

**DE NOVO CLASSIFICATION REQUEST FOR**  
Sensor Monitored Alimentary Restriction Therapy (SMART) Device

**REGULATORY INFORMATION**

FDA identifies this generic type of device as:

**Oral removable palatal space occupying device for weight management and/or weight loss.** An oral removable palatal space occupying device for weight management and/or weight loss is a prescription device that is worn during meals to limit bite size, thereby reducing the amount of food that is consumed. The device may contain recording sensors for monitoring patient use. This classification does not include devices that are intended to treat any dental diseases or conditions.

**NEW REGULATION NUMBER:** 21 CFR 876.5981

**CLASSIFICATION:** Class II

**PRODUCT CODE:** ONY

**BACKGROUND**

**DEVICE NAME:** Sensor Monitored Alimentary Restriction Therapy (SMART) Device

**SUBMISSION NUMBER:** DEN150033

**DATE OF DE NOVO:** July 31, 2015

**CONTACT:** Scientific Intake  
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**REQUESTER'S RECOMMENDED CLASSIFICATION:** Class II

**INDICATIONS FOR USE**

The SMART Device is intended to aid in weight management in overweight to obese individuals. The device is indicated for individuals with a body mass index (BMI) in the range 27-35 kg/m<sup>2</sup> in conjunction with behavioral modification instruction.

**LIMITATIONS**

The sale, distribution, and use of the device are restricted to prescription use in accordance with 21 CFR §801.109.

Healthcare professional use of the device requires completion of a training program for determining a patient's oral health status, making a palatal mold, and assessing potential issues with the device that may require service by the manufacturer.

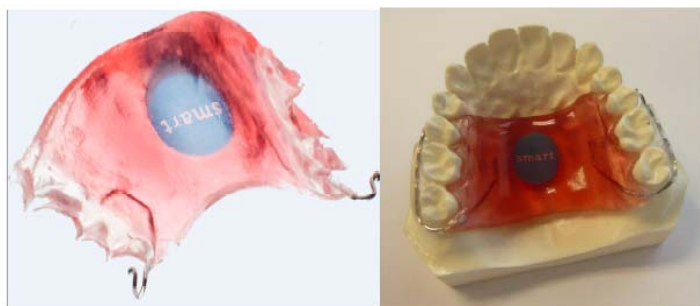
In the clinical study of the device, patients were required to use the SMART Device along with a weight management program of nutrition, diet, and exercise instruction provided on DVD.

PLEASE REFER TO THE LABELING FOR A MORE COMPLETE LIST OF WARNINGS, PRECAUTIONS AND CONTRAINDICATIONS.

### **DEVICE DESCRIPTION**

The SMART Device is an oral removable palatal space occupying device that includes an embedded temperature recording sensor. The device is intended to be worn only during meals, to limit bite size and slow the intake of food, thereby reducing the amount of food that is consumed. The SMART Device is available using wire clasps and using a wraparound method (the wraparound technique is an added alternative to accommodate different oral anatomies) where the wires are coated with acrylic and wrapped around teeth in a symmetrical manner to secure the fit of the device (see Figure 1, below).

Figure 1. SMART Device



\*wire clasp version (left) and wraparound version (right)

The device is then removed after each meal or snack and the patient or healthcare professional has the option to use the temperature recording sensor embedded in the device to monitor device usage. This component of the SMART Device automatically records adherence, eliminating manual record-keeping by the user. The sensor is operated by a 3 volt lithium coin battery and measures ambient temperature at 5 minute intervals, storing the time and temperature data. The battery and the sensor are both double-encased and hermetically sealed in the acrylic.

The SMART Device is provided with the Palatal Mold Kit and SMART Reader components. The Palatal Mold Kit is used to fabricate the SMART Device to match the patient's oral anatomy. The device is made from a mold of the upper oral cavity of the patient taken by a trained healthcare provider using the Palatal Mold Kit.

The SMART Reader (See Figure 2, below) is an optional component that connects the sensor to a computer. Usage data are uploaded using infrared data transfer and a record of use can be produced. The user is provided instructions to download software for communicating between a personal computer and the SMART Reader and for displaying the time of day that the SMART Device was used. This software allows information from the embedded sensor to be uploaded to a secure, password protected Patient Portal website. Use of the Patient Portal allows the patient or healthcare provider to assess frequency of device usage.

Figure 2. SMART Reader



### **SUMMARY OF NONCLINICAL/BENCH STUDIES**

Non-clinical/bench studies conducted on the SMART Device to demonstrate a reasonable assurance of safety and effectiveness of the device are summarized below.

#### **BIOCOMPATIBILITY/MATERIALS**

Based on the nature of contact and duration of exposure, the SMART Device is considered a surface device, mucosal membrane contacting for a limited duration. In accordance with ISO10993-1, Biological evaluation of medical devices, the following tests were performed on the SMART Device:

- Cytotoxicity
- Sensitization
- Irritation

The results supported the biocompatibility of the SMART Device.

Based on the nature of contact and duration of exposure, the Palatal Mold Kit is considered a surface device, mucosal membrane contacting for a limited duration. Previous clearance (K082560) of the Palatal Mold Kit materials and biocompatibility testing certification from the manufacturer support the biocompatibility of the Palatal Mold Kit.

### **SHELF LIFE/STERILITY**

The SMART Device is provided non-sterile. The expected use life of the SMART Device is 1.2 years, based on the clinical and non-clinical testing.

### **ELECTROMAGNETIC COMPATIBILITY AND ELECTRICAL SAFETY**

#### **Electromagnetic Compatibility (EMC):**

The SMART Device was evaluated for conformance to IEC 60601-1-2 (2014), and was found to comply with all applicable requirements of this EMC testing standard.

#### **Electrical Safety:**

The SMART device was evaluated for conformance to ANSI/AAMI ES60601-1 (2012) (general requirements) and IEC 60601-1-11 (2010) (electrical systems used in a home healthcare environment). Review of the results concluded that the device complies with all of the electrical safety requirements specified in this standard.

### **SOFTWARE**

The SMART Device software functions to communicate with the SMART Reader and to collect data from the sensor and send information to a Patient Portal website.

The software/firmware was reviewed according to the "Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices," dated May 11, 2005. Details of the software review are described below:

- The graphing component of the software in the Online Portal uses Microsoft Excel.
- The software provides graphing tools and a macro-programming language. The device uses Microsoft Excel, by Microsoft Corporation, Version 2003 (11.6355.6360 SP1), release date 2003.
- All of the elements of software documentation corresponding to the risk level of the software ("Minor" Level of Concern as outlined in FDA's Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices) was provided and is adequate. The following software documentation, specified in the FDA document Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices," was provided and is adequate.

### **PERFORMANCE TESTING – BENCH**

Non-clinical performance tests were conducted to demonstrate mechanical integrity and functionality of the SMART Device. Table 1 below summarizes each of these bench tests, which included appropriate acceptance criteria for the intended use of the device.

Table 1. Summary of Non-clinical Performance Testing

Test	Purpose	Acceptance Criteria	Results
Force Measurement	Testing was performed to determine the amount of compression force placed on the premolars and molars	Exerted force b(4)	Passed
Durability Measurement	Testing was performed to determine durability of simulated use	No abrasions, tears, separation, or indications of wear for simulated use of 1.2 years (438 days)	Passed
Battery Life	Testing was performed to determine the use life of the battery	Battery use life $\geq$ 1.2 years (438 days)	Passed

**SUMMARY OF CLINICAL INFORMATION**

Clinical data from a pivotal and confirmatory study were leveraged to evaluate the safety and effectiveness of the SMART Device.

Pivotal Study:

The pivotal study was a randomized (1:1:5), controlled, prospective, open-label study to evaluate the safety and effectiveness of the device in an overweight to obese population (BMI of 26-36 kg/m<sup>2</sup>), along with a weight management program of nutrition, diet, and exercise instruction provided on a DVD. Subjects who met the inclusion and exclusion criteria and successfully completed a 4 week weight-stabilization period were weighed and randomized to one of the two groups. The device group received the SMART Device, plus nutrition, diet and exercise education via a DVD. The control group received the same nutrition, diet and exercise education via a DVD. Study site assessments occurred every two weeks through 16 weeks at which time the subjects were weighed, assessed for any adverse events, and watched the educational DVD. One-hundred seventy-three (173) subjects completed the screening and weight stabilization periods and were randomized into device (n=102) and control (n=71) groups at five US centers. This population constituted the intent-to-treat (ITT) population. The ITT population included all enrolled subjects with any missing data filled-in using the last observation carried forward (LOCF) approach. The per protocol (PP) population (n= 41 device, n=67 control) included the subjects who were adherent to study protocol, with attendance of at least 4 of 7 visits for both groups, and, for the device group, use of the device at least 33% of the time. The primary effectiveness endpoint was that 40% of the device group would achieve 5% total body weight loss (%TBWL) as compared to 10% or less of the control group, as measured at the end of the 4 month study period. Secondary endpoints included an evaluation of the incidence of adverse events (goal of less than 10%) and differences in changes in the SF-36 (Quality of Life 36 Question ‘Sort Form’) scores between the treatment and control group.

Pivotal study results demonstrated, in the ITT population, that 20.6% (21 of 102) lost more than 5% TBWL as the end of the 16 week study as compared to 5.6% (4 of 71) of the control group that lost more than 5% TBWL. Therefore the pivotal study did not meet the primary effectiveness endpoint. The PP population demonstrated that 48.8% (20 of 41) lost more than 5%

TBWL as the end of the 16 week study as compared to 4.5% (3 of 67) of the control group that lost more than 5% TBWL.

The ITT population demonstrated 1.65% TBWL at 16 weeks as compared to the control group that demonstrated 0.36% TBWL. The PP population demonstrated 4.39% TBWL as compared to the control group that demonstrated 0.29% TBWL at 16 weeks. In regard to excess weight loss (EWL), at 16 weeks, the ITT population demonstrated 14.55% EWL as compared to the control group that demonstrated 3.95% EWL. The PP population demonstrated 38.14% EWL as compared to the control group that demonstrated 2.31% EWL. There were no clinical significant changes in the SF-36 scores between the treatment and control groups.

The pivotal study demonstrated that there were 6 device-related adverse events in 5 subjects. The observed device-related AE rate of 4.9% (5 of 102) is less than the pre-defined goal of 10%. However, the 95% confidence interval for this rate was [1.6%, 11.1%], so it cannot be claimed that the true device-related AE rate is less than 10%. These events were classified as non-serious and were resolved quickly without need for further medical intervention (transient choking on food (n=2), gag reflex on insertion (n=1), mouth soreness (n=1) and gum irritation (n=2)). No serious adverse events (SAEs) were associated with use of the SMART Device.

Due to failure to meet the pre-specified primary endpoints, high dropout rates (only 41 subjects were included in the PP population), and non-compliance (35 of 102 of the treatment group were excluded) of device usage in the pivotal study, the sponsor conducted an additional clinical study, the confirmatory SMART Practices Study, to provide additional supportive safety and effectiveness data.

#### Confirmatory Study:

The confirmatory SMART Practices Study was a prospective, single-arm, multicenter study that evaluated the safety and weight loss effectiveness of the SMART Device in addition to a DVD weight loss education program for overweight and obese individuals with BMI between 27 and 35 kg/m<sup>2</sup>. A total of 146 subjects were consented at 4 US investigational centers. Seventy-six (76) subjects were enrolled in the Intent-to-Treat (ITT) population, and 67 subjects completed the last study visit (study period was 16 weeks). Subject assessments occurred every two weeks at which time the subjects were weighed, assessed for any adverse events, and watched an educational DVD. During the biweekly visits, adherence data were taken from the SMART sensor and uploaded to a computer using the Client Software. Enrollment included a 5-day consecutive run-in period where subjects self-evaluated the fit of the device, a healthcare provider examined and confirmed the fit, and subjects were instructed to use the device during every eating episode, including meals, snacks, and sugar-sweetened beverages.

The study included two pre-specified co-primary endpoints. The first co-primary endpoint evaluated whether at least 40% of the subjects would be observed to have at least 5% weight loss (%TBWL), while the second co-primary endpoint evaluated whether the observed mean %TBWL would be at least 4%. These primary endpoints assessed weight loss at week 16 relative to baseline and were analyzed in the Per Protocol (PP) population. The PP population included

subjects who used the device for at least 33% of all meals and at least 7 times per week for at least 14 of the 16 study weeks, and completed the final study visit.

Secondary endpoints included: mean %Excess Weight Loss (%EWL), mean absolute weight loss (AWL), proportion of subjects achieving greater than 4%TBWL proportion of subjects achieving greater than 12% EWL, relationship between SMART Device usage and weight loss, and scores on an objective clinical evaluation of the fit of the device (SMART Fit Acceptability Sub Study: dental professionals assessed clinical fit of the device in 20 subjects).

The confirmatory study results demonstrated that 30% (12 of 40) of the subjects in the PP population had at least 5% TBWL, thus this co-primary endpoint was not met. The 95% CI for this success rate was [17%, 47%]. In regard to the second co-primary endpoint, the mean %TBWL observed in the PP population was 2.9% [95% CI: 1.8%, 4.1%] and the co-primary endpoint was not met. Although not a pre-specified primary endpoint analysis, the ITT population demonstrated that 20.9% (15 of 76) had at least 5% TBWL and mean TBWL was 2.2%.

In regard to secondary endpoint results, the mean %EWL in the PP and ITT populations was 18.76% and 13.66%, respectively. Mean AWL was 2.35 kg and 1.70 kg in the PP and ITT population, respectively. Forty (40) percent (16 of 40) of the PP and 28.9% (22 of 76) of the ITT population had at least 4% TBWL at week 16. In addition, 60% (24 of 40) of the PP and 47.4% (36 of 76) of the ITT population achieved at least 12% EWL at week 16. Weight loss was associated to some degree with the level of device use, however, higher use did not necessarily lead to greater weight loss success. One hundred percent (20 of 20) of subjects assessed for fit by dental professionals were determined to have good clinical fit.

In regard to safety, the confirmatory study demonstrated that there were twenty-four (24) adverse events reported for 12 subjects in the study (15.8%). Of those 24 events, 3 events in 2 subjects were considered as being possibly related to the device. The three events were a hard palate abrasion and two tongue lacerations that were all considered moderate in severity and resolved without medical intervention. All subjects that had possibly device-related adverse events completed the study.

#### Consumer Preference Study:

In a separate consumer and provider acceptance study, 24 subjects who had a BMI of at least 26.5 kg/m<sup>2</sup> were initially weighed and fitted for a device. The primary goal of this testing was to measure subject acceptance and satisfaction with the device, and satisfaction with weight loss, over 30 days. A secondary goal was to assess provider experiences. Subjects reported comfortable use within 1-3 days of exposure to the device and acceptance and satisfaction were high. While all 24 subjects lost weight at the 30 day weigh-in, 19 of the 24 (79%) lost more than 4 pounds with a mean weight loss of 5.9 pounds and an average of 75% usage during eating periods. Providers were satisfied with the ease of the mold fitting, minimal office time needed, device quality, and motivation of subjects.

#### **LABELING**

The labeling includes a Device User Guide, Physician’s Instructional Guide, Palatal Mold-Making Instructions, and package labels for the SMART Device. The labeling provided satisfies the requirements of 21 CFR § 801.109 Prescription devices. The Device User Guide and Physician’s Instructional Guide address some of the hazards and risks of the device for the intended use and incorporate safety statements to mitigate these risks. The labeling includes:

- Safety instructions intended to minimize the risks of improper insertion, removal and use of the SMART Device.
- Contraindications and warnings to ensure usage of the device for the intended patient population.
- A detailed summary of the clinical testing including device effectiveness and device related adverse events
- Palatal Mold making instructions for the physician.

**RISKS TO HEALTH**

The table below identifies the risks to health that may be associated with use of Oral removable palatal space occupying device for weight management and the measures necessary to mitigate these risks.

**RISK MITIGATION:**

<b>Identified Risk</b>	<b>Mitigation Method</b>
Tooth Movement, Irritation and Soreness of Mouth or Gums, <ul style="list-style-type: none"> <li>• Improper mold making</li> <li>• User error</li> <li>• Damage to material (soft edge separation)</li> </ul>	Non-clinical Performance Testing Labeling Training
Choking or Gag Reflex	Clinical Performance Testing Labeling
Adverse Tissue Reaction	Biocompatibility Evaluation
Incorrect data interpretation <ul style="list-style-type: none"> <li>• Hardware Malfunction (sensor malfunction)</li> </ul>	Non-clinical Performance Testing Labeling Training
Electrical Shock and Electrical Interference With Other Devices	Non-clinical Performance Testing
Weight Gain	Clinical Performance Testing Labeling



**SPECIAL CONTROLS:**

In combination with the general controls of the FD&C Act, the Oral removable palatal space occupying device for weight management is subject to the following special controls:

1. The patient-contacting components of the device must be demonstrated to be biocompatible for its intended use.
2. Non-clinical performance testing must demonstrate that the device performs as intended under anticipated conditions for use, as follows:
  - a) Mechanical testing must demonstrate that the device performs as intended for the labeled use life and does not create forces that result in movement of teeth and damage to teeth.
  - b) Electrical safety and electromagnetic compatibility testing must demonstrate that the device performs as intended.
  - c) Software verification and validation must demonstrate that the device performs as intended.
  - d) Battery testing must demonstrate that the device battery performs as intended.
3. Clinical performance testing must demonstrate the device performs as intended and must include an evaluation for choking.
4. Device labeling must address the following:
  - a) Patient labeling must state:
    - i. the clinical benefit of weight management and/or weight loss as assessed by using percent total body weight loss;
    - ii. treatment must be offered in combination with a behavioral modification program;
    - iii. instructions on how to use the device as intended; and
    - iv. the use life of the device.
  - b) Physician labeling must state:
    - i. the clinical benefit of weight management and/or weight loss as assessed by using percent total body weight loss;
    - ii. treatment must be offered in combination with a behavioral modification program;
    - iii. instruction on how to use the device as intended; and

- iv. the use life of the device.
- 5. Training must be provided to health professionals that include procedures for determining a patient's oral health status, instructions for making the palatal mold, and assessment of issues with the device that may require service by the manufacturer.

### **BENEFIT/RISK DETERMINATION**

The risks of the device are based on data collected in clinical studies described above. The pivotal study demonstrated that there were 6 device-related adverse events (transient choking on food (n=2), gag reflex on insertion (n=1), mouth soreness (n=1) and gum irritation (n=2)) in 5 subjects that were non-serious and resolved quickly without need for further medical intervention. No serious adverse events (SAEs) were associated with use of the SMART Device in the pivotal study. In the confirmatory study, there were twenty-four (24) adverse events reported for 12 subjects in the study (15.8%). Of those 24 events, 3 events in 2 subjects were considered as being possibly related to the device (hard palate abrasion (n=1) and tongue lacerations (n=2) that were all considered moderate in severity and resolved without medical intervention. Therefore, the device has a very low-risk and favorable safety profile, with the only device related adverse events being transient in nature and resolving without medical intervention.

The probable benefits of the device are also based on data collected in clinical studies as described above. The pivotal study demonstrated that the ITT population lost 1.65% TBWL at 16 weeks as compared to the control group that lost 0.36% TBWL. The pivotal study did not meet the primary efficacy hypothesis (a statistically significant difference in weight loss between SMART Device users and control subjects at the end of four months of treatment) as only 20.6% (21 of 102) lost more than 5% TBWL as the end of the 16 week study as compared to 5.6% (4 of 71) of the control group that lost more than 5% TBWL (p= 0.0059). The PP population demonstrated 4.39% TBWL as compared to the control group that demonstrated 0.29% TBWL at 16 weeks (the second co-primary endpoint that mean %TBWL would be at least 4% in PP population was met). In the confirmatory study, the ITT population lost 2.2% TBWL. The confirmatory study did not meet the co-primary study endpoints (Endpoint 1) at least 40% of the subjects would be observed to have at least 5% TBWL and 2) the observed mean %TBWL would be at least 4%) as only 30% (12 of 40) of the subjects in the PP population had at least 5% TBWL and the %TBWL observed in the PP population was 2.9%.

The effectiveness results from the pivotal and confirmatory studies for the SMART Device demonstrated minimal weight loss of 1.65 to 2.2% at 16 weeks in patients who used the device when compared to baseline. This level of effectiveness is not clinically significant as it is less than 5% TBWL. Hence the device is not appropriate for an indication of weight loss. However, the results do demonstrate that patients who used the device were able to maintain weight at 16 weeks when compared to baseline. Therefore, the SMART Device (based on the pivotal and confirmatory studies) has demonstrated effectiveness when used as a weight management tool.

In conjunction with the indication that specifies that the device is effective for weight management, the probable benefits of a small amount of weight loss outweigh the few risks of the device.

An additional factor to be considered in determining probable risks and benefits for the SMART device include robustness of the analysis of the study results and degree of the effectiveness. As stated above, due to failure to meet the pre-specified primary endpoints, high dropout rates, and non-compliance of device usage in the pivotal study, the Sponsor conducted the confirmatory SMART Practices Study. The results of the pivotal study were repeatable as the confirmatory study demonstrated a similar TBWL in the treatment group (1.65 vs 2.2 %TBWL, respectively). As stated above, the low risks of the device are outweighed by the devices effectiveness as a weight management device.

### Patient Perspectives

Patient perspectives considered for the SMART Device included the evaluation of a consumer preference study that assessed acceptance and satisfaction with use of device and weight loss achieved, over 30 days in 24 patients. Subjects reported comfortable use within 1-3 days of exposure to the device and acceptance and satisfaction was high. While all 24 subjects lost weight at the 30 day weigh-in, 19 of the 24 (79%) lost more than 4 pounds with a mean weight loss of 5.9 pounds and an average of 75% usage during eating periods.

### Benefit/Risk Conclusion

In conclusion, given the available information above, the data support the device to be used as an aid for weight management in overweight to obese individuals with a body mass index (BMI) in the range of 27-35 kg/m<sup>2</sup> in conjunction with behavioral modification instruction, and the probable benefits outweigh the probable risks for the SMART Device. The device provides benefit as a weight management device and the risks can be mitigated by the use of general and the identified special controls.

### CONCLUSION

The *de novo* for the SMART Device is granted and the device is classified under the following:

Product Code: ONY

Device Type: Oral removable palatal space occupying device for weight management and/or weight loss

Class: II

Regulation: 21 CFR 876.5981