April 22, 2019

Biomet Manufacturing Corp
Dalene Binkley
Regulatory Affairs Project Manager
56 East Bell Drive
Warsaw, Indiana 46582

Re: K182516
Trade/Device Name: Comprehensive® Nano Stemless Shoulder
Regulation Number: 21 CFR 888.3660
Regulation Name: Shoulder joint metal/polymer semi-constrained cemented prosthesis
Regulatory Class: Class II
Product Code: PKC
Dated: March 18, 2019
Received: March 19, 2019

Dear Ms. Binkley:

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/CombinationProducts/GuidanceRegulatoryInformation/ucm597488.htm); 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 http://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm.

For comprehensive regulatory information about medical devices and radiation-emitting products, including information about labeling regulations, please see Device Advice (https://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/) and CDRH Learn (http://www.fda.gov/Training/CDRHLearn). 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 (http://www.fda.gov/DICE) for more information or contact DICE by email (DICE@fda.hhs.gov) or phone (1-800-638-2041 or 301-796-7100).

Sincerely,

For Mark N. Melkerson
Director
Division of Orthopedic Devices
Office of Device Evaluation
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: 06/30/2020
See PRA Statement below.

510(k) Number *(if known)*
K182516

Device Name
Comprehensive® Nano Stemless Shoulder

Indications for Use *(Describe)*
1. Primary total shoulder arthroplasty.
2. Non-inflammatory degenerative joint disease including osteoarthritis

Comprehensive Nano Stemless Shoulder humeral components have a porous coated surface coating and are indicated for uncemented biological fixation applications.

The Comprehensive Modular Hybrid Glenoid is intended to be implanted with bone cement. The porous titanium peg may be inserted without bone cement.

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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510(k) Summary

In accordance with 21 CFR §807.92 and the Safe Medical Devices Act of 1990, the following information is provided for the Comprehensive Nano Stemless Shoulder 510(k) premarket notification. The submission was prepared in accordance with the FDA guidance document, 'Format for Traditional and Abbreviated 510(k)s', issued on August 12, 2005.

Sponsor:

Biomet Inc.
56 East Bell Drive
PO Box 587
Warsaw, IN 46581
Establishment Registration Number: 1825034

Contact Person:

Dalene T. Binkley
Regulatory Affairs Project Manager
Telephone: (574) 372-6789

Date:

April 22, 2019

Subject Device:

Trade Name: Comprehensive® Nano Stemless Shoulder
Common Name: Shoulder Prosthesis

Classification Name:

PKC– Shoulder joint metal/polymer semi-constrained cemented prosthesis (21 CFR § 888.3660)

Predicate Devices:

K143552	Simpliciti Shoulder System	Wright Medical (formerly Tornier) (Primary Predicate)
K171858	Sidus Stem-Free Shoulder	Zimmer GmbH
K173388	Equinoxe Stemless Shoulder	Exactech
K060692	Comprehensive Primary Shoulder	Biomet Manufacturing Corp.

Purpose and Device Description:

The Comprehensive Nano Stemless Shoulder is part of the Comprehensive Shoulder System intended for use in total shoulder arthroplasty. The humeral component is used as part of an anatomic configuration with a *Versa-Dial*® humeral head that articulates against the Comprehensive

hybrid glenoid component. The head is connected to the Nano humeral component by a taper adaptor.

The Comprehensive Nano Stemless Shoulder is manufactured from Ti6Al4V alloy. It consists of a central tapered region and six outer wings. The taper has a machine finish and accepts the taper adaptor of the humeral head component. The bone-contacting outer surface features a porous coating of plasma sprayed titanium alloy for cementless fixation in the proximal humerus. Six sizes are available - 30 mm through 40mm in 2mm increments.

Intended Use and Indications for Use:

1. Primary total shoulder arthroplasty.
2. Non-inflammatory degenerative joint disease including osteoarthritis

Comprehensive Nano Stemless Shoulder humeral components have a porous coated surface coating and are indicated for uncemented biological fixation applications.

The Comprehensive Modular Hybrid Glenoid is intended to be implanted with bone cement. The porous titanium peg may be inserted without bone cement.

Summary of Technological Characteristics:

The rationale for substantial equivalence is based on consideration of the following characteristics:

- **Intended Use:** The proposed Comprehensive Nano Stemless Shoulder and the predicate components have identical intended uses.
- **Indications for Use:** The proposed Comprehensive Nano Stemless Shoulder and the predicate components have same or very similar indications for use.
- **Materials:** The proposed Comprehensive Nano Stemless Shoulder and the predicate components are composed of the same or similar biocompatible substrate materials and the same or similar surface finish for fixation.
- **Design Features:** The proposed Comprehensive Nano Stemless Shoulder components and the predicate components have similar design features. The validations for the design differences have not identified any issues that would impact the safety and efficacy of the devices.

- **Sterilization:** The proposed Comprehensive Nano Stemless Shoulder components and the predicate components are provided sterile and single use only.

Summary of Performance Data (Nonclinical and/or Clinical)

Non-clinical testing demonstrated that the proposed device meets the performance requirements as defined by Design Control activities and is substantially equivalent to the predicate devices in terms of safety and efficacy.

- **Non-Clinical Tests:**
  - Fatigue Testing
  - Axial Pull Out Testing
  - Torque out testing
  - Taper Disengagement Testing
  - MRI Conditional Testing
    - Radio Frequency (RF), Torque, Displacement
      - ASTM F2119, ASTM F2053, ASTM F2182

- **Clinical Tests:**

The Comprehensive nano IDE Clinical Study was designed as a prospective, randomized, blinded, multi-center study. The performance of the Comprehensive nano Humeral Component was analyzed for 116 subjects who reached the two-year follow-up time point or were removed from the study at that point, and compared to 123 subjects who received the Comprehensive mini stem. Success was analyzed based on three independent co-primary endpoints. Of the 112 nano subjects who completed two-year follow-up, 14 were outside the protocol defined visit window (1 to 95 days). Of the 121 mini stem subjects who completed two-year follow-up, 16 were outside the protocol defined visit window (1 to 178 days). They include the following:

Study Endpoints

a. ASES mean scores in each group at two years;
b. % of subjects in each group without unanticipated device-related adverse events, fracture, perforation of the bone or joint dislocation, fracture, perforation or dissociation of the device, or revision or removal of any component, and

c. Radiographic success at two years defined by:
   - Subsidence of the humeral component < 5mm, and
   - Migration of the humeral component < 5mm, and
   - No progressive lucency around the humeral component > 2mm in two or more contiguous zones, and
   - Migration of the glenoid component < 5mm, and
   - No progressive lucency > 2mm around the entire glenoid component

Endpoint a: ASES Comparison

The mean ASES score was calculated for subjects in both groups at two years. The mean ASES score for the nano group was 92.5 at two years, and the mean ASES score for the mini stem group was 92.2 at two years. The difference between the two groups was calculated (0.27), and using a 95% Confidence Interval, the nano was shown to be non-inferior at the two year time point (p = <0.0001, 95% CI lower bound = -2.81).

Variable	Visit Time	Comparing Test P Value	Mini Stem mean±std	Nano mean±std
ASES Score	PREOP	0.5576	25.8 ± 9.6	25.1 ± 10.7
	6 WEEK	0.5285	60.1 ± 18.3	61.5 ± 17.4
	3 MONTH	0.8917	80.2 ± 16.4	80.5 ± 15.3
	1 YEAR	0.2999	91.2 ± 12.8	92.8 ± 12.2
	2 YEAR	0.8858	92.2 ± 13.5	92.5 ± 14.9

When compared to the Minimal Clinically Important Difference (MCID) of 20.9 points defined by Tashjian et al, three subjects in the mini stem group and two subjects in the nano group did not meet[1] this ASES improvement at two years[1]. The following table summarized this data:

[1] Tashjian RZ, Hung M, Keener JD, Bowen RC, McAllister J, Chen W, Ebersole G, Granger EK, Chamberlain AM. Determining the minimal clinically important difference for the American Shoulder and Elbow Surgeons score, Simple Shoulder Test, and visual analog scale (VAS) measuring pain after shoulder arthroplasty. J Shoulder Elbow Surg. 2017 Jan;26(1):144-148).

ASES Score MCID Improvement at 2 Years

Group	ASES Improvement > 20.9?	N	%	Fisher Exact Test P Value
Control	No	3	2.48%	1.000000
	Yes	118	97.52%	.
Investigational	No	2	1.79%	.
	Yes	110	98.21%	.

Endpoint b: Revision/Removal/Unanticipated Adverse Device Effect

Nine subjects in the nano group (1 humeral fracture, 2 revisions, 1 glenoid perforation, 1 dislocation and 4 glenoid fractures) and 9 subjects in the mini stem group (3 humeral fractures, 4 revisions, and 2 dislocations) failed this criteria.

The outcomes success rate for subjects in the Comprehensive nano group was 92.2% (107 of 116). The outcomes success rate for subjects in the Comprehensive mini group was 92.7% (114 of 123). The difference (-0.0044) was well within the 95% non-inferiority confidence interval (p = 0.0063, 95% CI lower bound = -0.0674). Based on endpoint b, the Comprehensive nano was shown to be non-inferior to the Comprehensive mini stem.

Endpoint c: Radiographic Success

Radiographic Success is defined as subsidence of the humeral component less than 5mm, migration of the humeral component less than 5mm, no progressive lucency around the humeral component greater than 2mm in two or more contiguous zones, migration of the glenoid component less than 5mm, and no progressive lucency greater than 2mm around the entire glenoid component.

All subjects in both groups successfully passed the radiographic endpoint criteria.

Device-Related Adverse Events Reported during Comprehensive nano IDE Clinical Study

The table below provides a summary of all events reported during this study for subjects who received a study device that were classified by the principal investigator as definitely related, probably related, or possibly related to the device. All adverse events not considered related to the device are excluded from the table.

Adverse Event Description	Number of Occurrences, nano group	Occurrence Rate, nano group (n = 116)	Number of Occurrences, mini stem group	Occurrence Rate, mini stem group (n = 123)
Dislocation	2	2/116 (1.7%)	1	1/123 (0.8%)
Hematoma	0	0	1	1/123 (0.8%)
Humeral Fracture or Perforation	0	0	1	1/123 (0.8%)
Implant or Part Failure or Fracture	0	0	1	1/123 (0.8%)
Inadequate Range of Motion	1	1/116 (0.9%)	3	3/123 (2.4%)
Infection	1	1/116 (0.9%)	0	0
Unusual Shoulder Pain	3	3/116 (2.6%)	5	5/123 (4.1%)
Other Shoulder-Related Complication				
• Dropped Glenoid During Surgery	1	1/116 (0.9%)	0	0
• Glenoid Radiolucency	4	4/116 (3.4%)	2	2/123 (1.6%)
• Glenoid Perforation during Implantation	1	1/116 (0.9%)	0	0
• Humeral Radiolucency	3	3/116 (2.6%)	3	3/123 (2.4%)
• Increased Soreness, Clicking, Weakness, Catching	1	1/116 (0.9%)	0	0
• Locking Sensation	0	0	1	1/123 (0.8%)
• Osteopenia	1	1/116 (0.9%)	1	1/123 (0.8%)
• Popping/Cracking in Shoulder	2	2/116 (1.7%)	0	0
• Revision: Infection	0	0	1	1/123 (0.8%)
• Shoulder Migration	0	0	1	1/123 (0.8%)
• Shoulder Stiffness	1	1/116 (0.9%)	0	0
Total Number of Subjects who Experienced a Device-Related Adverse Event	**20**	**20/116 (17.2%)**	**20**	**20/123 (16.3%)**

Two revisions of the Comprehensive Shoulder System with nano Humeral Component were reported during this study. The first patient was revised due to inadequate range of motion, shoulder pain, and a suspected infection. The second patient was revised following suspected infection. In both cases, infection of the operative shoulder was later confirmed. Neither revision was classified by the investigator as related to the study devices.

Four revisions of the Comprehensive mini stem were reported through the course of the study, one of which was classified as possibly related to the device. One subject was revised following a fall and a deep shoulder infection, and this event was classified as possibly related to the study device by the investigator. One subject was revised following unusual shoulder pain, suspected rotator cuff tear, and suspected infection which was confirmed post-operatively (not device related). One subject was revised following pain, immobility, and limited function stemming from a suspected complete subscapularis tear that was confirmed intra-operatively (not device related). The last subject was revised following a potential subscapularis tear with dislocation/subluxation, where the subscapularis tear was confirmed intra-operative (not device related).

Serious Device-Related Adverse Events Reported during Comprehensive nano IDE Clinical Study

There were no serious device-related adverse events reported during the Comprehensive nano IDE Clinical Study.

Substantial Equivalence Conclusion

Based on consideration of indications for use, technological characteristics, and results of non-clinical and clinical testing, it was established that the Comprehensive Nano Stemless Shoulder demonstrates substantial equivalence to the listed predicate devices.