FDA Executive Summary

Prepared for the
Spring 2025 Review by the
FDA's Pediatric Advisory Committee

Minimally Invasive Deformity Correction (MID-C) System
(H170001)

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I. INTRODUCTION

In accordance with the Pediatric Medical Device Safety and Improvement Act, this review provides a safety update based on the post-market experience with the use of the Minimally Invasive Deformity Correction System ("MID-C") from ApiFix, Ltd. in pediatric patients since approval in 2019. The purpose of this review is to provide the Pediatric Advisory Committee (PAC) with post-market safety data so the committee can advise the Food and Drug Administration (FDA) on whether they have any new safety concerns and whether they believe that the Humanitarian Device Exemption (HDE) remains appropriate for pediatric use. This document summarizes the safety data the FDA reviewed since HDE approval in October 2019. It includes data from the sponsor's Annual Report, post-market medical device reporting (MDR) of adverse events (AEs), and peer-reviewed literature.

II. INDICATIONS FOR USE

The MID-C System is indicated for use in patients with adolescent idiopathic scoliosis (AIS) for treatment of single curves classified as Lenke 1 (thoracic major curve) or Lenke 5 (thoracolumbar/lumbar major curve), having a Cobb angle of 40 to 60 degrees which reduces to less than or equal to 30 degrees on lateral side-bending radiographs, and thoracic kyphosis less than 55 degrees as measured from T5 to T12.

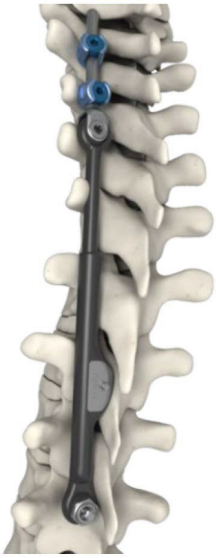
Use of the MID-C System in patients with curves of lower magnitudes (i.e., less than 40 degrees) is based on the risk for curve progression.

Modifications from the Humanitarian Use Device (HUD) Designation:
The Indication for Use statement was modified from that granted for the original HUD designation to have a more stringent (30 versus 35 degrees) major curve side-bending reduction criterion to ensure a flexible curve. Subsequently, the Cobb angle inclusion criteria were expanded from 45-60 degrees to 40-60 degrees. An additional statement was added to the Indications for Use ("Use of the MID-C System in patients with curves of lower magnitudes (i.e., less than 40 degrees) based on the risk for curve progression") in a regulatory submission after the original HDE approval.

III. BRIEF DEVICE DESCRIPTION

The MID-C System is a non-fusion spinal device intended for treatment of adolescent idiopathic scoliosis and acts as an internal brace to achieve correction and stabilization of scoliotic deformity without the need for a spinal fusion. The device is a ratchet-based, expandable rod that attaches to the spine using two pedicle screws, one placed superior and one inferior to the apex of the curve. An optional extender is available composed of a 5.5mm rod and two pedicle screws to anchor the superior end of the implant with two screws rather than one. The MID-C System is made of titanium alloy (Ti-6Al-4V ELI) components with some components coated in an amorphous diamond-like coating (ADLC). The device is implanted on the concave side of the spinal deformity, around the apex of a flexible single major curve, and acts as an internal brace to correct and stabilize scoliotic deformity via incremental ratchet lengthening. The system passively elongates when tensile load is applied via the pedicle screws, and the length of the device expands in 1.3 mm increments. The ratchet and pawl mechanism permit one-way

elongation while maintaining the length of the device under compressive loads. In addition, the system includes instrumentation for insertion, manipulation, and removal of the implants.



Device Type	Image	Sizes		Material
Pedicle Screws		Lengths: 30-50mm (5mm increments)	Diameters: 5.0-7.0mm (0.5mm increments)	Ti-6Al-4V ELI (ASTM F136) Coated with ADLC
MID-C System		Device Lengths:	Extension Lengths:	Ti-6Al-4V ELI (ASTM F136) Coated with ADLC
		85mm	30	
		95mm	30	
		105	40	
		115	40	
		125	50	
Optional		Configurations: 0° or 15° (left and right)		Ti-6Al-4V ELI (ASTM F136)

IV. REGULATORY HISTORY and Current Status

The MID-C System received Humanitarian Use Device designation (HUD DEV-2015-0345) on December 21, 2015; however, an expansion of the patient population was granted on November 14, 2019. The HDE was approved on August 20, 2019 (and the expanded patient population approved by supplement on December 16, 2019) by the Center for Devices and Radiological Health (CDRH) of the Food and Drug Administration. A summary of the HDE and PAS annual reports submitted for the MID-C System are presented in Table 1.

Table 1. H170001 Regulatory History

H170001 Reports	Status
PAS 6-Month Report	Report OK
HDE 1-year Annual Report	Report OK
PAS 12-Month Report	Report OK
PAS 18-Month Report	Report OK
PAS 24-Month Report	Report OK
HDE 2-year Annual Report	Report OK
PAS 36-Month Report	Report OK
HDE 3-year Annual Report	Report OK
PAS 48-Month Report	Report OK
HDE 4-year Annual Report	Report OK
PAS 60-Month Report	Report OK
HDE 5-year Annual Report	Report OK

V. SUMMARY OF CLINICAL DATA USED TO SUPPORT HDE APPROVAL

A clinical study was performed to support the safety and probable benefit of the Minimally

Invasive Deformity Correction System for subjects with adolescent idiopathic scoliosis and documented in the Summary of Safety and Probable Benefit (SSPB). As of September 15, 2018,

the MID-C System was implanted in 252 patients outside the US (OUS) and included clinical data from the following sources: (1) OUS prospective, multi-center, non-randomized, open label investigation in 20 subjects, (2) OUS commercial use on 197 patients, (3) OUS commercial use post-market prospective study on 26 subjects, and (4) OUS special access on 9 patients.

A target population (n=25) of all patients implanted with the HDE Device Version of the MID-C System as of September 15, 2018, was initially identified with the following criteria:

Target Population Indications

- Lenke type 1 or 5 curves
- Pre-operative Cobb angle between 45 to 60 degrees (inclusive)
- Flexible major curve (defined as lateral bending correction of 30 degrees or less)
- Thoracic kyphosis less than 55 degrees

To capture a larger sample size, an expanded population (n=49) was included that met an expanded US Indications for Use, as approved by supplement on December 16, 2019, defined by the following criteria:

Expanded Target Population Indications

- Lenke type 1 or 5 curves
- Pre-operative Cobb angle between 40 to 60 degrees (inclusive)
- Flexible major curve (defined as lateral bending correction of 30 degrees or less)
- Thoracic kyphosis less than 55 degrees

The majority of the subjects were female (42/47, 89.4%), and the mean age at time of surgery was 15.0 years. Common primary assessments collected for all subjects were: skeletal maturity as determined by Risser grade and curve magnitude as determined by Cobb angle.

The prespecified primary probable benefit endpoint of the study was:

- Cobb angle at 24 months post-implantation, with success defined as a major Cobb angle of less than or equal to 35 degrees and no curve progression greater than 10 degrees compared to baseline

To more fully understand the probable benefits of the MID-C System, ApiFix also conducted additional subgroup analyses that varied the Cobb angle threshold as described above:

- Main Cobb angle $\leq 40°$ and no curve progression greater than 10° compared to baseline
- Main Cobb angle $\leq 45°$ and no curve progression greater than 10° compared to baseline
- Main Cobb angle $\leq 50°$ and no curve progression greater than 10° compared to baseline

These additional endpoints were assessed based on published literature establishing 40-50° as thresholds at which risk of subsequent curve progression is low.[1]

Individual subject success was defined as achievement of a Main Cobb angle less than or equal to 35 degrees following treatment with the MID-C System, and no curve progression compared

to baseline at 24 months post-surgery. Six (6) out of the 8 subjects in the target population (75%) and 18 out of the 20 subjects in the expanded population (90%) with 24-month data met the success criteria in this study and were considered probable benefit successes. At the last follow-up visit greater than 24 months, all 20 patients in the expanded population had improvement of the primary Cobb angle (greater than 5 degrees compared to baseline), including the 2 patients who did not meet the primary probable benefit endpoint. The average improvement of the primary Cobb angle for these 20 patients is calculated as approximately 21 degrees compared to the average baseline Cobb angle of 45 degrees, resulting in approximately 40-50% curve correction. Furthermore, assessment of skeletal maturity concludes 86% of these patients were skeletally mature at the 24-month timepoint.

The primary safety endpoint evaluated was reoperation performed for any reason at any timepoint and included all serious adverse events (SAEs) that resulted in reoperation. In this clinical study, AE data were classified as either device related AE or SAE. AE data were available for 63 patients and included 21 patients (33.3%) who reported a non-serious AE. The most common AE event types reported were pain (13/63, 20.6%), nausea and vomiting (3/63, 4.8%), and limited movement range of the spine (3/63, 4.8%). The non-serious AE data did not raise any notable safety concerns.

Reoperations (serious AEs) occurred in 45 out of 252 subjects (17.9%). Many of these reoperations occurred early in the use of the device and were attributed to an initial technology learning curve. This learning curve is present with similar devices used for spinal fusion in AIS with re-operation rates as high as 17.1% reported in a five-year cohort[2]. However, when limiting the reoperation rate to the expanded population, the reoperation rate falls to 6 out of 49 subjects (12.2%) which is comparable to historical literature and database reported rate of 8.5% at 2-years for target AIS population. No deaths or neurologic AEs were reported.

As the MID-C System is a non-fusion treatment, it offers patients the potential to avoid the long-term adverse consequences associated with fusion which include decreased spinal motion, pseudarthrosis, adjacent spinal segment degeneration, neurological complications, pain, implant failure or breakage, and subsequent surgical intervention.

Patient perspectives were considered as an additional factor in the determination of probable benefits and risks for the device through the administration of patient questionnaires.

1. A patient satisfaction questionnaire was administered following the clinical study. Patients were asked to score their responses to three questions on a scale of 1 to 5, with 1 being the most negative response and 5 being the most positive. 36 out of 45 patients (80%) reported they agree or strongly agree that they would have the procedure again (scores of 4 or 5). Similarly, 38 of 45 patients (84%) agreed or strongly agreed that they would recommend the procedure to another person (scores of 4 or 5). Lastly, 38 of 45 patients (84%) rated their general satisfaction with the procedure/treatment as a 4 or 5.

2. Scoliosis Research Society (SRS-22) survey: The SRS-22 survey was collected for the 20 patients in the pilot study. This survey consists of 22 questions, which are grouped into the following sub-score categories: function, pain, self-image, mental health and

satisfaction with back management. For each sub-score, higher scores indicate more positive responses. Overall, there was consistent improvement across sub-scores to two years in both cohorts.

In conclusion, given the available information above, the data on the Minimally Invasive Deformity Correction System collected under the study support that the probable benefits outweigh the probable risks for use of this device for treatment of select patients with adolescent idiopathic scoliosis.

VI. POST-MARKET DATA: ANNUAL DISTRIBUTION NUMBER

Section 520(m)(6)(A)(ii) of the Federal Food, Drug, and Cosmetic Act (FD&C Act) allows HDEs indicated for pediatric use to be sold for profit as long as the number of devices distributed in any calendar year does not exceed the annual distribution number (ADN). On December 13, 2016, the 21st Century Cures Act (Pub. L. No. 114-255) updated the definition of ADN to be the number of devices "reasonably needed to treat, diagnose, or cure a population of 8,000 individuals in the United States." Based on this definition, FDA calculates the ADN to be 8,000 multiplied by the number of devices reasonably necessary to treat an individual. Given that only one of the MID-C systems should be necessary to treat an individual the total ADN for MID-C System is 8,000.

The fifth HDE Annual Report was submitted on August 23, 2024 which included the Reporting Period from August 24, 2023 through July 12, 2024. The 60-Month PAS Report was submitted on August 14, 2024 and included the Reporting Period from August 23, 2019, through July 12, 2024. Table 2 provides the number of devices distributed in the fifth year (August 2023-July 2024). To date, there have been 325 HDE approved MID-C System devices distributed on the U.S. market, with the first patient treated with the device on June 30, 2020.

Table 2. Annual Distribution Number – Reporting Period: August 2023-July 2024

Device	Annual Distribution Limit	Total since HDE Approval (as of 7/12/24)	Reporting Period Total (8/2023-7/2024)
MID-C System	8,000	314	89

Of note: The first procedure conducted with the MID-C System was conducted OUS in April 2012. From that date until October 1, 2024, a total of 325 devices have been distributed in the US while a total of 975 devices have been distributed worldwide with the same number of procedures performed. Thus, 650 devices have been distributed OUS from April 2012 to October 1, 2024.

VII. POST-MARKET DATA: POST-APPROVAL STUDY (PAS)

PAS Conditions of Approval

The MID-C System HDE (H170001) was approved on August 20, 2019.

The objective of the PAS is to assess the ongoing safety and probable benefit of the MID-C System in a registry population.

The MID-C System Registry is a multi-center, single-arm, prospective post-approval registry study to provide ongoing safety and probable benefit assessment of the MID-C System in treatment of patients with adolescent idiopathic scoliosis. Skeletal maturity is assessed using the Risser grade, Sanders score, or a combination of the two. All patients treated in the first 24 months are enrolled and followed through 60 months from the time of each patient's index surgery, with interim visits at the immediate post-operative time point up to 6 weeks, 6 months, 12 months, and annually thereafter post-procedure. A minimum number of 200 patients are to be enrolled in this study, with at least 50 patients enrolled by 24 months, 100 patients enrolled by 36 months (if enrollment is still ongoing), and 200 patients enrolled by 48 months (if enrollment is still ongoing). This study includes a minimum of 10 centers with sequential enrollment from each site that agrees to participate.

The primary safety endpoints are SAEs and device- or procedure-related AEs. Additional safety analyses include the: rate of AEs, including by relatedness to device or procedure, AE severity and rate of reoperation, including by type of reoperation.

The current primary probable benefit endpoint identified as a Condition of Approval in the HDE Approval Order is maintenance of major Cobb angle less than or equal to 40 degrees at 60 months post-surgery.

Secondary endpoints are analyzed annually up to 60 months post-surgery, and will include the following:

1. Maintenance of major Cobb angle less than or equal to 40 degrees.
2. Curve progression no greater than 10 degrees of the secondary curve above or below the implant.
3. Composite endpoint analysis (maintenance of major Cobb angle less than or equal to 40 degrees AND freedom from SAEs during MID-C System procedure and procedure/device related SAEs following surgery).
4. Analysis of the failure attributable to conversion to another spinal implant OR major Cobb angle that exceeded 40 degrees at defined follow-up visit OR any curve progression at defined follow-up compared to baseline OR death OR permanent disability.

All safety and probable benefit data are collected at the following time points: pre-operative, immediate post-operative up to 6 weeks, 6 months, 12 months, and annually thereafter until 60-month post-operative data from each patient are collected. This study is estimated to last a total of 84 months. Descriptive statistics and 95% confidence intervals are to be presented for all analyses. For continuous variables, means and standard deviations are shown. For categorical variables, frequencies and percentages are presented.

The study population is comprised of pediatric patients (defined as persons younger than 22 years of age) that require surgical treatment or have failed non-surgical treatments to obtain and

maintain correction of progressive spinal deformities with a Cobb angle of 30-60 degrees, with a flexible curve, and thoracic kyphosis less than 55 degrees, as measured from T5 to T12.

PAS Study Status

The original PAS protocol was accepted on October 23, 2019, and the sixty-month PAS report was approved on September 11, 2024. As of this date, fourteen (14) sites have study IRB approval with a total of two hundred and one (201) patients enrolled. This study is estimated to last a total of 84 months from the date of PAS approval.

Two hundred and one (201) patients have surgery dates scheduled, two hundred and one (201) patients have undergone implantation, two hundred and one (201) patients have had their six-week follow-up, one hundred and ninety-three (193) patients have had their six-month follow-up, one hundred and seventy-three (173) patients have had their twelve-month follow-up, one hundred and twenty-seven (127) patients have had their twenty-four-month follow-up, seventy-seven (77) patients have had their thirty-six-month follow-up, and nine (9) patients have had their forty-eight-month follow-up. Patient demographics and follow-up are summarized below in Table 3 and Table 4.

Table 3. PAS Patient Demographics

Patient Demographics	
N	201
Age (years) at Surgery	14.9 ± 2.1
Sex	74% (149/201) Females 26% (52/201) Males
Risser Sign	0 – 19% (38/201) 1 – 5% (11/201) 2 – 7% (14/201) 3 – 15% (30/201) 4 – 32% (64/201) 5 – 22% (44/201)
Lenke Class	67% (134/201) Lenke 1 33% (67/201) Lenke 5

Source: Constructed based on data from H170001 annual reports

Table 4. PAS Patient Follow-up Status

Patient Follow-up per Study Visit	
Study Visit	Completed
Pre-Op	201
6-week	201
6-month	193
12-month	173
24-month	127
36-month	77
48-month	9
60-month	N/A

Source: Constructed based on data from H170001 annual reports

Interim Results:

Probable Benefit:

At the 6-week visit, the average major Cobb angle was 19.1° ± 7.1°, at the 6-month visit for all of the 168 patients for whom the angle was measured had maintained a major Cobb angle less than 40°, 138 patients (99%) maintained a major Cobb angle less than 40° at the 12-month visit, 84 patients (90%) maintained a major Cobb angle less than 40° at the 24-month visit, and 37 patients (73%) maintained a major Cobb angle less than 40° at the 36-month visit (Table 5). In 99% (166/168) of patients at the 6-month visit and in 99% (138/140) of patients at the 12-month visit showed the secondary Cobb angle was improved from the pre-operative angle to 18.3° ± 9.5° and 17.5° ± 10.8°, respectively, and therefore showed reduction in curve size and no increase above 10° in the secondary curve (Table 6).

Table 5. PAS Probable Benefit Summary: Major Cobb Angle

Major Cobb Angle							
	Pre-Op	6-week	6-month	12-month	24-month	36-month	60-month
N	200	197	168	138	84	37	0
Cobb Angle	45.6 ± 6.5°	19.1 ± 7.1°	17.5 ± 8.3°	16.4 ± 9.2°	20.4 ± 11.3°	21.5 ± 10.5	-

Source: Constructed based on data from H170001 annual reports

Table 6. PAS Probable Benefit Summary: Secondary Cobb Angle

Secondary Cobb Angle							
	Pre-Op	6-week	6-month	12-month	24-month	36-month	60-month
N	200	196	166	138	83	37	0
Cobb Angle	30.2 ± 7.2°	18.1 ± 9.5°	18.3 ± 9.5°	17.5± 10.8	18.8 ± 10.6	20.0 ±10.4°	-

Source: Constructed based on data from H170001 annual reports

Safety:

No serious adverse events have been reported to date.

VIII. ADVERSE EVENTS

Known Adverse Events

AEs collected during the clinical study that were used to support the safety and probable benefit of MID-C System in patients with adolescent idiopathic scoliosis were presented in the SSPB at the time of approval. For the initial target study population (n=252), 45 patients (17.9%) required reoperation. For the expanded target study population (n=49), 6 patients (12.2%) required reoperation. Table 7 lists all AE types reported in the clinical study, or identified by clinical experts, that were classified as related to the device or procedure.

Table 7. Known Adverse Event Types

AEs Related to Device or Procedure	Systemic AEs
1. Screw/nut loosening 2. Device loosening, migration, breakage, malposition 3. Sizing issues 4. Anatomic/technical difficulty 5. Inability to implant the device 6. Intraoperative device revision 7. Loss or inadequate curve correction 8. Curve development above and/or below the instrumented levels 9. Requirement for subsequent surgical intervention 10. Neurologic 11. Heterotopic ossification 12. Trunk imbalance 13. Interference with imaging 14. Unintended spontaneous fusion 15. Bone fracture 16. Dural tear/leakage 17. Surgical site seroma, bursitis, crepitus 18. Skin penetration by device 19. Wound dehiscence 20. Hematoma 21. Wound infection, superficial, deep 22. Intraoperative neurologic injury 23. Intraoperative vascular injury, excessive blood loss, hypotension 24. Anesthesia, airway, ventilation 25. Visceral injury 26. Blood transfusion 27. Allergic reaction 28. Ophthalmic injury, including blindness 29. Pain (back, surgical site, extremity, other) 30. Infection 31. Device malfunction 32. Screw pull-out	1. Deep vein thrombosis 2. Pulmonary embolism 3. Atelectasis, pneumonia 4. Cardiac 5. Dysphagia 6. Dysphonia 7. Gastrointestinal (ileus, ulceration, bleeding, malnutrition) 8. Foreign body reaction 9. Pressure sores 10. Genitourinary (infection, urine retention) 11. CSF leak/meningocele 12. Chest tube insertion 13. Infection (systemic) 14. Hematologic 15. Endocrine/metabolic 16. Hepatobiliary 17. Immunologic 18. Gynecologic 19. Ophthalmologic 20. Psychological 21. Surgical procedure: non-spinal 22. Wound infection: non-spinal 23. Death

From the AEs reported in Table 7, Table 8 summarizes the six (6) AE types that were classified as device or procedure-related SAEs. All SAEs required reoperation with device loosening, migration, breakage, and malposition being the most common (9/252, 3.6%) followed by loss or inadequate curve correction (8/252, 3.2%), infection (8/252, 3.2%), device malfunctions (6/252, 2.4%), screw pull-out (5/252, 2%), and screw/nut loosening (5/252, 2%). When restricting the

analysis to patients who met the expanded US indications, the most common SAE requiring reoperation was procedure related (5/49, 10.2%) followed by device related (1/49, 2%).

Table 8. Known SAE Types Related to the MID-C System or Procedure

SAEs Related to MID-C System or Procedure
1. Device loosening, migration, breakage, malposition 2. Loss or inadequate curve correction 3. Infection 4. Device malfunctions 5. Screw pull-out 6. Screw/nut loosening

Overview of MDR Database

Strengths and Limitations of MDR Data

Each year, the FDA receives several hundred thousand MDRs of suspected device-associated deaths, serious injuries and malfunctions. The MDR database houses MDRs submitted to the FDA by mandatory reporters (manufacturers, importers and device user facilities) and voluntary reporters such as health care professionals, patients and consumers. The FDA uses MDRs to monitor device performance, detect potential device-related safety issues, and contribute to benefit-risk assessments of regulated devices. MDR reports can be used effectively to:

- Establish a qualitative snapshot of adverse events for a specific device or device type
- Detect actual or potential device problems used in a "real world" setting/environment, including:
    - Rare, serious or unexpected adverse events
    - Adverse events that occur during long-term device use
    - Adverse events associated with vulnerable populations
    - Off-label use, and
    - Use error

Although MDRs are a valuable source of information, this passive surveillance system has limitations, including the potential submission of incomplete, inaccurate, untimely, unverified or biased data. In addition, the incidence or prevalence of an event cannot be determined from this reporting system alone due to potential under-reporting of events and lack of information about frequency of device use. Because of this, MDRs comprise only one of the FDA's several important post-market surveillance data sources. Other limitations of MDRs and FDA's internal MDR database include:

- MDR data alone cannot be used to establish rates of events, evaluate a change in event rates over time, or compare event rates between devices. The number of reports cannot be interpreted or used in isolation to reach conclusions about the existence, severity, or frequency of problems associated with devices.
- Confirming whether a device caused a specific event can be difficult based solely on information provided in each report. Establishing a cause-and-effect relationship is especially difficult if circumstances surrounding the event have not been verified or if the device in question has not been directly evaluated.
- MDR data is subjected to reporting bias, attributable to potential causes such as reporting practice, increased media attention, and/or other agency regulatory actions.
- MDR data does not represent all known safety information for a reported medical device and should be interpreted in the context of other available information when making device-related or treatment decisions.

MDR's Associated with the MID-C System

The FDA's internal MDR Database was searched on November 4, 2024, utilizing the following search criteria:

1. Manufacturer Name ("ApiFix") and Brand Name ("MID-C")

    - 59 unique MDRs were found
2. Manufacturer or Company Name (“ApiFix”)
    - No events not already contained in search criterion 1
3. Brand Name or Generic Name or Concomitant Product containing "MID-C"
    - No events not already contained in search criterion 1
4. PMA/510K: “H170001” OR “170001”
    - No events pertaining to MID-C not already contained in search criterion 1

The search resulted in fifty-nine (59) MDRs for the MID-C System. Thirty-five (35) MDRs took place within the US, while 24 MDRs took place OUS. Descriptive summaries of all 35 unique US MDRs this year are provided below.

United States (US) MDRs

MDR#1: 3013461531-2023-00047
The surgeon reported to the sponsor that the patient (14-year-old female) underwent revision surgery due to ratchet malfunction. No report of patient harm or complications were received. ApiFix investigated this event and stated that ratchet malfunction (resulting in a backup of the distraction) can result from physical trauma, practicing high-demand sports, and tissue growth inside the ratchet mechanism. It was noted that ratchet malfunction may be reported together with pain, curve progression, or noise. Device failure is a known risk, as noted in the literature and SSPB.

MDR#2: 3013461531-2023-00049
The surgeon reported to the sponsor that during the index procedure, the patient (16-year-old female) was discovered with a broken implant and was scheduled for revision surgery. After removal of the broken implant, it was observed that the tissue around the T5-T6 region was healthy. Implant breakage is a known risk, as noted in the literature and SSPB. Furthermore, the risk assessment indicated that implant breakage can occur due to trauma, high-demand sports, hyperkyphosis, incorrect pedicle screw insertion, or improper surgical technique (such as inserting the pedicle screws via the wrong trajectory). ApiFix investigated this event, and corrective actions note the importance of screw insertion trajectory. Furthermore, the surgeon noted metallosis (classified grade III) in the T7-T10 region, coating bone, muscle, and surrounding the distal end of the implant (screw). A tissue sample was collected and sent for histopathological analysis.

MDR#3: 3013461531-2023-00055
The surgeon reported to the sponsor that the patient (12-year-old female) underwent device explantation, as there were complications of discomfort. After explantation, the surgeon placed the patient into an external brace. ApiFix investigated this event and noted that mechanical failure of the MID-C mechanism resulting in patient re-operation due to inadequate curve correction is a known risk.

MDR#4: 3013461531-2023-00056
Prior to this reporting period, the patient (17-year-old female) underwent implant removal following screw breakage. Within this reporting period, the surgeon reported to the sponsor that

the patient experienced wound dehiscence following their implant removal. The patient was successfully treated with wet to dry wound dressings. Both screw breakage and wound dehiscence are known device or procedure-related risks, as noted in the literature and SSPB.

MDR#5: 3013461531-2023-00057
The surgeon reported to the sponsor that the patient (13-year-old female) experienced screw migration, which was evident two weeks post-operation visit and had worsened by the six-week post-operation visit. The most distal screw and the inferior proximal screw were ploughing, causing the kite angle to worsen and the device to lengthen excessively. Despite these issues, the patient remained asymptomatic with no implant prominence or notable deformity. The patient underwent revision surgery, during which the inferior polyaxial screw and additional ApiFix screw were replaced with larger screws. Screw migration is a known risk, as noted in the literature and SSPB.

MDR#6: 3013461531-2023-00059
The surgeon reported to the sponsor that the patient (13-year-old female) felt some clicking in her back. X-ray images show failure of the device's ratchet mechanism. Ratchet malfunction or device failure is a known risk, as noted in the literature and SSPB. Revision/explantation surgery has not been confirmed.

MDR#7: 3013461531-2023-00060
The surgeon reported to the sponsor that the patient (23-year-old female) underwent revision surgery due to screw pull-out. During the revision surgery, the patient's polyaxial screws were replaced with bigger screws (7.0x35) and moved one level (T4/T5 to T5/T6). Additionally, a new MID-C and extender of the same size and type were replaced. ApiFix investigated this event, and clinical investigations could not conclude if the kite angle collapsed thereby pulling the screw with it or vice versa. Note that screw pull-out is a known risk, as noted in the literature and SSPB.

MDR#8: 3013461531-2023-00061
The surgeon reported to the sponsor that the patient (female, age unknown) had a broken rod, confirmed by X-ray images. It was noted that the patient experienced an acute onset of pain the week prior the visit. Device breakage is a known risk, as noted in the literature and SSPB. The surgeon replaced the broken rod with a new rod and intraoperatively observed metallic debris around the broken rod area. The explanted device was sent to the manufacturer for further analysis. Histopathological test results concluded that the black discoloration observed in the tissue is a normal and anticipated outcome for metallic implants with an amorphous diamond-like coating (ADLC). The device is expected to be returned to the manufacturer for evaluation.

MDR#9: 3013461531-2023-00062
The surgeon reported to the sponsor that the patient (16-year-old female) was diagnosed with an inflamed bursa over the distal 1/3 of the incision. ApiFix received additional information indicating that the bursa, which was superficial and fluid-filled, had burst on its own, draining all fluid since the date of diagnosis. Furthermore, the surgeon noted an open sinus tract in the middle of the incision where the bursa was located. The patient underwent debridement of the spine with removal of the device. The explanted device was sent to the manufacturer for further

analysis. The report indicated that the device was in normal condition, and that the causal relationship between the device and the inflamed bursa event remains inconclusive. Infection is a known device or procedure-related risk, as noted in the literature and SSPB.

MDR#10: 3013461531-2023-00063
The surgeon reported to the sponsor that following the index procedure, the patient (18-year-old male) was observed with a broken screw. ApiFix investigated this event and found that the implant bridged eight vertebrae instead of the recommended seven, and the extender kite angle was straight (0°) rather than the suggested 5°-15°. Additionally, three (3) upper polyaxial screws were used instead of the recommended two (2). The risk assessment indicated that screw breakage could result from improper screw insertion, size selection, or application of side forces during torquing. Device breakage is a known risk, as noted in the literature and SSPB.

MDR#11: 3013461531-2023-00064
The surgeon reported to the sponsor that the patient (18-year-old male) experienced worsening right-sided pain, migrating down to the thigh. An MRI revealed moderate fluid and edema, spondylosis grade 1 with spondylolisthesis L5-S1, and minimal central canal distension. Furthermore, the surgeon noted swelling and new spinal issues, possibly stemming from a recent motor vehicle accident. The device was removed due to pain. ApiFix investigated this event and noted there were no obvious manufacturing or design defects that contributed to the removal. Pain is a known device or procedure-related risk, as noted in the literature and SSPB.

MDR#12: 3013461531-2023-00065
The surgeon reported to the sponsor that the patient (17-year-old female) underwent removal surgery following the index procedure due to a fractured/broken ApiFix screw at T12. The explanted device was sent to the manufacturer for further analysis. It was reported that beach marks or striations were observed on the fracture surface of the device possibly indicative of fatigue failure mechanisms. The risk assessment indicated that screw breakage could result from improper screw insertion, size selection, or application of side forces during torquing. Device breakage is a known risk, as noted in the literature and SSPB.

MDR#13: 3013461531-2024-00001
The surgeon reported to the sponsor that the patient (15-year-old male) converted to fusion due to a worsening kyphosis and curve progression. ApiFix investigated this event and noted the device was fractured around the mid-point of the pole showing signs of wear. Furthermore, it was noted that curve progression can result from several reasons, such as device misplacement, operating on patients out of the approved indication, implant size selection, extender misalignment, screw misplacement/migration, screw pull-out, implant breakage, infection, ratchet malfunction, etc. The progression can be either or both the primary or secondary curve and may also be reported together with pain and/or spine imbalance. Cause for the secondary curve progression could not be determined. Inadequate curve correction, loss of curve correction, and curve development above and/or below the instrument levels are known risks, as noted in the literature and SSPB.

MDR#14: 3013461531-2024-00006
The surgeon reported to the sponsor that the patient (15-year-old female) underwent explantation surgery due to pain after significant weight gain and increased kite angle (significant proximal junctional kyphosis). ApiFix investigated this event and noted that the device appeared normal with no obvious signs of wear or failure.

MDR#15: 3013461531-2024-00009
The surgeon reported to the sponsor that the patient (14-year-old male) underwent explantation surgery due to possible infection. After device removal, the surgeon observed signs of infection. The explanted device is expected to be returned to the manufacturer for further evaluation. Infection is a known device or procedure-related risk, as noted in the literature and SSPB.

MDR#16: 3013461531-2024-00010
The surgeon reported to the sponsor that the patient (12-year-old female) underwent explantation surgery due to screw pull-out and subsequent implant migration. According to the report, the most distal of the proximal screws plowed through the pedicle causing an increase in the kite angle. ApiFix investigated this event and noted that the device appeared normal with no obvious signs of wear or failure. Screw pull-out (loosening) and device migration are known risks, as noted in the literature and SSPB.

MDR#17: 3013461531-2024-00011
The surgeon reported to the sponsor that the patient (17-year-old female) had generalized back pain with pain into both legs. It was further reported that the leg pain may be aggravation of a pre-op known condition. The patient underwent physical therapy and was given a new prescription for pain management. After unsuccessful pain relief, the patient underwent removal surgery. The surgeon noted poor bone quality and a possible underlying soft tissue disorder. Preoperative MRI findings included mild neural foraminal narrowing at L5-S1 and narrowing at the L4-L5 recess with possible contact of the descending L5 nerve root. Prior to removal, findings showed a disc bulge at L4-L5 with mild right neural foraminal narrowing and a small disc bulge at L5-S1 without significant spinal canal or neural foraminal narrowing. ApiFix investigated this event and noted that during inspection, the device appeared normal but that the ring's movement was stuck, indicating an issue with its mobility. Disassembly revealed wear on the ring, extender, and outside housing of the spherical ring on the pole. However, it was reported that the spherical rings themselves showed no wear. ApiFix noted that the device's removal was unrelated to its performance.

MDR#18: 3013461531-2024-00012
The surgeon reported to the sponsor that the patient (female, age unknown) experienced an assortment of wound complications (i.e., wound drainage, wound infection, and wound dehiscence). The patient was treated with Keflex, a commonly prescribed antibiotic for skin and soft tissue infections. Due to persistent wound drainage and dehiscence, the patient underwent a washout and revision surgery with a new ApiFix rod/extender. During washout, the surgeon noted that the patient's skin and subcutaneous tissue was purulent around the implanted site. The surgeon also noted that there was a hole at the distal aspect of the fascia with exposed hardware. ApiFix investigated this event, and the histopathological test results concluded *E. coli*, signifying in infection. Risk assessment noted that early infections (e.g., wound complications) can be

surgery related and may be resolved without sequala following conservative treatment. Wound infection is a known risk, as noted in the literature and SSPB.

MDR#19: 3013461531-2024-00015
The surgeon reported to the sponsor that the patient (16-year-old male) underwent revision surgery due to a broken rod. ApiFix investigated this event and noted that the device was fractured around the mid-point of the pole (rod). The fracture plane was worn smooth, and a fracture mode could not be confirmed. After removal of the extender component, the spherical rings were inspected for wear. Wear and deformity were observed on the spherical ring of the base. However, no wear was visibly observed on the spherical ring of the pole. Risk assessment noted that implant breakage can occur due to trauma, high-demand sports, hyperkyphosis, incorrect pedicle screw insertion, or improper surgical technique. Device breakage is a known risk, as noted in the literature and SSPB.

MDR#20: 3013461531-2024-00018
The surgeon reported to the sponsor that the patient (19-year-old female) underwent device removal due to pain/discomfort. Pain is a known risk, as noted in the literature and SSPB. It was reported that when the patient flexes and extends, there is snapping and popping noises possibly due to muscles rubbing against the implants. Following removal surgery, the device was examined, and the popping noises experienced by the patient may be attributed to the device popping in a locked mode. The explanted device is expected to be returned to the manufacturer where a failure analysis will be conducted.

MDR#21: 3013461531-2024-00019
The surgeon reported to the sponsor that the patient (female, age unknown) underwent revision surgery due to a broken rod and a Lenke 5 curve. ApiFix investigated this event and noted that the explanted device was fractured around the mid-point of the pole (rod). The fracture plan was worn smooth, and thus the fracture mode could not be characterized or identified. No signs of wear were visible on the spherical ring of the pole after removal of the extender component. This event included information on ApiFix's corrective actions over the years intended to improve surgical outcomes and product performance. These include detailed training for surgeons on screw insertion trajectory, updates to the MID-C 125 to allow more overlap between components, and the addition of a trial tool to detect excess tissue. Additionally, precautions regarding severe sports were added to training and instructions, and continuous improvement efforts were initiated to investigated and minimize implant breakage. Device breakage is a known risk, as noted in the literature and SSPB.

MDR#22: 3013461531-2024-00020
The surgeon reported to the sponsor that the patient (17-year-old female) underwent revision surgery to replace a screw that had migrated. The patient had reported some increased pain and clinically was showing an increased translation and rotation of the spine. CT scans verified that the screw had migrated outside of the pedicle. Device migration is a known risk, as noted in the literature and SSPB., and can lead to complications such as curve progression or screw pull-out overtime. This issue may be attributed to the surgeon's skill and the patient's anatomy, especially in the upper spine where pedicles are relatively small. ApiFix noted that the explanted device will not be returned for wear and failure analyses.

MDR#23: 3013461531-2024-00021
The surgeon reported to the sponsor that during the 2.5-year follow-up, the patient (14-year-old female) had experienced screw migration / pull-out (i.e., x-ray images confirmed that the patient's superior screw was beginning to plow). ApiFix investigated this event and concluded that the device appeared normal with no obvious signs of wear or failure. Device migration and screw pull-out (loosening) are known risks, as noted in the literature and SSPB.

MDR#24: 3013461531-2024-00022
The surgeon reported to the sponsor that the patient (14-year-old female) underwent implant removal due to curve progression, peri-implant pain/discomfort, and reports of noises. Inadequate curve correction, loss of curve correction, and pain (back, surgical site, extremity, other) are known risks, as noted in the literature and SSPB. Despite two concussions, no significant neurological symptoms were noted, and imaging showed no hardware failure. After implant removal, device failure mechanisms, as well as black-colored tissue metallosis surrounding all pedicle screws and ApiFix device, were observed. The device is expected to be returned to the manufacturer where a histopathological analysis is currently under review.

MDR#25: 3013461531-2024-00026
The surgeon reported to the sponsor that the patient (16-year-old male) underwent implant removal and transition to posterior spinal fusion due to maximum elongation reached and development of a secondary lumbar curvature. X-rays revealed that the implant was not placed according to the pre-operative plan (i.e., implant was placed at T4-T5-T12 as opposed to T5-T6-T12), and over time the implant elongation accommodated curve progression rather than correction. The explanted device is expected to be returned to the manufacturer for further evaluation.

MDR#26: 3013461531-2024-00027
The surgeon reported to the sponsor that during the one-year follow-up, the patient (16-year-old male) underwent revision surgery due to a fractured implant (confirmed via x-ray images) and increased discomfort. The patient is expected to convert to posterior spinal fusion. The device is expected to be returned for failure analysis after removal surgery / conversion to fusion. Device breakage is a known risk, as noted in the literature and SSPB.

MDR#27: 3013461531-2024-00028
The surgeon reported to the sponsor that the patient (18-year-old female) underwent implant removal and conversion to posterior spinal fusion (PSF) due to screw migration. A year prior (2023), x-rays showed that the upper screw appeared to have pulled out. A year later (2024), the screw had migrated, and the thoracolumbar curve had worsened. The device is expected to be returned for failure analysis after removal surgery / conversion to fusion. Device migration is a known risk as noted in the literature and SSPB.

MDR#28: 3013461531-2024-00031
The surgeon reported to the sponsor that the patient (18-year-old female) visited the clinic where it was found that the most distal proximal screw had migrated to the rib head (screw migration). The surgeon plans to remove the device and/or perform posterior spinal fusion (PSF), with the family to decide on the course of action. ApiFix noted that in the patient's X-rays from the

previous year, the upper screw appeared to have pulled out, but no remarks were made about its position at that time. The recent images show the screw has migrated, and that the patient's thoracolumbar curve has worsened. The explanted device will be returned to the manufacturer for analysis after the revision surgery, and a supplemental MedWatch report will be submitted if additional information arises. Device migration is a known risk as noted in the literature and SSPB.

MDR#29: 3013461531-2024-00033
The surgeon reported to the sponsor that the patient (15-year-old female), approximately 2.5 years post-index surgery for Lenke 1, underwent implant removal due to back pain and a broken rod. ApiFix investigated this event, and the analysis revealed a fracture in the pole (rod) component (around the mid-point of the pole). The sponsor has implemented corrective actions over the years to address such issues, including changes in implant design and surgeon training (for more information on the corrective actions, see MDR#21: 3013461531-2024-00019). Pain and device breakage are known risks, as noted in the literature and SSPB.

MDR#30: 3013461531-2024-00034
The surgeon reported to the sponsor that the patient (14-year-old female) has a broken rod. Revision surgery has not yet been confirmed. ApiFix noted that once additional relevant details become available, a supplemental report will be submitted. Device breakage is a known risk, as noted in the literature and SSPB.

MDR#31: 3013461531-2024-00035
The surgeon reported to the sponsor that the patient (17-year-old female) is scheduled for implant removal due to pain and a popping noise. Pain is a known risk, as noted in the literature and SSPB. The implant will be returned to the manufacturer for failure analysis, and a supplemental report will be submitted once additional details are available.

MDR#32: 3013461531-2024-00037
The surgeon reported to the sponsor that the patient (17-year-old female) may undergo implant removal and/or conversion to posterior spinal fusion due to ratchet malfunction. It was reported that the ratcheting system appeared to have malfunctioned as it regressed when compared to previous films, and that the patient's Cobb angle increased to 33 degrees from 22 degrees when compared to previous films. The device is expected to be returned where a failure analysis will be conducted. Once additional relevant details become available, a supplemental report will be submitted. Device failure is a known risk, as noted in the literature and SSPB.

MDR#33: 3013461531-2024-00038
The surgeon reported to the sponsor that the patient (14-year-old female) required revision surgery due to a loose screw and implant at maximum elongation. Subsequently, the patient underwent a second revision procedure, where a "kite angle collapse" was observed requiring surgical intervention. During this second revision, an additional screw was added to T7, with the existing screws at T5 and T6. The originally placed ApiFix screw remained unchanged. ApiFix investigated this event, and their findings did not lead to a clear conclusion about the cause of the reported event. However, extender misalignment was noted to be a known risk from not properly aligning components, selecting incorrect screw sizes, faulty tools, or with time and potential

implant migration or curve progression. ApiFix plans to close this complaint but will monitor this failure mode via their post-market surveillance activities. Screw loosening is a known risk, as noted in the literature and SSPB.

MDR#34: 3013461531-2024-00039
The surgeon reported to the sponsor that the patient (16-year-old female) underwent revision surgery after a ratchet malfunction was identified on X-rays taken during a clinic visit. The radiographic findings revealed that the ratchet mechanism had broken, resulting in further lengthening than intended and an increase in the Cobb angle from 24 to 29 degrees. During revision surgery, the MID-C rod and extender were replaced, and a third polyaxial screw was inserted. No patient harm or complications were reported. The sponsor had previously taken correction actions regarding the spring in the ratchet and had added a stopper pin to help prevent this event from occurring. The explanted device is expected to be returned to the manufacturer for analysis. Once additional relevant details become available, a supplemental report will be submitted. Device failure is a known risk, as noted in the literature and SSPB.

MDR#35: 3013461531-2024-00040
The surgeon reported to the sponsor that the patient (16-year-old female) is scheduled for implant removal due to complications of pain potentially associated with changes in the weather. The implant is expected to be returned to the manufacturer following the removal for failure analysis. Once additional relevant details become available, a supplemental report will be submitted. Pain is a known risk, as noted in the literature and SSPB.

A summary of all 35 unique US MDRs this year is shown in Table 9.

Table 9. US MDRs

Adverse Event Type	Number of Events	Source
Implant Breakage	9	FDA's internal MDR search
Screw Pull Out/Migration	6	FDA's internal MDR search
Ratchet Malfunction	5	FDA's internal MDR search
Pain	5	FDA's internal MDR search
Screw Fracture	2	FDA's internal MDR search
Lack of Correction	3	FDA's internal MDR search
Infection	2	FDA's internal MDR search
Wound Dehiscence	2	FDA's internal MDR search
Maximum Elongation Reached	1	FDA's internal MDR search
Total	35	FDA's internal MDR search

Outside of the United States (OUS) MDRs

It is important to note that a significant number of devices implanted OUS are of an older MID-C device generation with a wider range of Indications for Use. As such, OUS AEs are not necessarily indicative of current or future US AEs, however, they are useful to examine. A summary of all 24 unique OUS MDRs this year is shown in Table 10.

Table 10. OUS MDRs

Adverse Event Type	Number of Events	Source
Implant Breakage	5	FDA's internal MDR search
Max Elongation Reached	4	FDA's internal MDR search
Ratchet Malfunction	3	FDA's internal MDR search
Screw Pull-Out/Migration	3	FDA's internal MDR search
Screw/Nut Loosening	3	FDA's internal MDR search
No AE Reported (Device Explanted)	3	FDA's internal MDR search
Screw Fracture	1	FDA's internal MDR search
Lack of Correction	1	FDA's internal MDR search
Pain	1	FDA's internal MDR search
Total	24	FDA's internal MDR search

Discussion on Black Residue/Black Discoloration

The black residue/black discoloration in the tissue surrounding the MID-C system that was noted in 2022 via two MDRs, in 2023 via one MDR, and this year via three MDRs. ApiFix stated that the black residue/black discoloration may be the result of Amorphous Diamond-Like Coating (ADLC) wear which was a known occurrence at HDE approval. All moving titanium components of the MID-C System are coated with an ADLC layer to improve wear resistance. Examples of ADLC coated components are shown in Table 11. All observations were reported in addition to another primary event; the black discoloration events were observed during the course of reoperation surgery and has not been attributed to any serious or symptomatic AEs.

Table 11. ADLC Coated Components of the ApiFix Rod

Device Region	Image
Base	
Pole	
Spherical Ring	

Additionally, ApiFix conducted histologic evaluations on tissue samples containing said black discoloration. These evaluations largely reported little/no necrosis, and minimal fibrosis while one evaluation reported fibrosis, wear debris, macrophages, and edema. ApiFix states that the minimal levels of necrosis, fibrosis, wear debris, macrophages, and edema found are likely due to the trauma of breakage of the implant and not due to implant composition.

True Failure Analysis

True failure rate analysis was performed for all patients with X-ray measurements available in the ApiFix registry. Patients with missing data or available X-rays that were not yet measured were not accounted for in the analysis. Per the study protocol, True failure rate analysis is defined as conversion to another spinal implant OR major Cobb angle that exceeded 40° at defined follow-up visit OR any curve progression at defined follow-up compared to baseline OR death, OR permanent disability. Table 12 demonstrates a success rate of 100%, 96%, 82%, and 71% at 6-months, 12-months, 24-months, and 36-months respectively, from the true failure analysis.

Table 12. True Failure Rate Analysis

Population	Visit	Success		Failure		All	
		n	%	n	%	N	%
PAS all population	6 months	168	100%	0	0%	168	100%
	12 months	135	96%	5	4%	140	100%
	24 months	76	82%	17	18%	93	100%
	36 months	36	71%	15	29%	51	100%
	Total	180	90%	19	10%	199	100%

Summary of MDRs

As of October 1, 2024, a total of two hundred and fifty-one (251) worldwide MDRs have been identified related to the ApiFix MID-C System since HDE approval. Though the discoloration of tissue reported last year in two OUS MDRs and this year in one MDR can be a sign of metallosis and additional safety concerns, the discoloration presented by the MID-C System is not an unanticipated finding for metallic implants with ADLC coatings and does not appear to be

harmful based on available data. However, additional monitoring will be conducted as minimal data has been collected in the US with only 325 subjects currently implanted and only 173 subjects reporting data out to 12 months (as of June 2024). Table 13 summarizes all MDRs associated with the MID-C System. As of October 2024, the MDRs reported represent a 26.46%

rate in the US and a 25.74% rate worldwide most resulting in reoperation. Spinal fusion surgery for AIS can expect a reoperation rate of 4.1% at 24-months[3] and 9.9% at 60-months[2], while The Tether™ –Vertebral Body Tethering System, a non-fusion spinal device intended for treatment of AIS, has a secondary surgery rate, composed of both revisions and reoperations, of 14.0%.[5] The increase in the MID-C System MDR rate does not appear to present a new safety signal at this time and will be closely monitored.

Table 13. MDR Rate

	Total OUS and US	Total OUS and US	Total US	Total US
	MDRs	Rate	MDRs	Rate
Up to December 1, 2021	62	10.37% (62/598)	5	5.26% (5/95)
December 1, 2021 – October 1, 2022	56	43.08% (56/130)	15	20.27% (15/74)
October 2, 2022 – October 1, 2023	74	50.64% (74/133)	31	36.47% (31/85)
October 2, 2023 – October 1, 2024	59	51.75% (59/114)	35	49.30% (35/71)
Cumulative	251	25.74% (251/975)	86	26.46% (86/325)

Literature Review

A clinical literature search in PubMed was performed by the FDA for articles published from October 2, 2023, through October 1, 2024. The following terms were used: "ApiFix", "MID-C", "QGP", "Posterior Ratcheting Rod System". The following inclusion/exclusion criteria were used to further refine the articles to ones relevant for this HDE:

Inclusion Criteria:

- It provides relevant information regarding technical and clinical features of the device subject of the search, or
- It provides relevant information regarding performance and/or safety of the device subject of the Search, or
- It provides information relevant to determining the probable benefit of the subject device, and
- It contains sufficient information for a rational and objective assessment, and
- It is based on an appropriate study design.

Exclusion Criteria:

- Those involving implants other than those of interest
- Isolated case reports
- Random experience
- Reports lacking sufficient detail to permit scientific evaluation
- Unsubstantiated opinions

- Non-clinical studies

- Review papers
- Tethered spinal cord studies
- Foreign language (non-English) literature

After reading the titles, abstracts, and full-texts, and applying the inclusion/exclusion criteria, one article was found during this reporting period.[6] The article evaluated the 24-month follow-up reports of 36 patients between 2018 and 2020. It found an improvement in the major curve and 11 AEs, 4 due to continued growth of the patient and 7 due to infections or problems with the anchorage of the implant. They concluded patients with the MID-C System showed significant improvement in the major curve with AE rate similar to established vertebral body tethering methods.

While the list of adverse events is much more comprehensive in the SSPB as compared to the literature, this search demonstrates that the types of adverse events documented in the literature are expected given the clinical data published in the SSPB for the MID-C System. It does not appear that any additional safety signals nor concerns have arisen since HDE approval.

IX. SUMMARY

Evaluation of data available to CDRH, including the HDE 3-year Annual Report, MDRs, published scientific literature, and correspondence with the sponsor, has identified no new safety signals compared to what was known and anticipated at the time of HDE approval in August 2019. Additionally, the MID-C System has been continually re-designed with updates since HDE approval. These changes were intended to mitigate early known AEs and improve the safety and probable benefit profile of the device. Based on the available data, and considering the probable benefits and risks, the FDA believes that the HDE remains appropriately approved for pediatric use.

Therefore, FDA recommends continued surveillance and will report the following to the PAC in 2026:

- Annual distribution number
- Literature review
- MDR review
- Update on the PAS

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