SUMMARY of SAFETY and CLINICAL PERFORMANCE (SSCP) for HEALTH CARE PROFESSIONNALS
SPINE-FIX®

Foreword

This Summary of Safety and Clinical Performance (SSCP) is intended to provide public access to an updated summary of main aspects of the safety and clinical performance of the device.

The SSCP is not intended to replace the Instructions For Use as the main document to ensure the safe use of the device, nor intended to provide diagnostic or therapeutic suggestions to intended users or patients

The following information is mainly intended to users (health care professionals such as surgeons). A summary intended for patients can be found at the end.

1. Device Identification and general information

1.1. Device Trade Name(s): **Spine-Fix®**

The medical device has also the following private labels: MVX, Vertefix Plus, Vertocure LVHA+, SPONDY FX, SPF 1, HPFIX +, ONCO 10, LVM+, AVECEM, P-CEM, FIX C

1.2. Manufacturer name and address(es):

TEKNIMED S.A.S.		
Headquarters 8, rue du Corps Franc-Pommiès 65500 Vic en Bigorre France	*Production and facilities* 11-12, rue d'Apollo - ZI de Montredon 31240 L'Union France	*Supply Chain site (labelling)* ZI de la Herray 65500 Vic en Bigorre France

1.3. Manufacturer's SRN (Single Registration Number): **FR-MF-000001224**

1.4. Basic UDI-DI: **376017704B06D4**

1.5. Medical device nomenclature description / EMDN nomenclature: **P900403 - Non-resorbable filling and reconstruction devices**

1.6. Class of device: According to EU MDR 2017/745, Annex VIII, Rule 8, SPINE-FIX® is a **class III** device

1.7. Year when the first certificate (CE) was issued covering the device: **2004**

The medical device has been introduced for the first time in the following countries:

Country	Year of introduction
Europe	2004
Korea	2006
Thailand	2006
Mexico	2006
Colombia	2007
Taiwan	2010
Argentina	2012
Brazil	2013
Serbia	2013
Viet-Nam	2014
Israel	2015
Ukraine	2016

Macedonia	2017
Guatemala	2017
Lebanon	2019
China	2018
Malaysia	2019
Turkey	2020
United Arab Emirates	2020
Indonesia	2020
Honduras	2020
Bangladesh	2022
Dominican Republic	2022

1.8. Authorised representative if applicable; name and SRN: **NA as the manufacturer is located in the EU**.

1.9. NB's name (the NB that will validate the SSCP) and single identification number: **BSI Netherlands (CE 2797)**

2. Intended use of the device

2.1. Intended purpose

Spine-Fix® bone cement is intended for use in palliative percutaneous cementoplasty procedures (such as vertebroplasty, kyphoplasty), and in augmentation procedures (such as pedicular screws fixation).

2.2. Indication(s) and target population(s)

Spine-Fix® bone cement is indicated for the treatment of painful thoracic or lumbar vertebral compression fractures, and for augmentation of the fixation strength of pedicular screws.

Spine-Fix® bone cement is intended to be used in adult patients suffering from:
- painful vertebral compression fractures resulting from osteoporosis, benign or malignant lesions, or traumatic origin;
- spine deformity or disorder necessitating a spine fusion procedure involving pedicular screws.

2.3. Contraindications or restriction for use

- Procedures other than those stated in the INDICATIONS section.
- Coagulation disorders, or severe cardiopulmonary disease;
- Unstable vertebral fractures;
- Compromise of the vertebral body or of the pedicle walls;
- Hypersensitivity or allergy to one of the constituents of the product;
- Patients clearly improving on more conservative treatment;
- Prophylactic use in spinal metastatic or osteoporotic patients with no evidence of vertebral fracture.
- Due to non-sufficient available clinical evidence, Spine-Fix® bone cement is contraindicated in paediatric or adolescent patients, and in pregnant or breast-feeding women.

3. Device description

3.1. Description of the device

Spine-Fix® is a radiopaque injectable acrylic bone cement that allows consolidation of the vertebral body, resulting in an effective and rapid pain relief for the patient.



This low viscosity bone cement is made of two sterile components: Poly-methyl-methacrylate polymers (powder) and monomers (liquid) which must be mixed at the time of use.

Composition	% (w/w)
POWDER – 21g	
PMMA (Poly-methyl-methacrylate)	64.4
Benzoyl peroxide (BPO)	0.6
Barium sulphate ($BaSO_4$)	25.0
HAP	10.0
LIQUID – 9.2g	
MMA (Methyl-methacrylate)	97.6
N, N dimethyl-p-toluidine (DMPT)	2.4
Hydroquinone	20ppm

The powder component is mainly composed of polymethylmethacrylate (PMMA) polymers. It also contains benzoyl peroxide (BPO) as an initiator to start polymerisation. Barium sulphate ($BaSO_4$) and hydroxyapatite (HAP) are added as radiopaque medium.
The liquid component is composed of methyl-methacrylate (MMA) monomers. N, N dimethyl-p-toluidine (DMPT) is present as an activator to promote polymerisation when the powder and liquid are mixed. Without it, polymerisation would be too long and the heat generated during polymerisation wouldn't be controlled. Finally, Hydroquinone is present in very small quantities as a stabiliser to prevent premature polymerisation which may occur when the liquid is subjected to excessive heat or light.

When the powder and the liquid are mixed in the operating room, a low viscosity mixture is first obtained which gets more and more viscous with time until it finally hardens into a solid matrix. Injection must be performed during the viscous phase, before the final hardening of the cement which must take place inside the treated bone or cavity.

Spine-Fix® bone cement expected lifetime is 10 years. At the end of this expected lifetime, the cement is not intended to be removed and does not need any maintenance, unless a medical complication would require a surgery.

The product (powder and liquid) is supplied sterile.
It is a single use product.

3.2. Reference to previous generation(s) or variants if such exist, and a description of the differences

Spine-Fix® is not issued from any previous generation and has no variant.

3.3. Description of any accessories which are intended to be used in combination with the device

Spine-Fix® bone cement is intended to be used with the following accessories (sold separately by Teknimed):

- MiniMalax® mixing and injection system– Reference: T060406 – Classification: I sterile
- EasyKit® M mixing and injection system – Reference: T060415 – Classification: I sterile
- S5®M mixing and injection system – Reference: T060407 – Classification: I sterile
- Pure kit® mixing and injection system – Reference: T060425 – Classification: I sterile

3.4. Description of any other device or products which are intended to be used in combination with the device

No other devices or products are intended to be used in combination with Spine-Fix®.

4. Risks and warnings

4.1. Residual risks and undesirable side effects

- Leakage of spinal bone cement beyond the intended site of implantation. They are frequent and rates up to 54% have been reported in the literature[1], and up to 31% in a clinical study with Spine-Fix® (Cf. section 5.3). These leakages are almost always asymptomatic[2]. Yet, in some cases, when the cement penetrates into the vascular system, leakages can result in embolism of the lung and/or heart or other clinical sequelae (rates up to 1.5% reported in the literature[3], none concerning Spine-Fix®).
- Adverse reactions affecting the cardiovascular system (also known as Bone Cement Implantation Syndrome), including chest pain, tachycardia, signs of severe respiratory distress, and death have also been reported in the literature[4]. They are supposedly due to MMA monomer release during polymerisation, and/or to excessive exothermic reaction, and/or to too much pressure applied during cement injection. For this reason, patients should be monitored carefully for any change in blood pressure during and immediately following the application of bone cement. The anaesthetist should be told during the operation when the bone cement is implanted.
- Some isolated cases of perioperative fractures have also been reported, such as: Fracture of ribs, of posterior element or of pedicle in patients suffering from diffuse osteopenia or osteoporosis, in particular during thoracic vertebroplasty procedures, due to the high pressure exerted downwards while the needle is being inserted[4]; Fracture or collapse of a vertebra adjacent to the one injected due to an osteoporotic disease (0.6% in a clinical study with Spine-Fix®);

Other side effects include:
- Allergy to one of the bone cement constituents (rate up to 1.4% reported in the literature[5]);
- Exposure of the health care operators to monomer fumes[6].
- Transient nausea (1 case reported in a PMCF study on SPINEFIX®) and hematoma (1 case reported in a published series with SPINEFIX®[7])

Any serious incident occurring in relation to the Spine-Fix® bone cement must be reported without delay to the manufacturer and the competent local authority where the user and/or the patient is established.

4.2. Warnings and Precautions

Read instructions for use carefully prior use and follow preparation and handling instructions of the cement and its injection system carefully.
Ignoring the instructions for use may lead to potential undesirable effects.
For an optimum use of the cement, it is essential to perform a thorough pre-operative review of the patient before the intervention in order to confirm the indication and plan the surgical technique. The healthcare professional must be familiar with cement properties and handling characteristics, and experienced in cement injection procedures. It is advisable to respect the recommended preparation and application times.

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[1] Zhan Y. et al. *Risk Factors for Cement Leakage After Vertebroplasty or Kyphoplasty: A Meta-Analysis of Published Evidence*. World Neurosurg. 2017; 101:633–42.

[2] Tsoumakidou G. et al. *CIRSE Guidelines on Percutaneous Vertebral Augmentation*. Cardiovasc Intervent Radiol. 2017;40(3):331–42.

[3] Hinde K. et al. *Mortality Outcomes of Vertebral Augmentation (Vertebroplasty and/or Balloon Kyphoplasty) for Osteoporotic Vertebral Compression Fractures: A Systematic Review and Meta-Analysis*. Radiology. 2020;295(1):96–103.

[4] Krueger A. et al. *Management of pulmonary cement embolism after percutaneous vertebroplasty and kyphoplasty: a systematic review of the literature*. Eur Spine J. 2009;18(9):1257–65

[5] Goon A., Bruze M., Zimerson E., Goh C.H., Soo-Quee Koh D., Isaksson M. *Screening for acrylate/methacrylate allergy in the baseline series: our experience in Sweden and Singapore*. Contact Dermatitis 2008: 59: 307–313.

[6] Ungers L., Vendrely T., Barnes C. *Control of Methyl Methacrylate During the Preparation of Orthopedic Bone Cements*. 2007. Journal of Occupational and Environmental Hygiene, 4(4), 272–280.

[7] Anselmetti GC, Corrao G, Della Monica P, Tartaglia V, Manca A, Eminefendic H, Russo F, Tosetti I, Regge D. *Pain Relief Following Percutaneous Vertebroplasty: Results of a Series of 283 Consecutive Patients Treated in a Single Institution*. Cardiovasc Intervent Radiol (2007) 30:441–447

Conservation

- It is strictly forbidden to re-sterilise the product. This product is supplied sterile unless package has been opened or damaged.
- This device is packaged and sterilised for single use only. Do not reuse, reprocess or resterilise. Reuse, reprocessing, or resterilisation may compromise the structural integrity of the device and/or lead to device failure which may result in patient injury or illness. Also, reprocessing or resterilisation of single use devices may create a risk of contamination and/or cause patient infection or cross-infection, including, but not limited to, the transmission of infectious disease(s) from one patient to another.
- Before use, check the packaging carefully to ensure that it has not been opened nor damaged in a way that could affect its sterility.
- Do not use this product after the expiration date mentioned on the package.

Before use

- Do not implant products with defects.
- When removing the product from its packaging, be sure to follow asepsis rules.
- If packaging is unintentionally opened before use or damaged, do not use the product.
- Always check the condition of the liquid before carrying out the procedure. Do not use the liquid component if it shows any sign of thickening or premature polymerization. These conditions indicate that the product has not been stored correctly.

Cement preparation

- For controlled and optimal use of the cement, the doses are to be stored at the recommended temperature of 20°C for a minimum of 24 hours before use.
- The duration of the cement working phases depends on the ambient temperature and those of the components, but also on the degree of relative humidity of the operating room. A high temperature reduces waiting, injection and hardening time. A low temperature extends these times.
- Prechilling of bone cement and accessories for at least 24 hours is recommended if a lower viscosity or a prolonged handling time is required. Mixing time is the same as for non-prechilled cement, however application time and hardening time are prolonged.
- The application phases of Spine-Fix® cement have been determined using injection systems recommended by the manufacturer. They may vary if different systems are used. The recommended mixing time should be followed in order to prevent polymerization from progressing to such an extent that the cement is no longer fluid enough to allow easy transfer into the injection system and proper filling of the bone cavities.
- Additives (such as liquid antibiotics) are not to be mixed with the bone cement, as this will alter cement properties.
- The manufacturer does not recommend any surgical technique in particular; it is the responsibility of the healthcare professional to determine the appropriateness of the Spine-Fix® cement and specific technique for each patient.

Personnel safety

- The liquid component is a powerful lipid solvent. Do not allow the liquid to come into contact with rubber or latex gloves. Should contact occur, the gloves might dissolve and tissue damage may occur. Wearing a second pair of gloves may diminish the possibility of hypersensitivity reactions.
- The liquid monomer is highly volatile and flammable.
- Make sure the operating room is properly ventilated to eliminate monomer fumes as much as possible.
- Make sure electrocautery devices are not used near freshly implanted bone cements as that could cause the ignition of monomer fumes.
- Caution should be exercised to prevent excessive exposure to the concentrated fumes of the monomer, which may cause drowsiness, irritate the respiratory tract, eyes and even the liver.
- Do not allow personnel wearing contact lenses to be near or be involved in mixing of the bone cement.

Monitoring during application

- During application of the bone cement, radiological control is essential so that the healthcare professional can follow the progress of the filling and stop the procedure if the slightest leakage of cement is detected.
- Use appropriate imaging techniques to verify correct needle placement, absence of damage to surrounding structures, and appropriate location of the injected cement. Use imaging, such as fluoroscopy, to assess the ability of the vertebra to contain the injected bone cement.
- Avoid over-pressurizing the bone cement, as this may cause the bone cement to leak beyond the site of its intended application. Cement leakage may cause tissue damage, and nerve or circulatory problems. Excessive pressure can also be applied to the injection device, which could cause it to break.
- Leaks may also occur upon injection if the needle is in a vein or if there are undetected micro-fractures.
- The final polymerization stage occurs in situ and is an exothermic reaction with considerable liberation of heat. According to ISO 5833 standard, the temperature can reach up to 95°C. The heat produced in situ during polymerisation can lead in rare cases to modification of structure of the bone. Maintain the patient's position until the polymerization process has been completed, so as to obtain proper stabilisation or fixation.

Patient monitoring

- Adverse reactions affecting the cardiovascular system have been attributed to release of methylmethacrylate monomer into the circulatory system. Data indicate that the monomer undergoes rapid hydrolysis into methacrylic acid, and that a significant fraction of the circulating methacrylate is present in the form of free acid rather than methyl ester. Correlation between changes in circulating concentrations of methyl methacrylate / methacrylic acid and changes in blood pressure has not been established.
- Methyl methacrylate may cause hypersensitivity among high-risk persons, which can result in an anaphylactic reaction.

4.3. Other relevant aspect of safety, including a summary of any field safety corrective action (FSCA) if applicable

No field safety corrective actions have been issued for Spine-Fix®.

5. Summary of clinical evaluation and relevant information on post-market clinical follow-up (PMCF)

5.1. Summary of clinical data related to equivalent device, if applicable

Not applicable. No devices are claimed equivalent.

5.2. Summary of clinical data from conducted investigations of the device before the CE-marking, if applicable

Not applicable. No clinical investigations have been conducted before the CE-marking.

5.3. Summary of clinical data from other sources, if applicable

Performance and safety of Spine-Fix® were evaluated through a first PMCF study performed in 2004, in France.

The population of this study was composed of 168 patients (43 men and 125 women) with a mean age of 71,2 years. All patients (100%, n=168) presented a vertebral compression fracture (VCF), 75% (n=126) of them due to osteoporosis, and 25% (n=42) due to primary or secondary metastases. 78 patients presented a single vertebra fracture while 90 patients presented multiple fractured vertebrae, for a total of 337 treated vertebrae.

The procedures used to treat the 337 vertebrae were: 11 kyphoplasties (in 7 patients) and 326 vertebroplasties (in 161 patients).

Spinal cementoplasty procedures provided a clear alleviation of pain for all patients. At baseline, pain was described as “disabling” or “severe” by a majority of patients (89%), while by none of them (0%) immediately after the surgery, where pain rating was “moderate” (11%), “mild (39%) or “none” (50%). Finally, at 24 months follow-up, only very few patients (4%) still reported a “moderate” pain.

Spinal cementoplasty procedures provided a clear restoration of function for all patients. At baseline, a majority of patients (85%) described their function as “disabled” or “severe dysfunction” (89%), compared to none of them (0%) immediately after the surgery, where their rated their dysfunction as “moderate” (10%) or “mild (31%) and 63% reporting even a “normal” function. Finally, at 24 months follow-up, only very few patients (n=4, 3%%) still reported a “moderate” dysfunction.

Two complications were reported: 2 (1.2%) adjacent vertebral collapses, not related to the cement but due to the progression of the osteoporosis disease. Leakages were reported in 106 treated vertebrae (31% of the 337 procedures), none with sequelae.
To conclude, this clinical study demonstrated efficacity, performance and safety of SPINE-FIX® bone cement on a large population of patients beneficiating from vertebroplasty and kyphoplasty procedures.

3 publications in the scientific literature reported outcomes from patients having received Spine-Fix® in spinal or extraspinal procedures.

A first series[8] reported outcomes from 283 patients (mean age: 73.8 ±9.9 years) who underwent 310 percutaneous vertebroplasties on 749 vertebrae. Origins of compression fractures were osteoporosis (74.5%) or bone metastasis (17.6%). 1 (0.3%) severe perioperative complication occurred: a large hematoma that developed within the erector spinae muscle and required a blood transfusion and lengthened hospital stay. No permanent neurologic injury or symptomatic pulmonary embolism were observed. Mild transitory episodes of radicular pain, due to minimal cement leakage in the foraminal vein, were reported in 11 (3.9%) patients, successfully treated with oral drugs. At follow-up (range 1 – 24-month; median 7), median pain score (EVA) had decreased to 1/10 versus 8/10 at baseline. Two third (62%) of patients who used drugs before the procedure, did not require them after the procedure, suggesting that the severity of the symptoms significantly decreased after vertebroplasty ($p < 0.0001$). Authors conclude that outcomes from this large cohort shows that vertebroplasty with Spine-Fix® is a safe and reliable procedure in the treatment of vertebral compression fractures from osteoporosis and metastatic disease.

A second publication[9] analysed outcomes from a series of 51 patients (72 vertebrae), average age of 75.21 ±.01 year, who received low viscosity bone cement, of which Spine-Fix®, to treat vertebral compression fracture of osteoporotic (84.8%) or traumatic (23.6%) origin. Cement leakages occurred in 45 (62%) vertebrae and 17 adjacent fractures were reported. No patient encountered major complications such as cement emboli or neurologic deficit after the surgery. Pain relief was obtained after the procedure.

A third publication[10] presented outcomes from a total of 324 pedicle screws implanted in 55 patients (mean age 71.3 ±7.0). Back pain improved from a level of 5.6 ±2.3 to a level of 2.8 ±2.2 at follow-up on a visual analogic scale (VAS). Leg pain improved from a level of 6.1 ±2.2 to a level of 3.3 ±2.6 at follow-up. The patients' health condition (evaluated with the Korean ODI) also improved. No complications were reported.

Finally, outcomes of a series of 50 patients (mean age 64.7 ±11.2 years), presenting with painful bone metastases and treated with extraspinal percutaneous cementoplasty, were reported at an average follow-up of 8.9 ± 5.5 months (range, 3 - 24)[11]. Treatment was technically successful in all cases, with no significant changes in heart rate, blood pressure, or blood oxygen saturation during procedure. 6 patients had minor complications: 1 patient (2%) reported transient nausea for few minutes and 5 patients (10%) had asymptomatic leakages in the soft tissues along the needle tract. Two (4%) femoral diaphysis fractures occurred 1 month after the procedure, requiring open surgery. Mean postoperative pain score was 2.1 ± 2.5 versus 9.1 ±1.2 at baseline. Administration of narcotics was suspended in 94% of patients. Authors conclude that these results confirm that percutaneous cementoplasty with Spine-Fix® is safe and effective in providing pain relief in patients with up to 6 painful osteolytic bone metastases.

5.4. Overall summary of the clinical performance and safety

Spine-Fix® bone cement is a product issued from a well-known technology which has been used in interventional radiology and neurosurgery for many years. It allows successful stabilisation of fractured vertebrae, leading subsequently

[8] Anselmetti GC, Corrao G, Della Monica P, Tartaglia V, Manca A, Eminefendic H, Russo F, Tosetti I, Regge D. *Pain Relief Following Percutaneous Vertebroplasty: Results of a Series of 283 Consecutive Patients Treated in a Single Institution*. Cardiovasc Intervent Radiol (2007) 30:441–447

[9] Luo AJ, Liao JC, Chen LH, Lai PL. *High viscosity bone cement vertebroplasty versus low viscosity bone cement vertebroplasty in the treatment of mid-high thoracic vertebral compression fractures*. The Spine Journal 22 (2022) 524−534

[10] Son HJ, Choi SH, Heo DR, Kook I, Lee MK, Ahn HS, Kang CN. *Outcomes of the use of cement-augmented cannulated pedicle screws in lumbar spinal fusion*. The Spine Journal (2021) 1−9

[11] Anselmetti GC, Manca M, Ortega C, Grignani G, DeBernardi F, Regge D. *Treatment of Extraspinal Painful Bone Metastases with Percutaneous Cementoplasty: A Prospective Study of 50 Patients*. Cardiovasc Intervent Radiol (2008) 31:1165–1173

to clinical benefits for the patients such as pain alleviation and improved quality of life. Claims for performance and safety of Spine-Fix® have been verified and confirmed against outcomes from published series in scientific literature, and from Post-Market Clinical Follow-up (PMCF) studies, as described above and below.

5.5. On-going or planned post-market clinical follow-up

Teknimed has implemented and is currently conducting a post-market clinical follow-up to confirm clinical performance, and safety outcomes for all its Spine bone cements products, including Spine-Fix®. Inclusion of patients with Spine-Fix® is scheduled to start Q4 2022.

Title: Safety and Clinical Performance Assessment of Bone Cements and Injection Systems used in Spine Surgery - A Post-Market Clinical Follow-Up

Justification/Context: TEKNIMED has developed several bone cements currently used in vertebroplasty and kyphoplasty procedures in the treatment of vertebral weakness. Among those, one cement is also used in pedicle screw augmentation procedures. With the increasing use of these procedures, there is a need of real-life safety and efficacy data on the bone cements. This retro-prospective study is performed to confirm the safety and performance of TEKNIMED spine bone cements in their current clinical use.

Objective: The objective is to collect in a real-world setting, immediate, medium and long-term data after spinal surgery to assess the performance of vertebral cements to reduce pain and the safety of use of these cements.

Study design: This PMCF is a global, single arm, non-controlled, multi-centre, observational study. Data will be collected either prospectively or retrospectively.

Primary endpoint: Alleviation of Pain evaluated by a Visual Analog Scale (VAS) and the antalgic consumption

Performance endpoints: Quality of life, Patient satisfaction, Stabilization of vertebrae.

Safety endpoints: Adverse events will be documented during the study and categorized as whether they are serious and whether they are related to the TEKNIMED device.

Statistical Analysis: Statistical analyses will primarily be descriptive as no hypotheses are enunciated to be demonstrated. Each outcome will be reported for each product separately, however, some products may be grouped and summarized if the products are related and if needed (e.g.: cement + injection system). There are no intentions to compare or test data across products unless requested for a publication or other clinical evidence need. Should this later case occur, analytical analyses would be performed.

6. Possible diagnostic or therapeutic alternatives

People with severe pain from vertebral compression fractures who prefer not endure a cementoplasty procedure, are traditionally treated with nonsurgical treatment including a reduction in activities, medications, and bracing. The first aim of conservative therapy is to control the pain. Therefore, medications such as bisphosphonate (alendronate and zoledronic acid), acetaminophen, and nonsteroidal anti-inflammatory drugs (NSAIDs) are often recommended in relieving pain. Muscle relaxing drugs for nerve/bone pain are often prescribed. Importantly, opioids should only be used for very short periods of time (1-2 weeks) for acute pain. Moreover, braces are also used to reduce pain as the rigid style of the back brace limits spine-related motion at the level of the fractured vertebra and thus allows bone healing.

7. Suggested profile and training for users

Implantation of TEKNIMED products should only be performed in an adapted environment and by health care professionals (radiologists, surgeons) having a sound knowledge and full mastery in preparation techniques specific to the product. Preparation techniques may be acquired from qualified distributors. The operator is responsible for any complications or harmful consequences which might result from an erroneous indication or operative technique, an improper use of the equipment and/or a failure to comply with the safety rules provided in the instructions for use. Neither the manufacturer nor the authorized representative can be held responsible for these complications.

8. Reference to any harmonized standards and CS applied

Standard reference	Standard revision	Standard title	Applicability
> General standards			
EN ISO 13485	2016/A11: 2021	Medical devices -- Quality management systems -- Requirements for regulatory purposes	Fully whenever applicable
EN ISO 14630	2012	Non-active surgical implants -- General requirements	Fully whenever applicable
EN ISO 14971	2019 / A11: 2021	Medical devices -- Application of risk management to medical devices	Fully whenever applicable
EN ISO 14155	2020	Clinical investigation of medical devices for human subjects — Good clinical practice	Fully whenever applicable
EN 62366	2015 / A1:2020	Medical devices – Application of usability engineering to medical devices	Fully whenever applicable
XP S99-223	2020	Medical Device – Benefit / Risk management	Fully whenever applicable
> Product standards			
ISO 5833	2002	Implants for surgery — Acrylic resin cements	Fully whenever applicable
ISO 13779-3	2018 / A1: 2021	Implants for surgery — Hydroxyapatite — Part 3: Chemical analysis and characterization of crystallinity and phase purity	Fully whenever applicable
ISO 13779-6	2015	Implants for surgery — Hydroxyapatite — Part 6: Powders	Fully whenever applicable
ASTM F2118	2014	Standard test method for constant amplitude of force controlled fatigue testing of acrylic bone cement materials	Fully whenever applicable
ISO 2859-1	1999/A1: 2011	Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection	Fully whenever applicable
> Biocompatibility standards			
EN ISO 10993-1	2020	Biological evaluation of medical devices — Part 1: Evaluation and testing within a risk management process	Fully whenever applicable
EN ISO 10993-2	2006	Biological evaluation of medical devices — Part 2: Animal welfare requirements	Fully whenever applicable
EN ISO 10993-5	2009	Biological evaluation of medical devices — Part 5: Tests for in vitro cytotoxicity	Fully whenever applicable
EN ISO 10993-10	2021	Biological evaluation of medical devices — Part 10: Tests for irritation and skin sensitization	Fully whenever applicable
EN ISO 10993-11	2018	Biological evaluation of medical devices — Part 11: Tests for systemic toxicity	Fully whenever applicable
EN ISO 10993-12	2021	Biological evaluation of medical devices — Part 12: Sample preparation and reference materials	Fully whenever applicable
EN ISO 10993-17	2009	Biological evaluation of medical devices — Part 17: Establishment of allowable limits for leachable substances	Fully whenever applicable
ISO 10993-18	2020 / A1: 2022	Biological evaluation of medical devices — Part 18: Chemical characterization of materials	Fully whenever applicable
EN ISO 10993-23	2021	Biological evaluation of medical devices — Part 23: tests for irritation	Fully whenever applicable
> Labelling and packaging standards			
EN ISO 14698-1	2003	Cleanrooms and associated controlled environments — Biocontamination control — Part 1: General principles and methods	Fully whenever applicable

EN 556-1	2001 / AC:2006	Sterilization of medical devices. Requirements for medical devices to be designated "STERILE". Part 1: requirements for terminally sterilized medical devices	Fully whenever applicable
EN 556-2	2015	Sterilization of medical devices — Requirements for medical devices to be designated ''STERILE" — Part 2: Requirements for aseptically processed medical devices	Fully whenever applicable
EN 868-5	2018	Packaging for terminally sterilized medical devices — Part 5: Sealable pouches and reels of porous materials and plastic film construction — Requirements and test methods	Fully whenever applicable
EN 868-7	2017	Packaging for terminally sterilized medical devices — Part 7: Adhesive coated paper for low temperature sterilization processes — Requirements and test methods	Fully whenever applicable
EN ISO 11607-1	2020	Packaging for terminally sterilized medical devices — Part 1: Requirements for materials, sterile barrier systems and packaging systems — Amendment 1	Fully whenever applicable
EN ISO 11607-2	2020	Packaging for terminally sterilized medical devices — Part 2: Validation requirements for forming, sealing and assembly processes — Amendment 1	Fully whenever applicable
EN ISO 15223-1	2021	Medical devices. Symbols to be used with medical device labels, labelling and information to be supplied. General requirements	Fully whenever applicable
EN ISO 20417	2021	Medical devices — Information to be provided by the manufacturer	Fully whenever applicable
ASTM D 4169	2022	Standard Practice for Performance Testing of Shipping Containers and Systems	Fully whenever applicable
ASTM D 4332	2022	Standard Practice for Conditioning Containers, Packages, or Packaging Components for Testing	Fully whenever applicable
ASTM D 4728	2017	Standard Test Method for Random Vibration Testing of Shipping Containers	Fully whenever applicable
ASTM D 5276	2019	Standard Test Method for Drop Test of Loaded Containers by Free Fall	Fully whenever applicable
ASTM D 999	2008	Standard Test Methods for Vibration Testing of Shipping Containers	Fully whenever applicable
ASTM F 1929	2015	Standard Test Method for Detecting Seal Leaks in Porous Medical Packaging by Dye Penetration	Fully whenever applicable
ASTM F 88	2021	Standard test method for seal strength of flexible barrier materials	Fully whenever applicable
ASTM F1886 / F1886M	2016	Standard Test Method for Determining Integrity of Seals for Flexible Packaging by Visual Inspection 1	Fully whenever applicable
ASTM D 6653 / D 6653 M	2021	Standard Test Methods for Determining the Effects of High Altitude on Packaging Systems by Vacuum Method	Fully whenever applicable
ASTM D642	2020	Standard Test Method for Determining Compressive Resistance of Shipping Containers, Components, and Unit Loads 1	Fully whenever applicable

> Microbiology standards

EN ISO 11737-1	2018/A1: 2021	Sterilization of medical devices — Microbiological methods — Part 1: Determination of a population of microorganisms on products	Fully whenever applicable
EN ISO 11737-2	2020	Sterilization of medical devices — Microbiological methods — Part 2: Tests of sterility performed in the definition, validation and maintenance of a sterilization process	Fully whenever applicable
EN ISO 11138-1	2017	Sterilization of health care products — Biological indicators - Part 1: General requirements	Fully whenever applicable
EN ISO 11138-2	2017	Sterilization of health care products — Biological indicators — Part 2: Biological indicators for ethylene oxide sterilization processes	Fully whenever applicable
ANSI / AAMI ST72	2019	Bacterial endotoxins — Test methods, routine monitoring, and alternatives to batch testing	Fully whenever applicable

> Gamma sterilisation standards

EN ISO 11137-1	2015 / A2:2019	Sterilization of health care products — Radiation — Part 1: Requirements for development, validation and routine control of a sterilization process for medical devices	Fully whenever applicable
EN ISO 11137-2	2015 / A1: 2022	Sterilization of health care products — Radiation — Part 2: Establishing the sterilization dose	Fully whenever applicable

> Ethylene oxide sterilisation standards

EN ISO 11135-1	2014 / A1: 2019	Sterilization of health care products — Ethylene oxide — Part 1: Requirements for development, validation and routine control of a sterilization process for medical devices	Fully whenever applicable
EN ISO 10993-7	2008 / A1: 2022	Biological evaluation of medical devices — Part 7: Ethylene oxide sterilization residuals	Fully whenever applicable

> Aseptic processing standards

EN ISO 13408-1	2015	Aseptic processing of health care products — Part 1: General requirements	Fully whenever applicable
EN ISO 13408-2	2018	Aseptic processing of health care products — Part 2: Filtration	Fully whenever applicable

9. Revision history

Revision number	Date issued	Change description	Revision validated by the Notified Body
1.0	JUN 2022	Creation	☐ Yes, language: English ☑ No
1.1	01 DEC 2022	Update following clinical R1 of questions under initial MDR review: - Addition of EMDN nomenclature code instead of MDR codes - Addition of rates of occurrence for the “other side effects” - Update of Intended population (Adult) and of localisations for indications (thoracic and lumbar)	☑ Yes, language: English ☐ No
1.2	07 FEB 2023	Removal of osteoplasty indication	☑ Yes, language: English ☐ No

A summary of the safety and clinical performance of the device, intended for patients, is provided on next page.

SUMMARY of SAFETY and CLINICAL PERFORMANCE (SSCP) for PATIENTS - English Version
SPINE-FIX®

This Summary of Safety and Clinical Performance (SSCP) is intended to provide public access to an updated summary of the main aspects of the safety and clinical performance of the device. The information presented below is intended for patients or lay persons. A more extensive summary of its safety and clinical performance prepared for healthcare professionals is found in the first part of this document.

The SSCP is not intended to give general advice on the treatment of a medical condition. Please contact your healthcare professional in case you have questions about your medical condition or about the use of the device in your situation. This SSCP is not intended to replace an implant card or the Instructions For Use to provide information on the safe use of the device.

1. Device Identification and general information

1.1. Device Trade Name: **Spine-Fix®**

The medical device has also the following private labels: MVX, Vertefix Plus, Vertocure LVHA+, SPONDY FX, SPF 1, HPFIX +, ONCO 10, LVM+, AVECEM, P-CEM, FIX C

1.2. Manufacturer name and address(es):

TEKNIMED S.A.S.		
Headquarters 8, rue du Corps Franc-Pommiès 65500 Vic en Bigorre France	*Production and facilities* 11-12, rue d'Apollo - ZI de Montredon 31240 L'Union France	*Distribution site (labelling)* ZI de la Herray 65500 Vic en Bigorre France

1.3. Basic UDI-DI: **376017704B06D4**

1.4. Year when the device was first CE-marked: **2004**

2. Intended use of the device

2.1. Intended purpose

Spine-Fix® is a bone cement. It can be injected:
- directly into a vertebra (vertebroplasty),
- or into a vertebra with a small inflatable balloon (kyphoplasty),

It can also be used to strengthen the fixation of a screw into the vertebra (pedicular screws fixation).

2.2. Indication(s) and intended patient groups

Spine-Fix® is used to treat vertebral fractures (compression fractures of the vertebral body at the thoracic or lumbar level). It is also used to fix screws in vertebra (spine deformity or disorder necessitating a spine fusion procedure involving pedicular screws).

Target population: Adult patients with fractures of vertebra due to bone loss (osteoporosis), lesions (benign or malignant), trauma. Adult patients with deformity of the spine or disorder of the spine (necessitating a spine fusion procedure involving pedicular screws).

2.3. Contraindications

- Procedures other than those stated in the INDICATIONS section
- Disorder related to blood clot formation (coagulation);
- Severe conditions that affect heart and lungs (cardiopulmonary disease);
- Fracture of vertebra which are not stable;

- Damaged vertebra (compromise of the vertebral body or of the pedicle walls);
- Intolerance to constituents of the product (hypersensitivity or allergy);
- Patients clearly improving on treatment not using Spine-Fix;
- Use in prevention (prophylactic) in patients having spine disorders without fracture (metastatic or osteoporotic patients with no evidence of vertebral fracture);
- Not enough data are available on some categories of patients. Spine-Fix® cannot be used in children. Spine-Fix® cannot be used in breast-feeding or pregnant women.

3. Device description

3.1. Description of the device

Spine-Fix® is an acrylic bone cement. It is used to treat damaged vertebra. The result is an effective and rapid pain relief for the patient.



This bone cement is liquid. It is made of two sterile components: a powder and a liquid. They need to be mixed at the time of use.

Composition	% (w/w)
POWDER – 21g	
PMMA (Poly-methyl-methacrylate)	64.4
Benzoyl peroxide (BPO)	0.6
Barium sulphate ($BaSO_4$)	25.0
HAP	10.0
LIQUID – 9.2g	
MMA (Methyl-methacrylate)	97.6
N, N dimethyl-p-toluidine (DMPT)	2.4
Hydroquinone	20ppm

The powder is made of polymers (polymethylmethacrylate - PMMA). It also contains an additive to start the hardening reaction (benzoyl peroxide - BPO). Two other additives are added to appear dark on X-ray images (Barium sulphate - $BaSO_4$, and hydroxyapatite - HAP).

The liquid is made of monomers (methyl-methacrylate - MMA). An additive is added to start the hardening reaction (N, N dimethyl-p-toluidine - DMPT). It helps to control the reaction and the heat generated. A last additive (hydroquinone) is used in very small quantity. It avoids any premature hardening reaction during storage.

During surgery, powder and liquid are mixed. A liquid mixture is obtained. It becomes harder and harder over time. It finally becomes fully solid at the end of the reaction. Injection must be done when liquid. The final hardening phase occurs inside the bone.

Spine-Fix® expected lifetime is 10 years. At the end of this expected lifetime, the cement does not need to be removed and does not need any maintenance. The cement can remain in place all lifelong, unless a medical complication would require a new surgery.

The product (powder and liquid) is supplied sterile.

It is a single use product.

4. Risks and warnings

Contact your healthcare professional if you believe that you are experiencing side-effects related to the device or its use or if you are concerned about risks. This document is not intended to replace a consultation with your healthcare professional if needed.

4.1. Remaining risks and undesirable effects

- Leakage of bone cement outside the treated bone (They are frequent and rates up to 54% have been reported in the literature, and up to 31% in a clinical study with Spine-Fix® (Cf. section 5.3). These leakages are almost always asymptomatic. Yet, in some cases, when the cement penetrates into the vascular system, leakages can result in embolism of the lung and/or heart or other clinical sequelae (rates up to 1.5% reported in the literature, none concerning Spine-Fix®).
- Unexpected or unintended effect to blood circulatory system (cardiovascular system) (also known as Bone Cement Implantation Syndrome). It includes chest pain, a heart rate that's too fast (tachycardia), signs of severe respiratory distress, and death. They may be due to the hardening reaction (MMA monomer release during polymerization, and/or to excessive exothermic reaction, and/or to too much pressure applied during cement injection). For this reason, blood pressure should be monitored after implantation. The anesthetist should be told when the bone cement is implanted.
- Some patients suffered from fracture around the time of surgery (perioperative fractures such as: Fracture of ribs, of posterior element or of pedicle in patients suffering from diffuse osteopenia or osteoporosis, in particular during thoracic vertebroplasty procedures, due to the high pressure exerted downwards while the needle is being inserted; Fracture or collapse of a vertebra adjacent to the one injected due to an osteoporotic disease (0.6% in a clinical study with Spine-Fix®));

Other side effects include:

- Allergy to one of the bone cement constituents;
- Exposure of the health care operators to monomer fumes.
- Transient nausea and hematoma

Any serious incident occurring in relation to the device must be reported without delay to TEKNIMED and the competent local authority where the user and/or the patient is established.

4.2. Warnings and Precautions

No warning and precautions for patients. This device is only used by healthcare professionals.

Patients with intolerance to bone cement components should mention it to their surgeon.

4.3. Summary of any field safety corrective action (FSCA) if applicable

None. No FSCA have been issued since the release of Spine-Fix® on the market.

5. Summary of clinical evaluation and post-market clinical follow-up

5.1. Clinical background

Spine-Fix® bone cement comes from a safe technology. It has been used in surgery for many years. It treats fractured vertebrae. Patients have pain alleviation. Patients have improved quality of life. Performance and safety have been shown by clinical studies.

5.2. Clinical evidence for CE marking

A clinical study has been done in 2004 in France. It evaluated performance and safety of Spine-Fix®.
168 patients are treated in spine. A clear alleviation of pain for all patients is observed. A clear restoration of function for all patients is observed. Two complications were reported. 2 vertebrae near treated vertebra were damaged.

Complications were not due to bone cements. Complications were due to the progression of the disease. Leakage occurred in 106 treated vertebrae. None had impact on the patient.
This study has been done on a large population of patients. It showed efficacity, performance and safety of Spine-Fix® bone cement.
4 published scientific articles study Spine-Fix®. The bone cement is used in spine or outside of the spine.
Article 1[12]: 283 patients are treated in spine (vertebral compression fractures from osteoporosis and metastatic disease). Authors conclude that the use of Spine-Fix® is safe and reliable.
Article 2[13]: 51 patients are treated in spine (vertebral compression fracture of osteoporotic (84.8%) or traumatic (23.6%) origin). No patient encountered major complications. Pain relief was obtained after the procedure.
Article 3[14]: 55 patients are treated in spine (pedicle screws). The patients' health improved. No complications were reported.
Article 4[15]: 50 patients are treated outside of the spine (painful bone metastases treated with extraspinal percutaneous cementoplasty). Authors conclude that percutaneous cementoplasty with Spine-Fix® is safe and effective. It provides pain relief in patients.
Teknimed will start a new clinical study. It will include Spine-Fix®. It will start end of 2022.

5.3 Safety

Teknimed is always doing clinical studies (Scientific literature reviews, Post-Market Surveillance and Clinical Follow-up). They document and evaluate the benefits and risks of the product.
Main risks during spine surgery have been identified: leakage outside of the bone, unexpected or unintended effect to blood circulatory system, fracture (ribs, posterior parts of the vertebra, or pedicles).

6. Possible diagnostic or therapeutic alternatives

Patients who don't want to be treated with Spine-Fix® have alternatives. They can reduce their activities. They can use medications. They can use bracing. The first aim of these alternatives is to control the pain. Different medications are often recommended in relieving pain (bisphosphonate (alendronate and zoledronic acid), acetaminophen, and nonsteroidal anti-inflammatory drugs (NSAIDs), as well as muscle relaxing drugs for nerve/bone pain). It is important to only use opioids for very short periods of time (1-2 weeks). Braces are used to limit motion of the spine. It allows bone healing.

7. Suggested profile and training for users

Product should only be used in clinics or hospitals. It should be used by qualified health care professionals (radiologists, surgeons). They need to be expert in surgery using bone cements.

[12] Anselmetti GC, Corrao G, Della Monica P, Tartaglia V, Manca A, Eminefendic H, Russo F, Tosetti I, Regge D. *Pain Relief Following Percutaneous Vertebroplasty: Results of a Series of 283 Consecutive Patients Treated in a Single Institution*. Cardiovasc Intervent Radiol (2007) 30:441–447

[13] Luo AJ, Liao JC, Chen LH, Lai PL. *High viscosity bone cement vertebroplasty versus low viscosity bone cement vertebroplasty in the treatment of mid-high thoracic vertebral compression fractures*. The Spine Journal 22 (2022) 524−534

[14] Son HJ, Choi SH, Heo DR, Kook I, Lee MK, Ahn HS, Kang CN. *Outcomes of the use of cement-augmented cannulated pedicle screws in lumbar spinal fusion*. The Spine Journal (2021) 1−9

[15] Anselmetti GC, Manca M, Ortega C, Grignani G, DeBernardi F, Regge D. *Treatment of Extraspinal Painful Bone Metastases with Percutaneous Cementoplasty: A Prospective Study of 50 Patients*. Cardiovasc Intervent Radiol (2008) 31:1165–1173