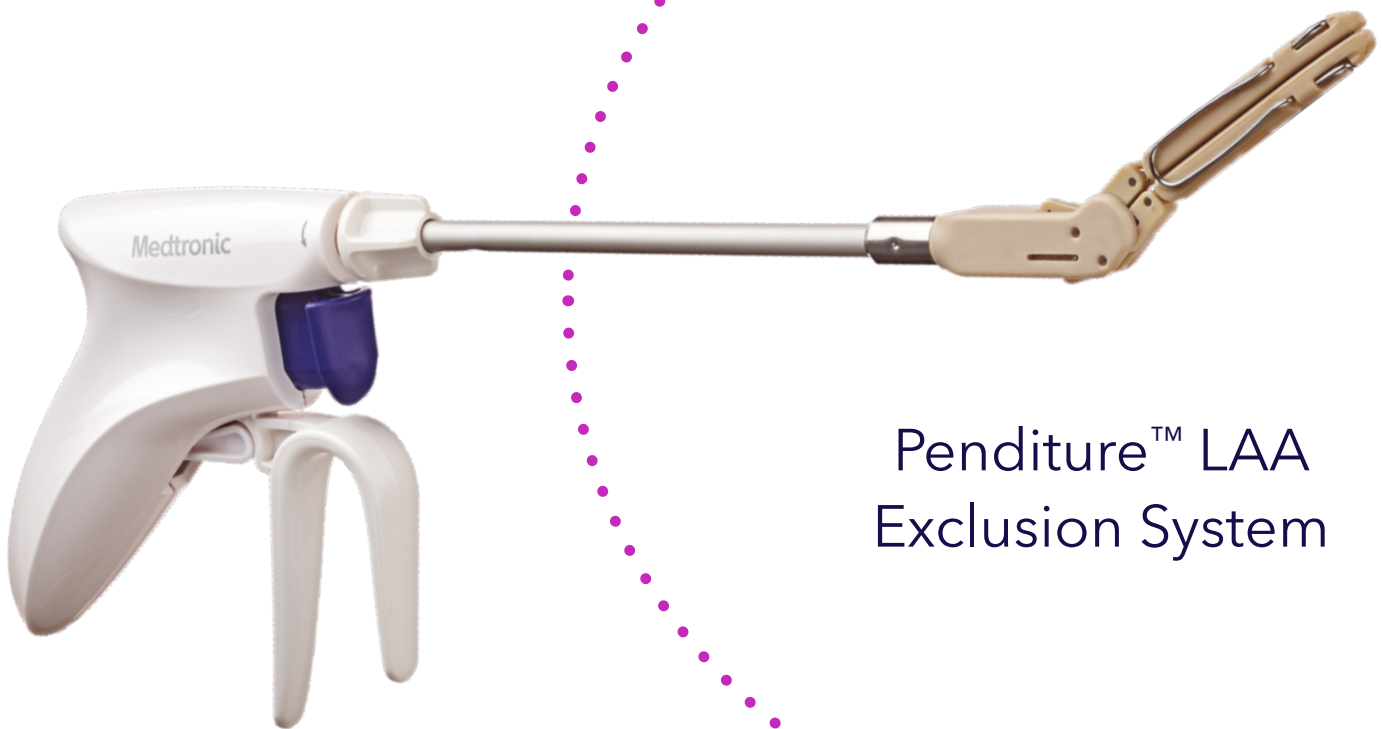


Medtronic

Left atrial appendage clipping in a canine model



Penditure™ LAA
Exclusion System

Left atrial appendage clipping in a canine model

Background

The left atrial appendage (LAA) is the main source of stroke in patients with atrial fibrillation, and atrial clipping is a treatment strategy to reduce the risk of blood clots in the LAA from entering the bloodstream and potentially causing a stroke in these patients.

Purpose and objectives

The objective of this study was to demonstrate substantial equivalence of the Penditure LAA exclusion system to the AtriClip®* Flex-V®* exclusion system when compared in a canine model 90 days after the procedure.

Study design

This Good Laboratory Practices (GLP) study was designed to evaluate the performance and safety of the study device (Penditure) in comparison to the control device (AtriClip Flex-V) in a canine model over 90 days. Twelve mongrel dogs (age range: 10.4–33.6 months) were enrolled in the study. A canine model was chosen because heart size, electrophysiological characteristics, and hemodynamics have been shown to be comparable to those of the human heart.

Six animals were assigned to the Penditure device, and six were assigned to the AtriClip Flex-V device for the 90-day study. A clinical user (interventionalist) performed the implantations.

For each animal, a thoracotomy was performed to expose the LAA. The study or control device was implanted on the LAA. One study or device was implanted per animal. Fluoroscopy was used for guidance. Transesophageal echocardiography (TEE) was performed post-implantation to evaluate device placement and to confirm

LAA closure. Fluoroscopy was also performed for quantitative measurement of the distance between the straight metal segments of the clips to approximate tissue thickness in vivo.

At 7 days and 90 days (before euthanasia) post-implantation, TEE was performed again to evaluate device placement, confirm LAA closure, and document any abnormalities. Fluoroscopy was performed for quantitative measurement of the distance between the straight metal segments of the clips to approximate tissue thickness in vivo.

After the animals were euthanized, a pathological gross examination was performed, and the heart, implant, and major organs (brain, liver, kidney, spleen, lungs) were saved for histopathologic analysis by a veterinary pathologist. Inspection and photographic documentation of the LAA (both external and intra-atrial views) were performed. The clips and surrounding tissue underwent processing for histopathologic evaluation.

Results

Six mongrel dogs were successfully implanted with the Penditure device, and six mongrel dogs were successfully implanted with the AtriClip Flex-V device.

No complications or procedural events occurred at implantation.

Left atrial appendage clipping in a canine model

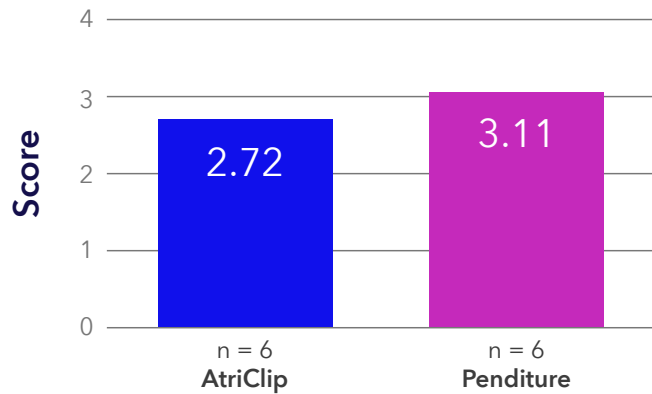
Tissue encapsulation

90 days

- Evaluation of the LAA closure sites showed that the devices were often completely incorporated in remodeled tissue.
- Mild to marked fibrous encapsulation was observed surrounding the Penditure device. Fibrous encapsulation is the end-stage healing response to biomaterials.
- The fibrous encapsulation scores were numerically higher in the Penditure group than the AtriClip Flex-V group (Figure 1).

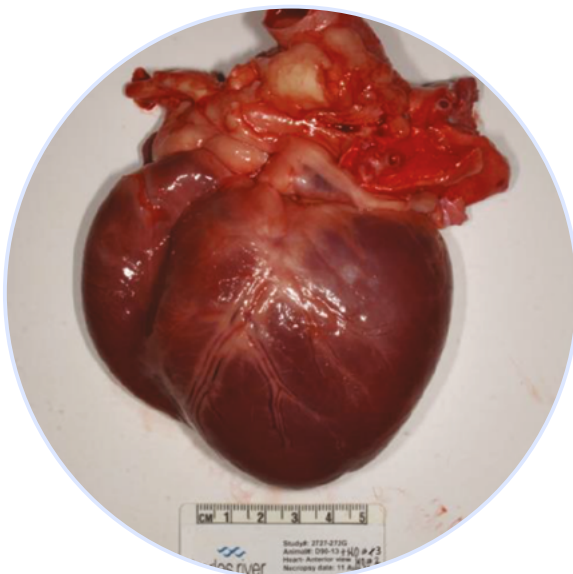
Figure 1

Fibrous encapsulation | 90 days

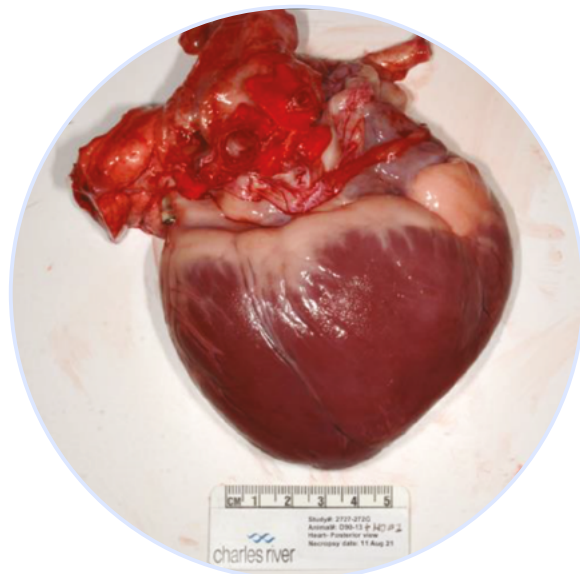


Penditure LAA exclusion system

90-day cohort



Heart, anterior view



Heart, posterior view

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Histopathology data for inflammation and fibrosis

- The tissue reaction to Penditure was characterized by the presence of none or rare (1 to 5) neutrophils, none to mild (0 to 10) lymphocytes, and rare to mild (1 to 10) macrophages per high-power field with **overall inflammation graded as minimal or mild**.
- **Tissue ingrowth into the Penditure** device was graded as minimal or mild and was characterized by the presence of narrow to thick bands of fibrosis/fibrous connective tissue and few inflammatory cells between the PEEK bars and between the PEEK bars and the nitinol springs.
- In summary, at 90 days, histopathological evaluation of the Penditure and AtriClip Flex-V devices showed that the overall inflammation (Figure 2), macrophages (Figure 3), multinucleated giant cells, fibrosis (Figure 4), and tissue ingrowth into the device (Figure 5) scores were lower in the Penditure group than the AtriClip Flex-V group.

Atraumatic tissue closure

- Relative tissue trauma was given a score of 1 by the interventionalist for all of the Penditure and AtriClip devices. A score of 1 was defined as fully rebounded tissue with minimal to no evidence of contact.

Figure 2

Overall inflammation | 90 days

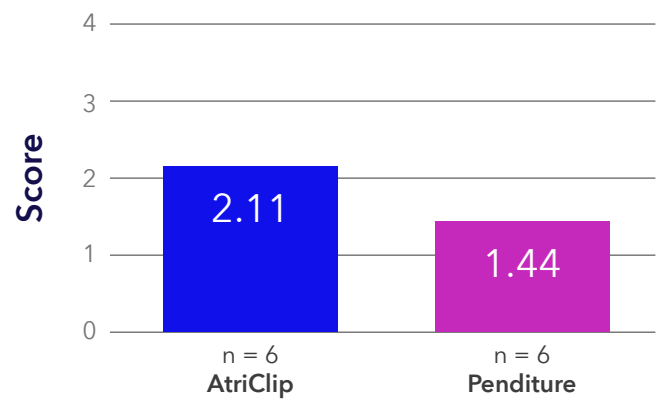
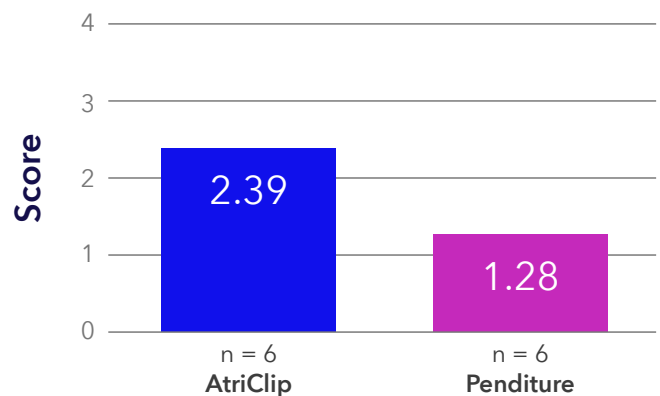


Figure 3

Macrophages | 90 days



Left atrial appendage clipping in a canine model

Device migration

- **At 7 days post-implantation and at the time of the final procedure, no migration, leakage, or abnormalities were observed for the Penditure or AtriClip Flex-V devices. All devices performed equally.**
- Gross necropsy, microCT, and histopathologic evaluation showed that the inflammation and healing, long-term (90-day) damage to the atrium or erosion into surrounding tissues after implantation, migration from time of implant, and non-target tissue evaluation acceptance criteria were met, demonstrating substantial equivalence of the Penditure LAA exclusion system to the AtriClip Flex-V LAA exclusion system.

Successful LAA closure

- TEE assessments post-implantation, at 7 days or at the time of the final procedure, did not show any residual flow or abnormalities for any of the clips except for the AtriClip in one animal, where slight residual flow was observed at the tip of the clip at post-implantation and after closure.
- **At 7 days post-implantation and at the final procedure, no migration, leakage, or abnormalities were observed for the Penditure or the AtriClip Flex-V devices. All devices performed equally.**
- In all animals, the endocardial surface surrounding the closure site was smooth, and there was no visible opening between the left atrium and the LAA.

Figure 4

Fibrosis | 90 days

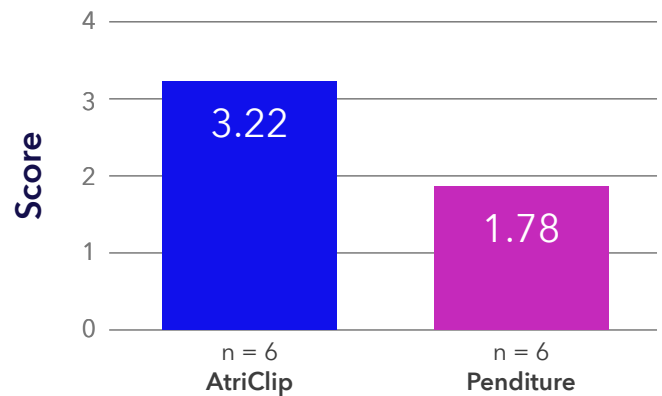
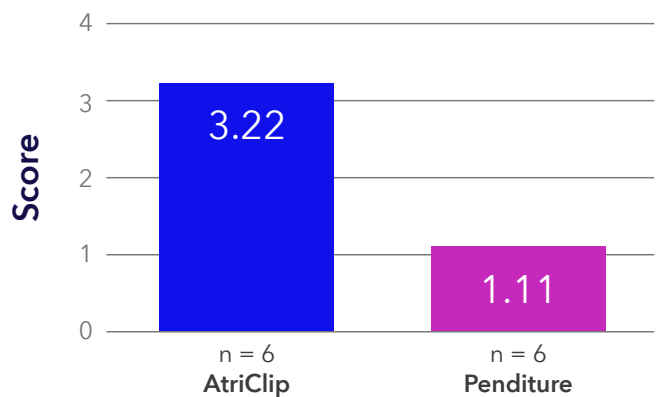


Figure 5

Tissue ingrowth into the device | 90 days



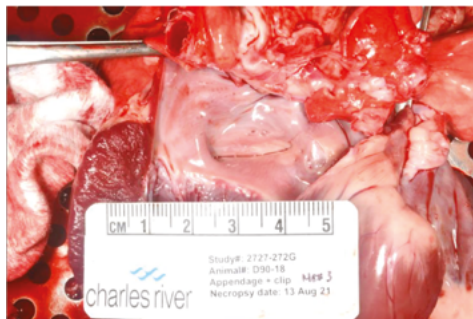
Left atrial appendage clipping in a canine model

Penditure LAA exclusion system

90-day cohort



View 1 | Closed LAA endocardial surface



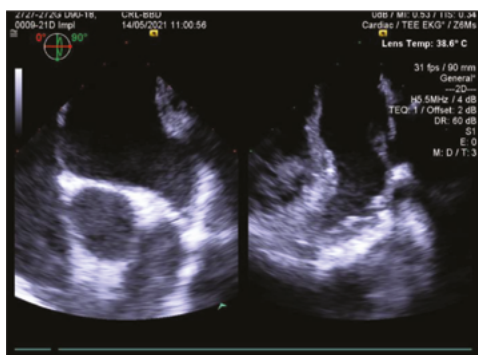
View 1 | Appendage with clip



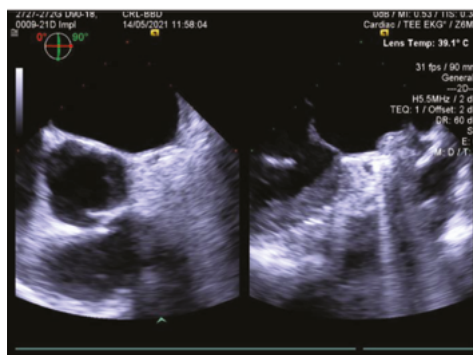
View 2 | Closed LAA endocardial surface



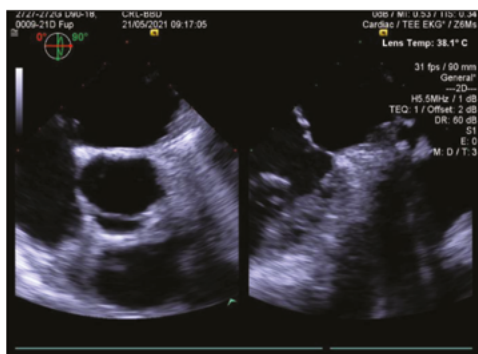
View 2 | Appendage with clip



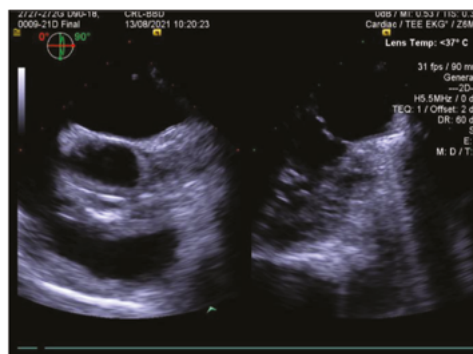
Pre-implantation



Post-implantation



7-day follow-up



Final

Conclusions

Overall, the Penditure LAA exclusion system showed a good safety profile without evidence of significant adverse effects. Gross necropsy evaluation showed a smooth endocardial surface and no visible opening between the left atrium and the left atrial appendage in all animals. The gross necropsy results appeared to be better in the Penditure device group, and the microCT results were relatively similar in both groups.

The histopathology results (overall inflammation, macrophages, multinucleated giant cells, fibrosis and tissue ingrowth into the device) appeared to be better in the Penditure devices than in the AtriClip Flex-V devices. Gross necropsy, microCT, and histopathologic evaluation showed that the inflammation and healing, long-term (90-day) damage to the atrium or erosion into surrounding tissues after implantation, migration from time of implant, and nontarget tissue evaluation acceptance criteria were met, demonstrating substantial equivalence of the Penditure LAA exclusion system when compared to the AtriClip Flex-V LAA exclusion system.

This material should not be considered the exclusive source of information, it does not replace or supersede information contained in the device manual(s). Please note that the intended use of a product may vary depending on geographical approvals.

See the device manual(s) for detailed information regarding the intended use, the (implant) procedure, indications, contraindications, warnings, precautions, and potential adverse events. For a MRI compatible device(s), consult the MRI information in the device manual(s) before performing a MRI. If a device is eligible for eIFU usage, instructions for use can be found at Medtronic's website manuals.medtronic.com.

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