CardioGenesis®

TMR History

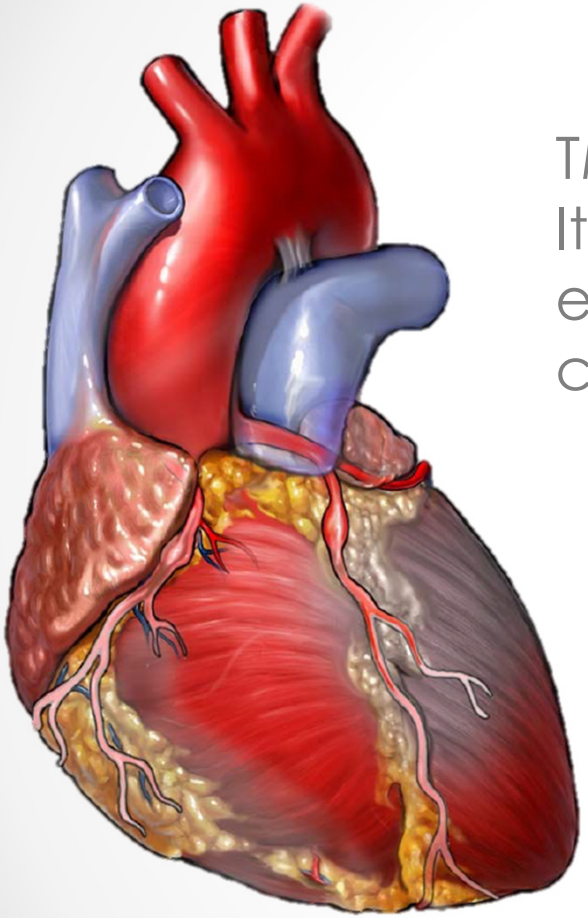
Physician Training

TMR: What is it?

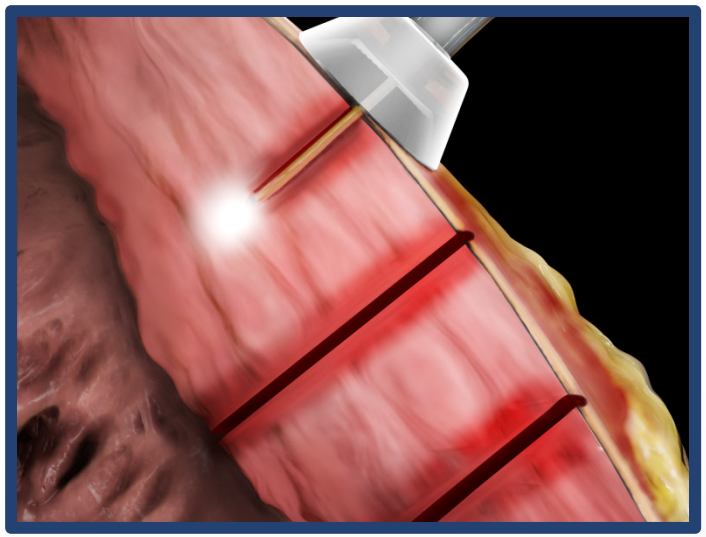
Transmyocardial Revascularization (TMR) is an FDA approved surgical procedure in which transmural channels are created in the left ventricular wall.

The channels are created by thermal ablation and a thermoacoustic wave.

How is it Done?

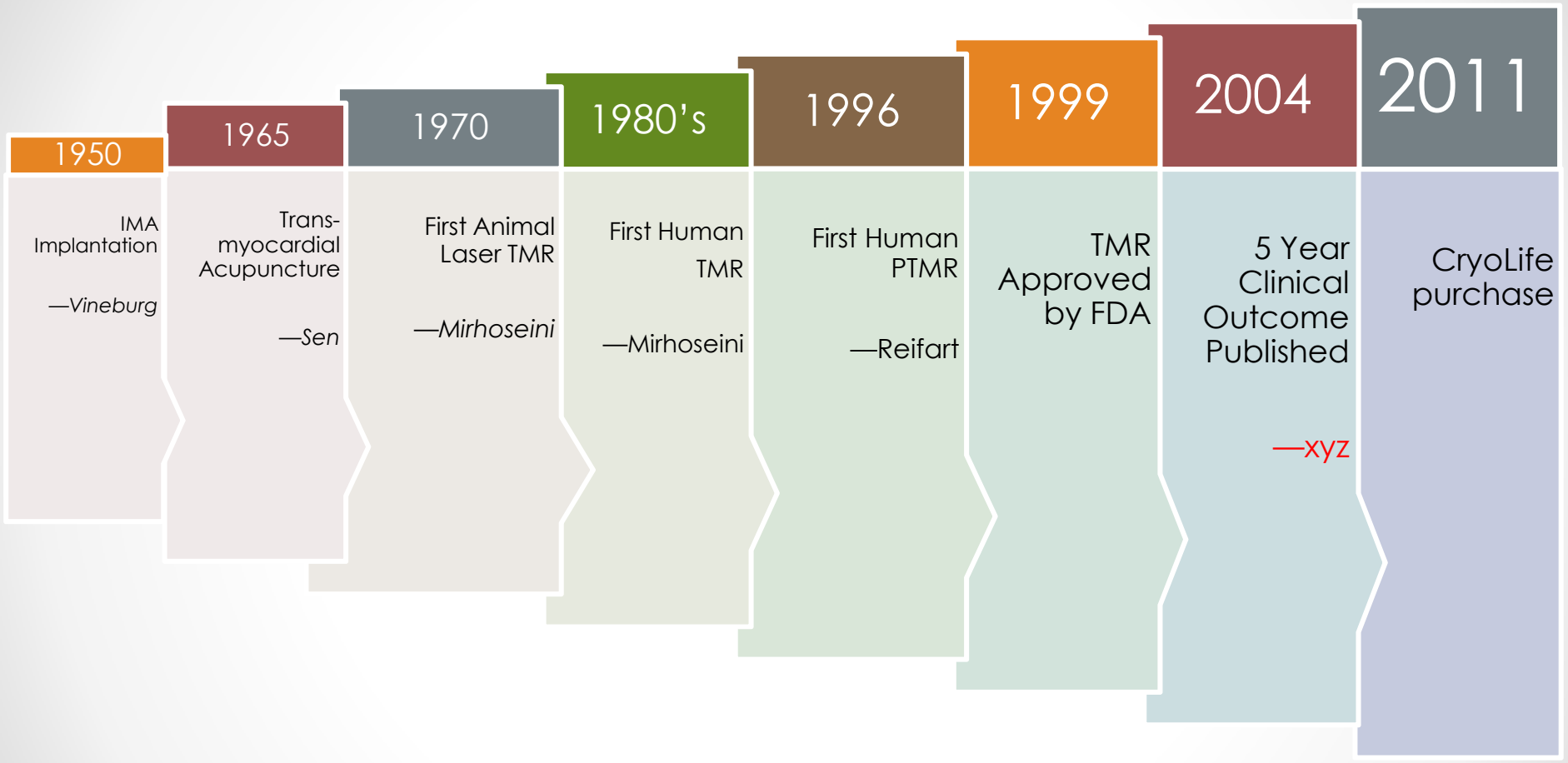


TMR uses an "outside-in" approach. It initiates the channel from the epicardial surface and goes completely through the left ventricle.



Transmural channels from epicardium to endocardium in the distal $^{2}/_{3}$ of the left ventricle

Timeline


1950
IMA Implantation
—Vineburg
1965
Trans-myocardial Acupuncture
—Sen
1970
First Animal Laser TMR
—Mirhoseini
1980's
First Human TMR
—Mirhoseini
1996
First Human PTMR
—Reifart
1999
TMR Approved by FDA
2004
5 Year Clinical Outcome Published
—xyz
2011
CryoLife purchase

The Original Concept

- Original TMR Concept: Reptilian Heart Model
- A similar revascularization technique was used in the 1960's in an attempt to mimic reptilian circulation. —Dr. Senn, Cardiac Acupuncture
- In the reptilian heart, perfusion occurs via intraventricular channels rather than coronary arteries.

Khomoto T., et al. *Circulation* 1997;95:1585 -91

FDA Approved Devices

- Holmium: YAG (Ho:YAG) Laser
  CardioGenesis Corporation
  Approved 02/1999

- Carbon Dioxide (CO_2) Laser
  Novadaq
  Approved 08/1998

Who gets it?

Patients with Inoperable CAD

- Diffuse artherosclerotic end-stage disease
- Profound physical limitations due to angina
- Patient/physician sense of hopelessness – TMR provides angina relief and improves quality of life which not only make the patient happy but also the Cardiologist
- Patients with an ejection fraction > 30%

Proven Clinical Benefit

Multiple prospective, controlled, randomized, multicenter clinical trials have demonstrated statistically significant benefits in patients treated with TMR, including:

- Survival
- Angina
- Event Free Survival
- Reduction in Cardiac Rehospitalizations
- Quality of Life

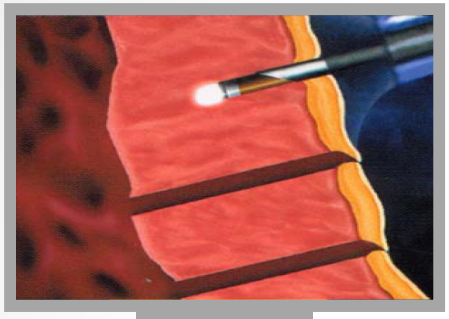
National Practice Guidelines

Workforce Recommendations for TMR in Patients with Stable Angina

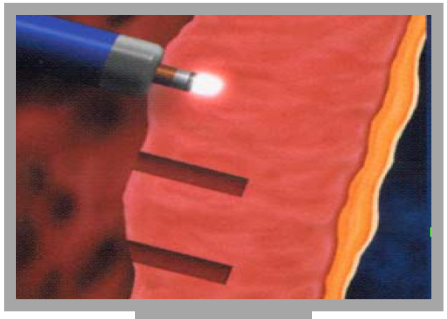
- STS Workforce on Evidence-Based Surgery[1]
  - As Sole Therapy
    - Class I, Grade A Evidence
  - As Adjunctive Therapy
    - Class IIA, Grade B Evidence
- ACC/AHA Task Force on Practice Guidelines[2]
  - Class IIA, Grade A Evidence
- Consensus Statement of the International Society of Minimally Invasive Cardiothoracic Surgery (ISMICS), 2006[3]
  - Recommends TMR for patients who have Class III or IV angina, either sole therapy or adjunctive to CABG, because it improves angina relief, reduces MACE (major adverse coronary events) and improves exercise performance.

1. Bridges C, et al. Ann Thorac Surg. 2004;77:1484-1502.
2. Gibbons RJ, et al. Circulation. 2003:1-10.
3. Diegeler A, et al. Innovations. 2006;1:314-322.

TMR Comparison



TMR

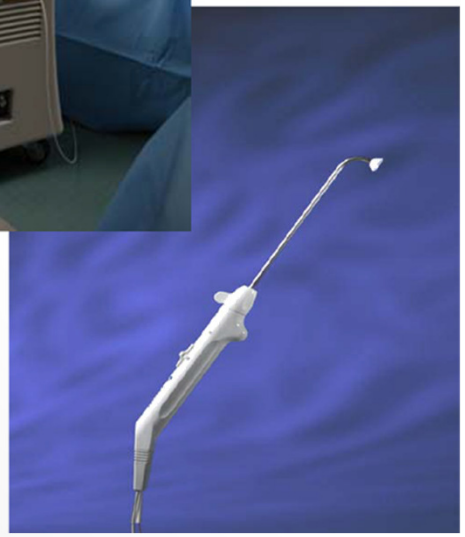


PMR

DMR

	TMR	PMR	DMR
Channel Creation	Yes	Yes	No (laser fiber is only placed on tissue wall for acoustical effect)
Depth of Channel Penetration into Tissue Surface	from epicardium through myocardium and endocardium (complete channel into ventricle)	3 mm depth from endocardium to myocardium (does not go out to epicardial surface)	None
Laser Type	Ho:YAG / CO_2	Ho:YAG	Ho:YAG
Clinical Benefit	Yes • Allen KB, et al. 5-year follow-up. Ann Thorac Surg. 2004;77:1228-34. • Allen KB, et al. 5-year adjunctive follow-up. Ann Thorac Surg. 2004; 78:458-65	Yes • PACIFIC Trial • BELIEF Trial	No • DIRECT Trial

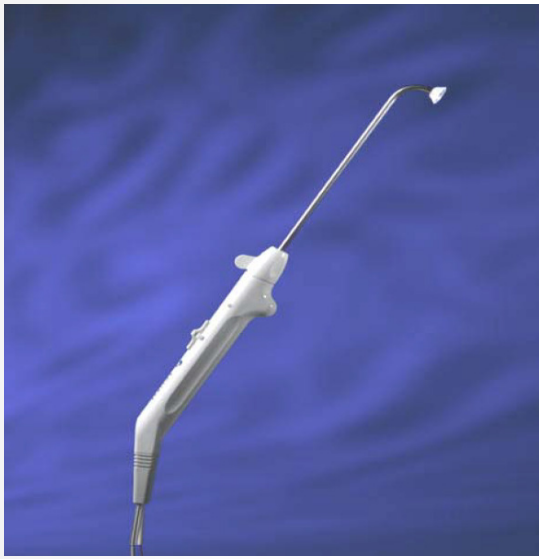
The Complete System

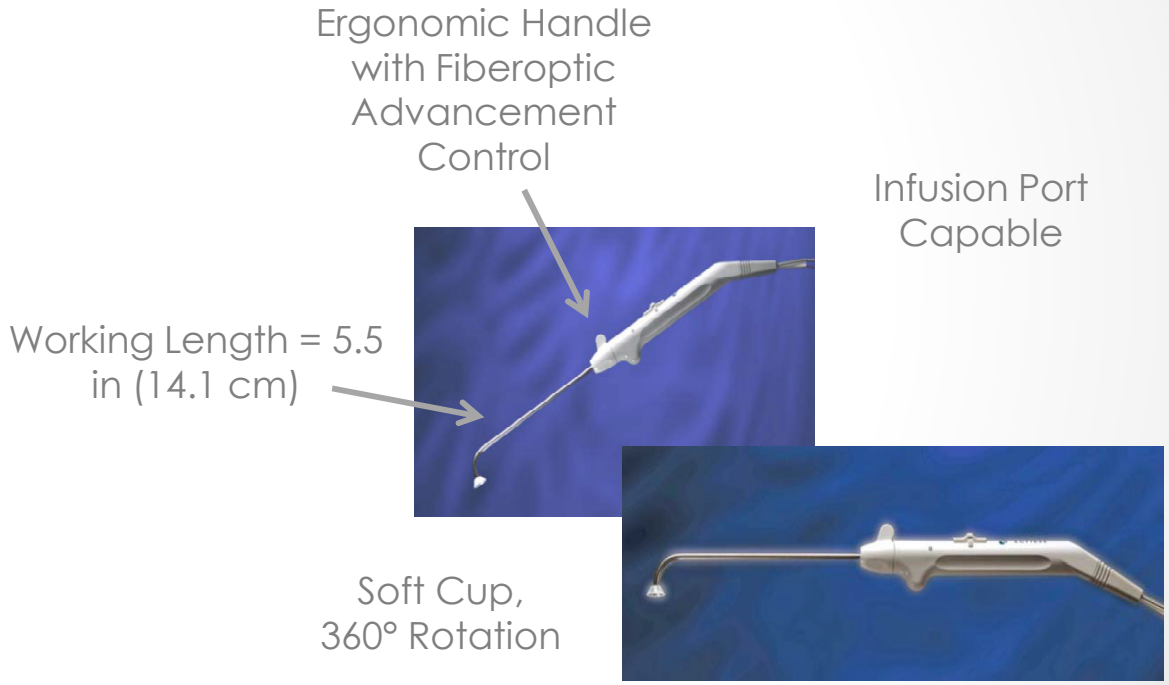


- Solid-state Holmium Laser
- Operates at 6–8 watts (1.2–1.6 joules)
- 2.1 micron wavelength, mid infrared range
- Pulse repetition rate – 5 Hz
- Pulse length – 200 microseconds
- 1 mm diameter fiberoptic delivery system
- 110 VAC, 115 Volt
- 21" length x 14" width x 36" height
- 120 lb (58 kg)
- No user alignment or calibration required
- No smoke evacuation required
- Rapid start-up

The Handpiece

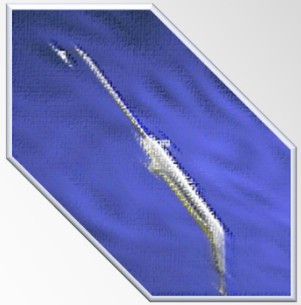
The Sologrip III® Surgical Handpiece





Developed by Surgeons for Surgeons

The Handpiece



Sologrip® III Handpiece System Specifications and Attributes

Handpiece Type	flexible fiberoptic delivery system allows for easy access to posterior of the left ventricle with minimal manipulation of the heart
Distal Rotating Tip	360° tip rotation control allows access to all areas of left ventricle and myocardium
Soft Cup Design	provides system stabilization on myocardial surface (beating or arrested heart)
One Handed Operation	allows for precise fiber advancement and control
Infusion Port Capabilities	future adaptable platform for use with angiogenic enhanced therapies
Fully Assembled	latex free
Sterile, Ready to Use	reduces preparation time
No Beam Alignment Necessary	improves access to the myocardium and provides procedural flexibility