796-7100).

Sincerely,

Michael E. Adjodha, M.ChE.
Assistant Director
DHT1B: Division of Dental and
ENT Devices
OHT1: Office of Ophthalmic, Anesthesia,
Respiratory, ENT and Dental Devices
Office of Product Evaluation and Quality
Center for Devices and Radiological Health

Enclosure

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Food and Drug Administration

Indications for Use

Form Approved: OMB No. 0910-0120
Expiration Date: 06/30/2023
See PRA Statement below.

510(k) Number *(if known)*

K222418

Device Name
Nuvola®

Indications for Use *(Describe)*
Nuvola® aligner is intended for the orthodontic treatment of malocclusion

Type of Use *(Select one or both, as applicable)*

☒ Prescription Use (Part 21 CFR 801 Subpart D) ☐ Over-The-Counter Use (21 CFR 801 Subpart C)

CONTINUE ON A SEPARATE PAGE IF NEEDED.

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K222418

510(k) SUMMARY

Gruppo Europeo Ortodonzia srl (G.E.O. srl) – Nuvola®

General Information

510(k) Sponsor	Gruppo Europeo Ortodonzia srl (GEO S.r.l.)
Address	via Cropani, 118 A/B 00173 - Rome, Italy
FDA Registration Number	---
Contact Person	Massimiliano Bucceri CEO and Founder
Contact Information	maxbucceri@nuvolaortodonzia.com +39 06 72671754
Date Prepared	05 August 2022

Name of Device and Name/Address of Sponsor

Name of Device	Nuvola
Name/Address of Sponsor	Gruppo Europeo Ortodonzia srl (GEO S.r.l.) via Cropani, 118 A/B 00173 - Rome, Italy
Trade/Proprietary Name	Nuvola®
Common Name	Aligner, Sequential
Classification Name	Orthodontic Plastic Bracket

Predicate Device

Name of Device	Invisalign System
Name/Address of Sponsor	Align Technology, Inc. , 2820 Orchard Parkway, San Jose, CA 95134
Trade/Proprietary Name	Invisalign System (K220287)
Common Name	Aligner, Sequential
Classification Name	Orthodontic Plastic Bracket

Reference Device

Name of Device	Ortho Aligner System
Name/Address of Sponsor	Ortho Lab Services LLC, 251 Little Falls Wilmington, DE 19808
Trade/Proprietary Name	Ortho Aligner System (K212496)
Common Name	Aligner, Sequential
Classification Name	Orthodontic Plastic Bracket

Intended Use

1. Device description

The Nuvola® device is a doctor-prescribed series of removable plastic orthodontic aligners intended as an alternative to conventional wire and bracket technology. The Nuvola® gently moves teeth in small increments from their original state to a final, treated state for improved dental alignment. The system is used in patients with primary, mixed, and permanent dentition. The system consists of a series of doctor prescribed and customized plastic aligners (thermoformed PET-G sheeting material) that gently move the patient's teeth in small increments from their original state to a more optimal, treated state to address malocclusion. The first device of the treatment matches the patient's dentition in its current state and then each subsequent aligner stage has the shape of the dentition shifted gradually toward the final desired position.

The main phases of Nuvola® production are described in the following:

The manufacturing process start with obtaining the dimensions and details of the patient's baseline dentition from the prescribing clinician who takes scans of the patient's teeth and upload them into Nuvola®Web software. The scanned data (digital CAD/CAM model) are imported into specialized dental software for treatment planning (Nuvola®Web). Specialized orthodontic CAD/CAM software will be used to develop the treatment plans and to produce standard 3D printer files that will facilitate the manufacturing of each sequential aligner in the treatment plan. The software application used for the manufacturing validation in this submission is the 3Shape Ortho System (K152086).

The Nuvola®Web software displays a series of 3-D dentition images with virtual tooth movements set up based on the doctor's prescription. The treating dental practitioner reviews these images and has the option to reject or request modifications to the set-up prior to approving it for aligner fabrication. Once the doctor approves the set-up, based on this set-up a custom-made series of thermoplastic polymer aligners are then manufactured at the aligner manufacturing facility. 3D printers are used to create the molds needed for each treatment step to provide the surface around which the aligner is thermoformed.

The final step is the thermoforming of a plastic sheet material to each of the sequential treatment steps. This process is done using a standard thermoforming equipment and the appropriate material as outlined in this submission. The thermoformed aligners are sent back to the dentist for distribution to the patient in sequential stages and that the dentist checks the aligners for fit and function and monitors the treatment from the first aligner until treatment is completed.

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2. Indications for Use

Nuvola® aligner is intended for the orthodontic treatment of malocclusion.

3. Non-clinical studies and tests performed

Non-clinical tests have been conducted to verify that the Nuvola® aligner meets all design specifications which supports the conclusion that it's Substantially Equivalent (SE) to the predicate and reference devices.
The following Non-clinical studies and tests were conducted and are summarized in the table below:

Manufacturing validation	Manufacturing validation was performed to verify that the manufacturing process for Nuvola® Aligner complies with the pre-established specifications and acceptance criteria.
Biocompatibility Testing	Biocompatibility was assessed in accordance with ISO 10993-1. The tests on the material Erkodur have been performed by the supplier of the material itself.
Shelf life	A 1-year shelf life was determined by real-time aging testing
Packaging	Package integrity, via simulated transport test per ISTA 2A, has been performed
Treatment Planning software validation	Nuvola®Web (treatment plan platform) is validated by G.E.O in accordance with IEC 62304:2006+AMD1:2015 and it turned out compliance with 21 CFR part 11.

3.1 Manufacturing validation

Manufacturing accuracy validation was performed to demonstrate the manufacturing process for Nuvola® Aligner. Two critical aspects of the manufacturing process were assessed:

- digital dentition models from treatment planning and they 3D printed molds, and
- the fitting of the first final thermoformed aligner

The test has been repeated for 5 times with 5 different patient cases. An independent 3rd party software was used to perform point-to-point and critical displacement measurement. All measurements were within the predefined tolerance of the manufacturing process. There were no differences in the intended and measured values observed in any cases used, meeting the pre-established specification. The suitability, function and form of the aligner were checked by the prescribing doctor make the patient worn the first aligner of the 5 treatment plans used for the validation, also in this case the results were comply with the pre-established specifications and acceptance criteria.

3.1.1 Material used

The material used to produce Nuvola aligner is a Thermoforming Sheet Material indicated for the fabrication of orthodontic and dental appliances (Erkodur, K200125). The material are pre-shaped flat plastic discs. The sheets are plasticized in appropriate thermoforming units and adapted onto patient's individual plaster models. After cooling the sheets are removed from the model and trimmed to fit. The use of thermoplastic materials for sequential aligners intended to treat malocclusions has been well documented in scientific literature regarding incremental tooth moving forces. All of the components found in Thermoforming Sheet Material have been used in legally marketed devices and/or were found safe for dental use.

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3.2 Biocompatibility Testing

The material that is in direct contact with the patient is a thermoforming sheet material already cleared by FDA (K200125) and it has been tested on its biocompatibility. The tests on the material Erkodur have been performed according to the standard EN ISO 10993-1 and FDA Guidance Document No. FDA-2013-D-0350. Biological effects to be considered for leachable are cytotoxicity, mucosa irritation, sensitization, acute systemic and sub-chronic toxicity, genotoxicity. The results of the testing prove that the insolubility of the Thermoforming Sheet Material is in compliance with EN ISO 10993-1 and FDA Guidance Document No. FDA-2013-D-0350 for the intended dental use.

3.3 Shelf life

A 1-year shelf life was determined by real-time aging testing. Performance testing were conducted after 24 months real-time aging under standard storage condition. The test results showed conformity with the pre-established specifications and acceptance criteria. For a conservative choice, it was decided to fix as shelf life to 12 months (1 year)

3.4 Packaging

Package integrity, via simulated transport test per ISTA 2A, has been performed. The results confirm that the Nuvola® packaging is suitable for transportation and storage.

3.5 Treatment Planning software validation

In order to support Nuvola® business, GEO has been developing a web-based platform called Nuvola®Web. This software is a Treatment Planning platform that allows users to manage in digital way the aligner treatment plan. Nuvola®Web is a classic web-based collaborative application dedicated to dentists who wish to request, manage the design and repair Nuvola® device which is a custom-made invisible aligner, upon presentation of a medical prescription.

Nuvola®Web is able to store all information in order to provide the user (doctor/dentist), with access to the application platform, a customized experience according to their preferences. Contact details, telephone and e-mail addresses, shipping and billing addresses. Once registered, the user is able to independently register the references of their patients, upload photographs, digitized dental impressions and diagnostic elements in electronic format (the main graphic standards are supported). Once the necessary information and medical prescription have been completed, it is possible to request and develop a treatment project designed to illustrate, through a three-dimensional (3D) graphic support, the evolution of dental movements, from the initial patient situation to the conclusion of the treatment. The platform includes a sophisticated 3D graphics feature, with the ability to show and store orthodontic information such as attachment points, inter-proximal reduction, arch occlusion, etc. Nuvola®Web is able to simultaneously but separately manage the two arches (lower and upper), managing and accounting for the number of aligners necessary to carry out the clinical project goals, in order to meet all the needs of the doctor, of the associated prescription and consequently of the patient treatment. Doctor is able to interact with the laboratory through multi-channel communication techniques (chat, web request, email, etc.) in order to refine and agree on the details of the treatment proposal. Once all the clinical aspects have been determined, the application platform is able to manage doctor's acceptance plan, to be followed up for the production phase. Once the treatment plan is approved by the doctor, the platform sends in digital format the images of the models agreed with the doctor to the 3D printers which will produce the necessary models according to the quantities and methods previously defined. Finally, the application tracks the production activities thus ensuring the correct shipping and billing of the product requested by the doctor.

Nuvola®Web is validated by G.E.O in accordance with IEC 62304:2006+AMD1:2015 and it turned out compliance with 21 CFR part 11.

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4. Clinical Studies

Clinical Studies was not conducted for this 510(k) Notification. Clinical Performance testing was not needed to establish substantial equivalence to the predicate and reference devices. The above-mentioned non-clinical test data characterizes all performance aspects of the device based on well-established scientific and engineering principles.

5. Comparison with Predicate Device

Proposed device and predicate device have the same indications for use, intended use, technological characteristics, and principle of operation.

In accordance with 21 CFR 807.92(a)(6) a summary of the technological characteristic's comparison of the proposed modified device to the predicate Device is provided below.

6. Technological Characteristics comparison with the Predicate and Reference Devices

	Subject Device	Predicate Device K220287	Reference Device K212496	Comparison
Device Name	Nuvola® aligner	Invisalign® System	Ortho Aligner System	
Manufacturer	Gruppo Europeo di Ortodonzia S.r.l. (G.E.O srl)	Align Technology, Inc.	Ortho Lab Services, LLC	
Classification Regulation #	21 CFR 872.5470	21 CFR 872.5470	21 CFR 872.5470	Same
Name Product	Orthodontic Plastic Bracket	Orthodontic Plastic Bracket	Orthodontic Plastic Bracket	Same
Code	NXC	NXC	NXC	Same
Class	II	II	II	Same
Indications for Use	Nuvola® aligner is intended for the orthodontic treatment of malocclusion.	The Invisalign System is intended for the orthodontic treatment of malocclusion.	The Ortho Aligner System is indicated for the treatment of tooth malocclusion in patients with permanent dentition (i.e. all second molars).	Same as predicate device
Mode of Action	Sequential aligners apply continuous gentle force to the teeth and/or position mandible forward.	Sequential aligners apply continuous gentle force to the teeth and/or position mandible forward.	The appliance applies gentle forces on teeth according to the plan prescribed by the doctor.	Same

	Subject Device	Predicate Device K220287	Reference Device K212496	Comparison
Device Description	Sequential thermoformed plastic aligners	Sequential thermoformed plastic aligners	Sequential thermoformed plastic aligners	Same
Description of Use	Aligners are worn for approximately 1-2 weeks of 20- 22 hours of wear per day, after which it is replaced by the next stage aligners. This is repeated for duration as prescribed by the Dental Practitioner.	Aligners are worn for approximately 1-2 weeks of 20-22 hours of wear per day, after which it is replaced by the next stage aligners. This is repeated for duration as prescribed by the Dental Practitioner.	Each removable preformed plastic tray is worn by the patient as prescribed by the doctor, usually a few weeks prior to using the next sequential aligner tray.	Same
Patient Population	Children, Adolescents and Adults	Children, Adolescents and Adults	Patients with permanent dentition (i.e. all second molars)	Same
Material	Thermoplastic polymer PET-G	Thermoplastic polymer	Thermoplastic PET-G	Same material as reference device
Material Properties	Acceptable materials properties established for use as aligner (polyethylene terephthalate glycol PET-G) Erkodur (K200125)	SmartTrack™ is material engineered for use with Invisalign orthodontic treatment (Polyurethane)	Polyethylene terephthalate glycol, PET-G)	Similar material to predicate device. Same as reference device
Manufacturing Process	Thermoforming on models	Thermoforming on models	Thermoforming on models	Same
Manufacturing Process Validation	An internal manufacturing Process Validation was performed	An internal manufacturing Process Validation was performed	Testing to validate the manufacturing process was performed.	Same
Treatment Planning software	Nuvola® Web software is a web-based collaborative application that allows the user to manage in digital way the aligner treatment plan	ClinChek® software Cloud-based technology that allows you to manage in digital way the aligner treatment plan	Ortho Lab Services uses their OrthoWare software to design the treatment plans for tooth movement	Similar to predicate device: same purpose but different technologies

	Subject Device	Predicate Device K220287	Reference Device K212496	Comparison
Software Description for tooth movement	3Shape Ortho System (K152086) dental software for tooth alignment uses digital scan (untreated state) to generate the image of a final, provisional treated state and then interprets a series of images that represent intermediate teeth states. The dental practitioner then reviews these images and has the option to reject or request modifications to the set-up prior to approving it for aligner fabrication. Once the dental practitioner approves the treatment plan, the software converts the files to produce the series of 3D models used to produce thermoformed aligners	Invisalign System 3-D Software (K081960) Produces 3Dmodel file of the PVS impression or the digital scan. Identifies the individual teeth that require treatment (i.e., repositioning). Creates a treatment plan (i.e., 3-D models that represent the treatment plan) which is reviewed by the treating dental practitioner using function to reject or request modifications to the set-up prior to approval.	OrthoWare software uses digital scans to generate images of the final treated states, and intermediate steps to achieve the final state, and convert those files to produce the series of customized aligners	Same purpose of the predicate device
Prescription Use	Rx only	Rx only	Rx only	Same
Single Patient	Yes	Yes	Yes	Same
Biocompatibility	Meets ISO 10993-1, -5, -10 requirements: Cytotoxicity and Sensitization/Irritation	Biocompatible in according to ISO 10993-1	Meets ISO 10993-1, -5, -10 requirements: Cytotoxicity and Sensitization/Irritation	Same
Process Flow Validation Testing	Performed testing to validate the finished device matches the software output design.	Performed testing to validate the finished device matches the software output design.	Performed testing to validate the finished device matches the software output design.	Same

7. Differences

	Subject Device	Predicate Device K220287	Reference Device K212496	Comparison
Treatment Planning software	Nuvola® Web software is a web-based collaborative application that allows the user to manage in digital way the aligner treatment plan	ClinChek® software Cloud-based technology that allows you to manage in digital way the aligner treatment plan	Information not available	Similar to predicate device: same purpose but different technologies
3D software for tooth alignment	3Shape Ortho System (K152086)	Invisalign System 3-D Software (K081960)	Information not available	Similar to predicate device.
Material Properties	Acceptable materials properties established for use as aligner (PET-G). Erkodur (K200125)	SmartTrack™ is material engineered for use with Invisalign orthodontic treatment (Polyurethane)	Acceptable materials properties established for use as aligner (PET-G)	Same as the Reference device. Similar material type to the predicate device

The subject and predicate device use similar material type, both PET-G and Polyurethane for dental application have similar characteristics. The thermoplastic polymer used by Nuvola® is PET-G, already FDA cleared Erkodur (K200125), that is one of most used the plastic materials to produce dental aligner, and it is the same used by the Reference Device. The software used for the management of the treatment plan between Subject and Predicate device are different: the Nuvola® Web is a web-based software whereas ClinChek® is a Cloud-based technology software; but they have the same purpose and are used in a similar way. Therefore, the using of different Treatment Planning software does not raise any questions regarding safety and effectiveness.
Regarding the dental software for tooth alignment G.E.O uses the already FDA cleared software 3Shape Ortho System (K152086) while Align Inc. uses a proprietary software: Invisalign System 3-D Software (K081960). They both use digital scans to generate images of the final treated states, and intermediate steps to achieve the final state, and convert those files to produce the series of customized aligners.

8. Substantial Equivalence

The Nuvola® (Subject Device) and the previously cleared predicate device Invisalign System are similar in that they have:

- same indications for use,
- same principles of operation
- same technological characteristics, and
- same manufacturing process

9. Conclusion

The Nuvola® device has the same intended use and indications for use as the previously cleared Invisalign System (K220287). In addition, the Nuvola® system has the same technological characteristics, and principles of operation as its predicate and reference device.

The software and materials differences between the Nuvola® system and its predicate device do not raise new questions of safety or efficacy.

Thus, the Nuvola® device is substantially equivalent previously cleared similar devices.