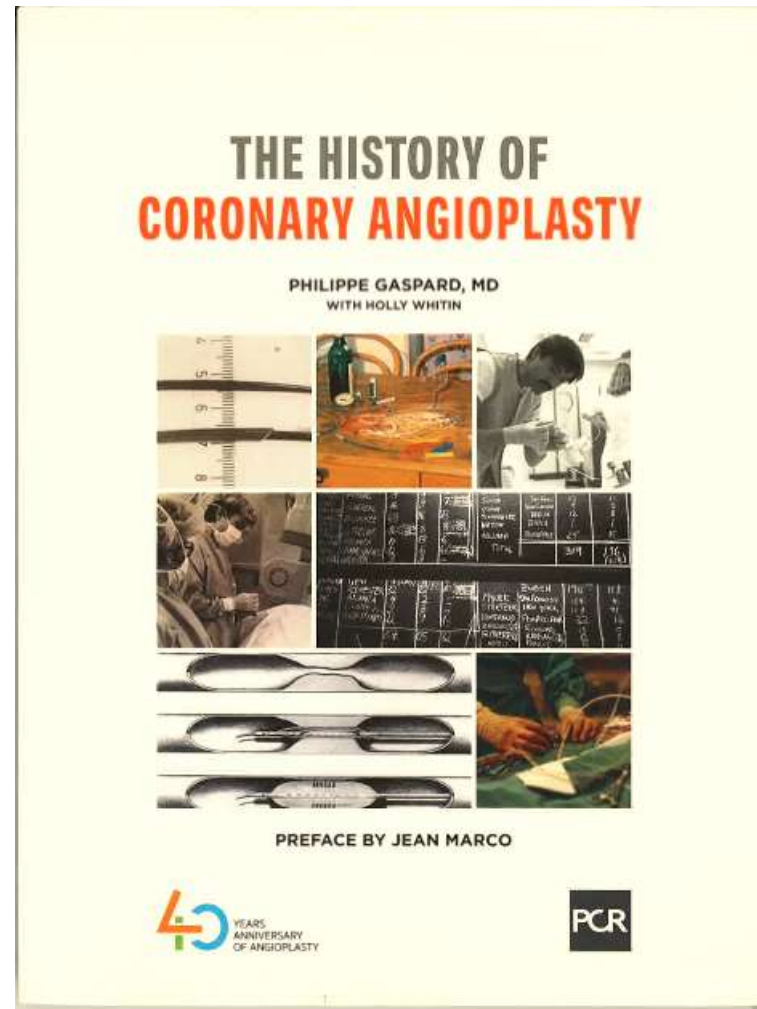


THE HISTORY OF CORONARY ANGIOPLASTY

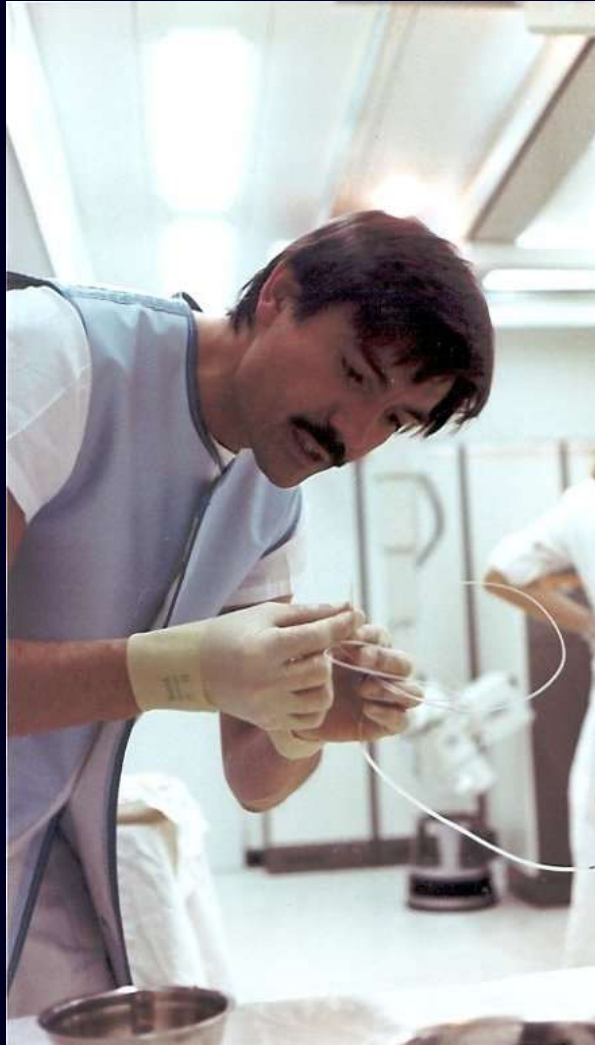
PHILIPPE GASPARD
WITH HOLLY WHITIN



40 YEARS
ANNIVERSARY
OF ANGIOPLASTY

PCR

40 Years of PTCA



« *Don't do that!* »



« *try to stop me!* »

The Work of the Predecessors



W. Forssmann

1929

Werner Forssmann

Death-defying experiments

1958

Mason Sones

« To open a door is to find other doors which are waiting to be opened. »

1964

Charles Dotter

No respect for boundaries



Dotter's catheter

1968

Eberhard Zeitler

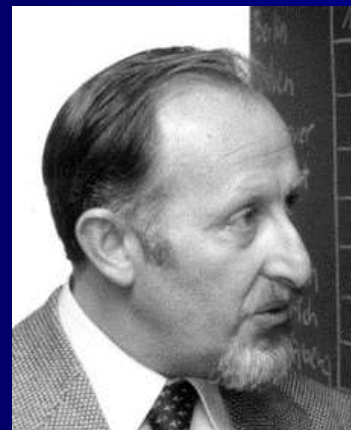
Development of Dotter's approach in Europe



M. Sones



C. Dotter

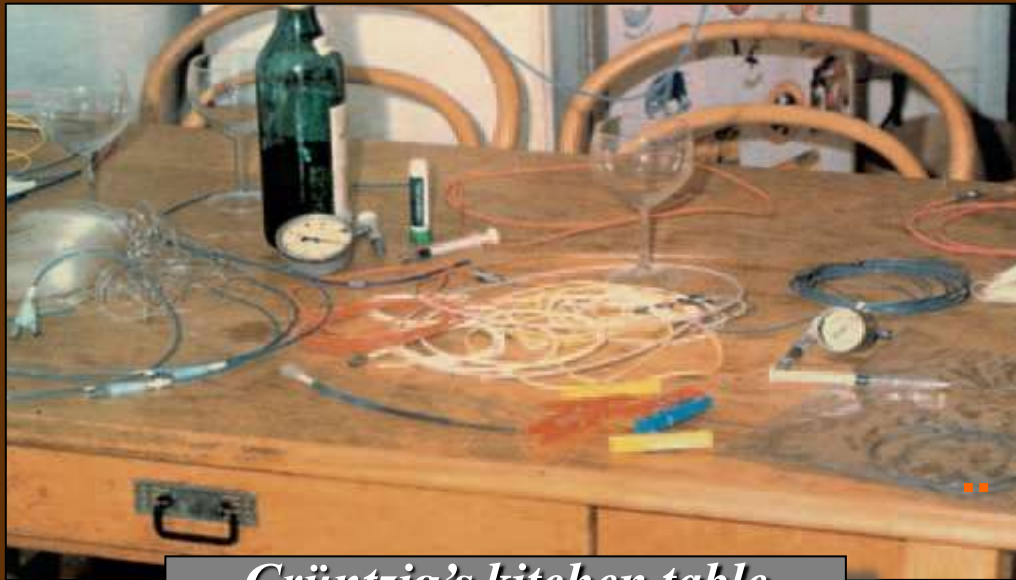


E. Zeitler



J.W. Waterhouse

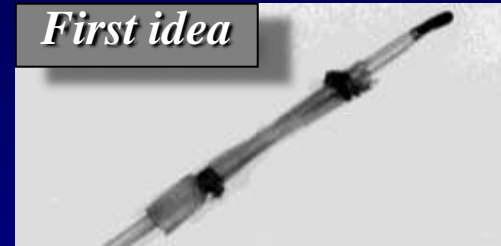
The Original Balloon Idea



Grüntzig's kitchen table

For 4 years the Grüntzig's kitchen table was used to produce and test the prototypes which, one day, would lead to coronary artery dilatation

First idea



DG 20-30



*Michaela.
Grüntzig*

*Walter
Schlumpf*



*Maria.
Schlumpf*



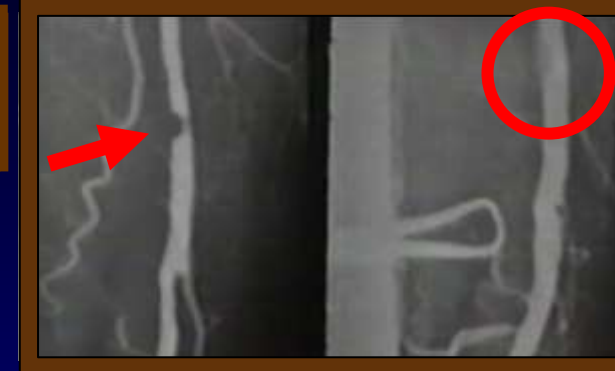
A. Grüntzig

Andreas Grüntzig

1972-76

Feb. 12, 1974

➤ *Superficial femoral angioplasty*



Andreas Grüntzig

1974-77

Feb. 12, 1974

➤ *Superficial femoral angioplasty*

Oct. 22, 1975

➤ *Canine coronary angioplasty*

AHA, Miami, Nov. 1976



Skepticism

The dog's poster

« *You must see the exhibit by this man from Zurich in the next row...* »

« *This will never work!* »



Marko Turina

Andreas Grüntzig 1974-77

Feb. 12, 1974

➤ *Superficial femoral angioplasty*

Oct. 22, 1975

➤ *Canine coronary angioplasty*

May 9, 1977

➤ *Intra-operative coronary angioplasty*



St Mary's Hospital, SF, CA

➤ *No debris found related to the balloon inflation*

➤ *Significant reduction of the dilated coronary stenosis without thrombosis*



Richard Myler



Elias Hanna

Andreas Grüntzig

1974-77

Feb. 12, 1974

➤ *Superficial femoral angioplasty*

Oct. 22, 1975

➤ *Canine coronary angioplasty*

May 9, 1977

➤ *Intra-operative coronary angioplasty*

Sept. 16, 1977

➤ *Percutaneous coronary angioplasty*



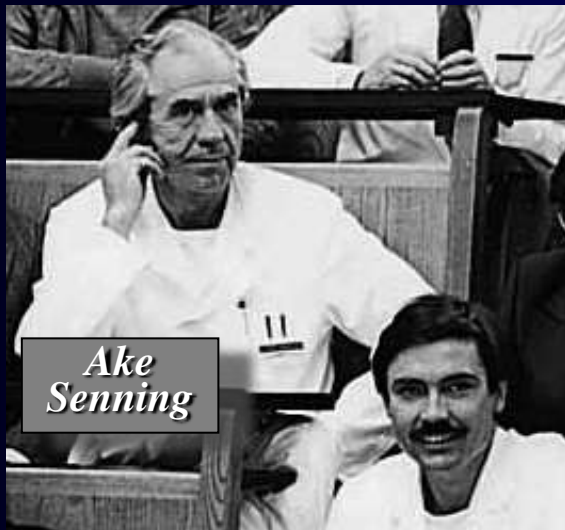
1977



2017

*Dolf
Bachmann*

*The first patient is still
alive and well today*



*Ake
Senning*

Andreas Grüntzig

*« With Grüntzig's procedure, patients
will die! »*

H. P. Krayenbühl

*« Dr Grüntzig, what is there to worry
about? If something goes wrong,
I will operate! »*

A. Senning



*Bernhard
Meier*

*Andreas
Grüntzig*

Andreas Grüntzig 1974-77

A portrait of Adolph Bachman, a middle-aged man with dark hair, wearing a light-colored dress shirt and a dark patterned tie. He is looking directly at the camera with a neutral expression. The background is an indoor setting with a window and a green plant.

Adolph Bachman
First PTCA Patient

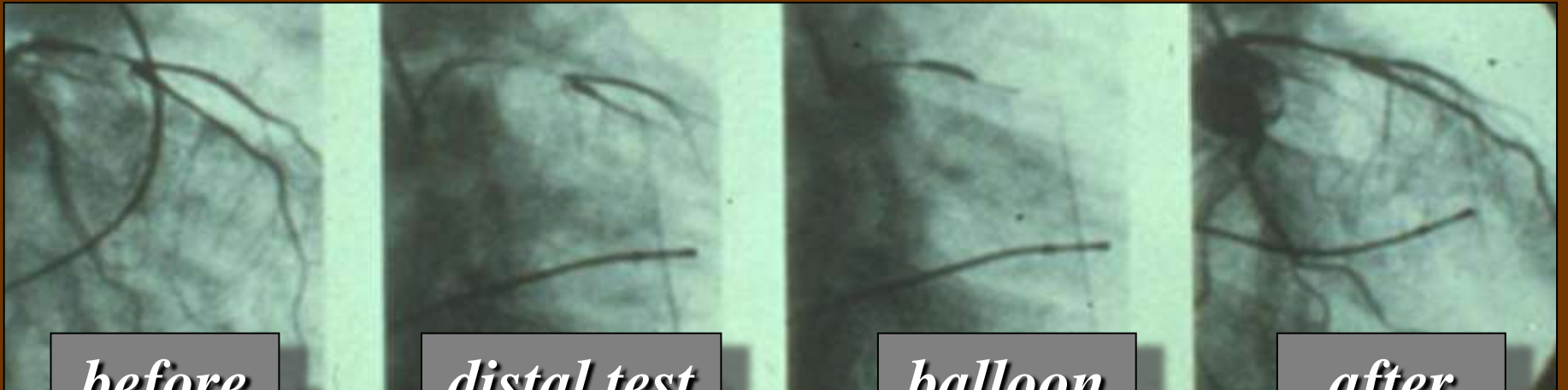
I first met Dr. Gruentzig...

A middle-aged man with dark, wavy hair is shown from the chest up. He is wearing a light yellow dress shirt and a dark blue patterned tie. He appears to be speaking, with his mouth slightly open. The background is an office environment, featuring a window with light-colored curtains on the left, a green plant on the right, and a desk with a printer or similar device in the lower-left background. The overall lighting is somewhat dim, typical of an indoor office space.

Everything was so clear.

Andreas Grüntzig - Friday, September 16, 1977

*It was not an accident or an unexpected incident.
This event came after intensive work over seven years*



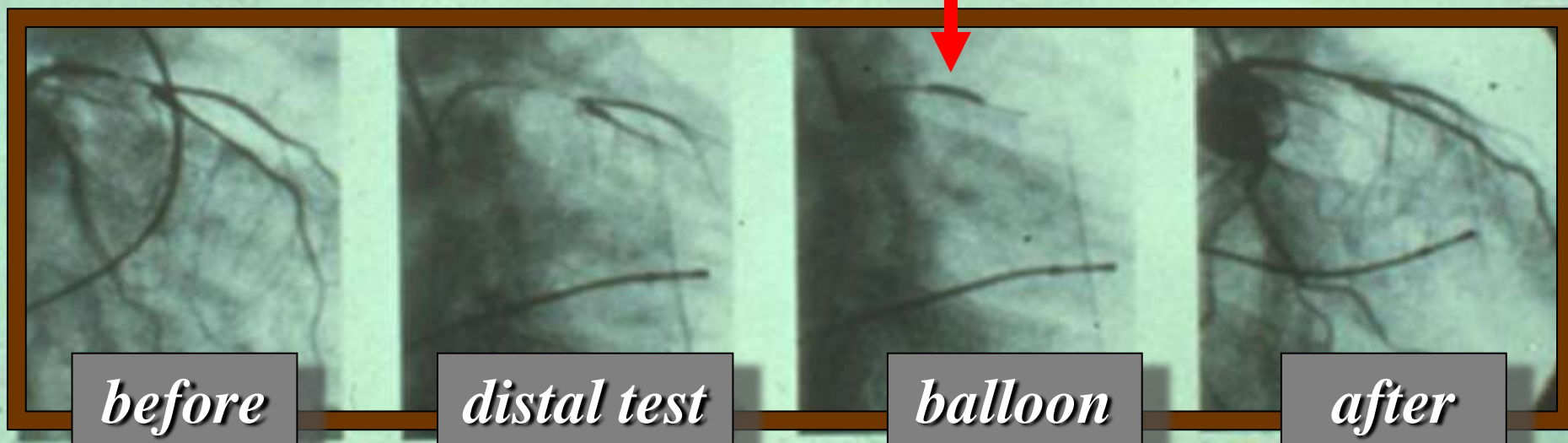
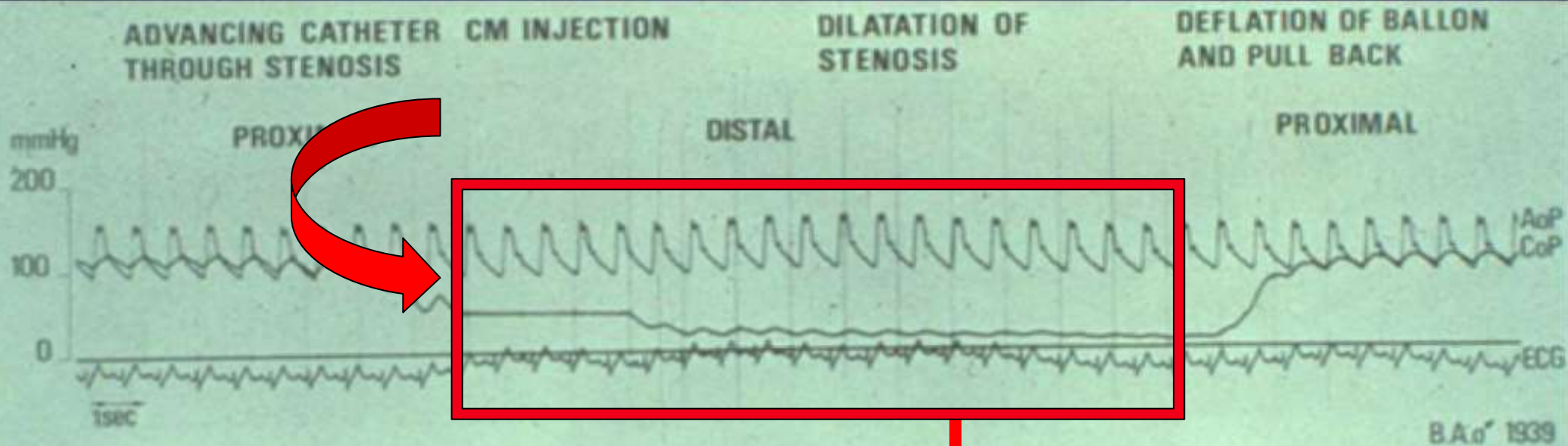
before

distal test

balloon

after

Andreas Grüntzig - Friday, September 16, 1977



1978 Aug. 7-10

First Teaching Course in Zurich

28 participants

*Andreas Grüntzig had already dilated 25 patients.
7 patients were dilated via live broadcast*

« He was enormously brave and extremely honest. »

D. Prigmore



The potential of this new method was coming to light

*From an angiographic image, it became possible to consider
a revolutionary simple treatment which permitted patients
to avoid bypass surgery in selected indications*

Andreas Grüntzig

The Grand Inventor

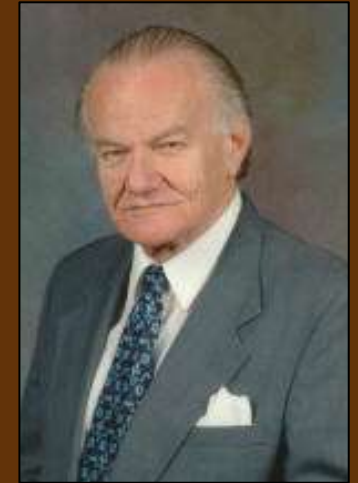
Francis Robicsek



Andreas Grüntzig

Andreas Grüntzig reported the results of his first 50 procedures to American cardiologists and cardiac surgeons

As the spokesperson of the cardiac surgeons hostile to balloon dilatation, Francis Robicsek tried to demolish Andreas Grüntzig's therapeutic approach



Hungarian-born North Carolina cardiac surgeon

South Atlantic

Aug. 1979

Cardiovascular Society

Francis Robicsek

The Grand Inquisitor

What kind of "miracle" procedure is this?

- *If 1 out of every 5 patients needs to be operated on*
- *If balloons cannot be advanced in 1 out of 3 coronary arteries*
- *If these "balloon jobs" close up again in a matter of time due to restenosis*



Any medication with such a failure rate would be yanked off the market!

Andreas Grüntzig's Responses



1 out of every 5 patients needs to be operated on

Every one of these patients was scheduled for bypass surgery in the first place

Balloons cannot be advanced in 1 out of 3 coronary arteries

Success rates are improving rapidly with refinements in the technique

These "balloon jobs" close up again in a matter of time due to restenosis

Better selection of indications should diminish the restenosis rate

1980

The Choice to Depart for Emory

« I am not happy here. I can use the cath lab only two days a week.

I want to teach the technique, to shepherd it and to become a Professor.

A. Grüntzig

Why don't you come see us and have a look at Emory? »

S. King



A. Grüntzig

S. King

Andreas finally obtained all he needed, whereas he had been rejected and treated like a pariah before

Andreas Grüntzig and Spencer King

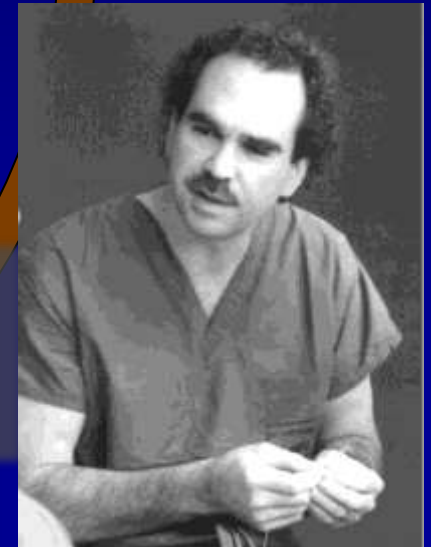
The Emergence of New Competitors

Andreas Grüntzig was trying to prove that coronary dilatation was feasible. His cautious pursuit limited this procedure to only 10 % of patients with coronary artery disease



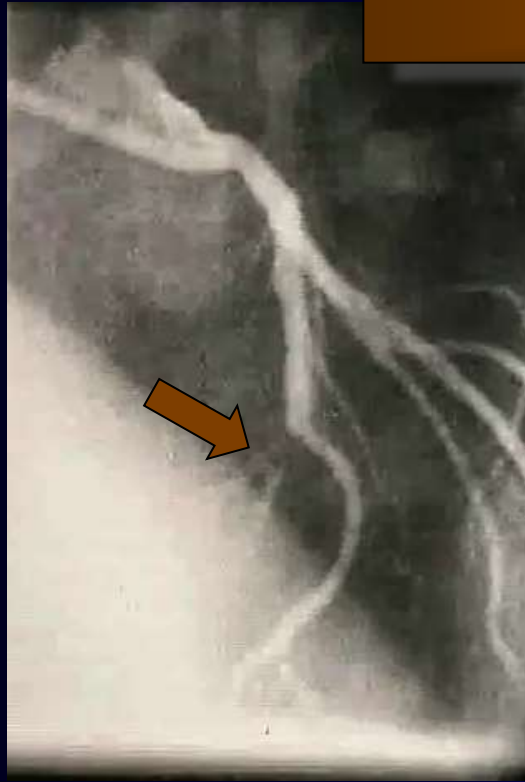
With John Simpson's steerable system, primary success rates increased from 60% to 90%

Geoffrey Hartzler had broken new ground, performing coronary angioplasty on the largest possible number of patients with coronary artery disease



1980

World's 1st Angioplasty for a Myocardial Infarction- Kansas City

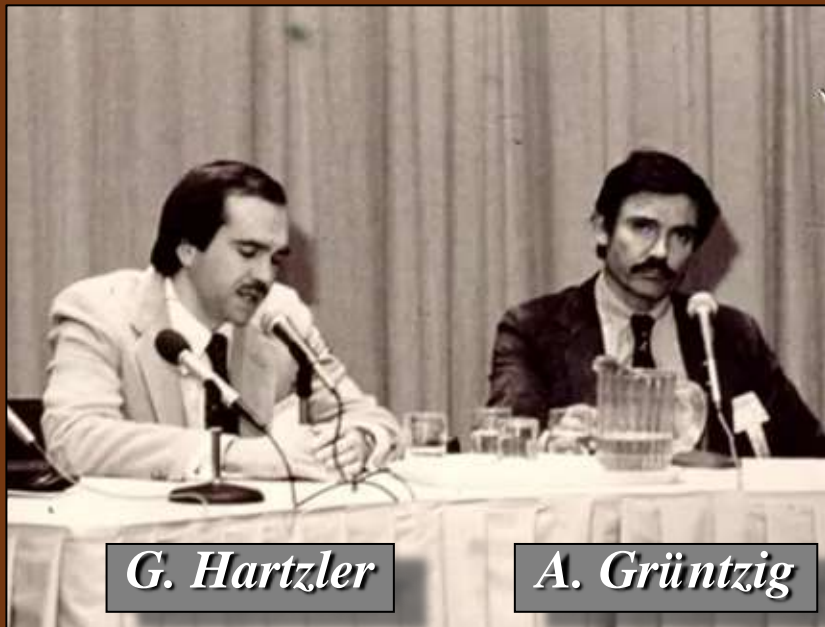


Geoffrey Hartzler

Aug. 1980

Opposing Views on Indications

Andreas was concerned about never putting a patient at risk in order to prove that coronary angioplasty was feasible



G. Hartzler

A. Grüntzig

However, the objective of Geoff was to share it with the largest number of patients possible

In July 1985, Andreas would finally recognize that Geoff's intuition to broaden indications for coronary angioplasty had been the right one

The Fall of Icarus (1985)

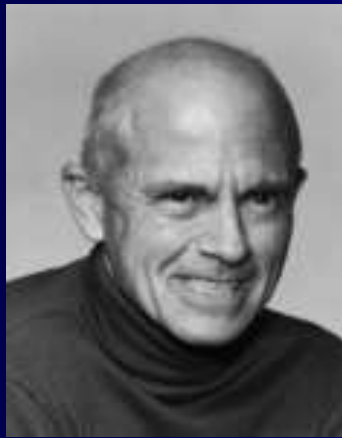


Merry-Joseph Blondel

1985



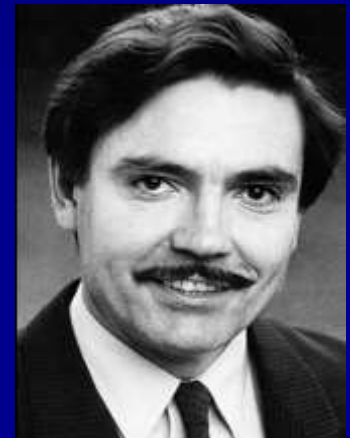
M. Judkins



C. Dotter

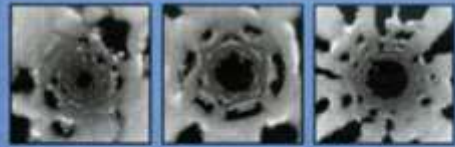


M. Sones



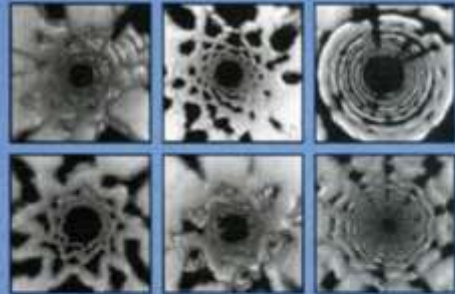
A. Grüntzig

1986–The Times They Are a-Changing



HANDBOOK OF CORONARY STENTS

FOURTH EDITION

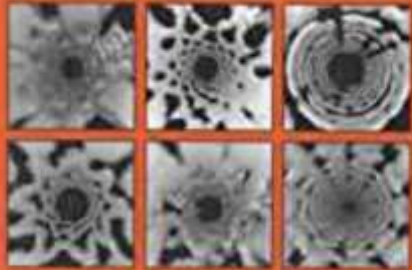


Editors
Patrick W Serruys • Benno J Rensing



HANDBOOK OF CORONARY STENTS

THIRD EDITION

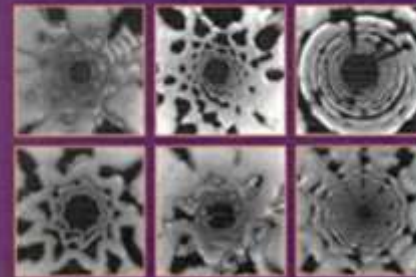


Editors
Patrick W Serruys • Michael JB Kutryk



HANDBOOK OF CORONARY STENTS

SECOND EDITION



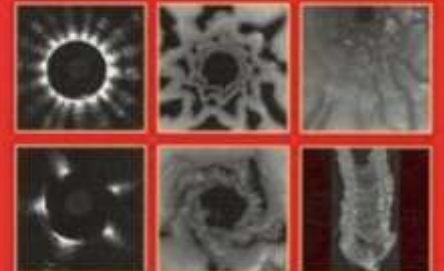
Rotterdam Thrombocenter Interventional Cardiology Group

Editors
Patrick W Serruys • Michael JB Kutryk



CORONARY STENTING CURRENT PERSPECTIVES

A Companion to the
HANDBOOK OF CORONARY STENTS



Editors
Michael JB Kutryk • Patrick W Serruys



Julio Palmaz

The Stent: A Shared Idea, A Breakthrough Device

The History of the Stent

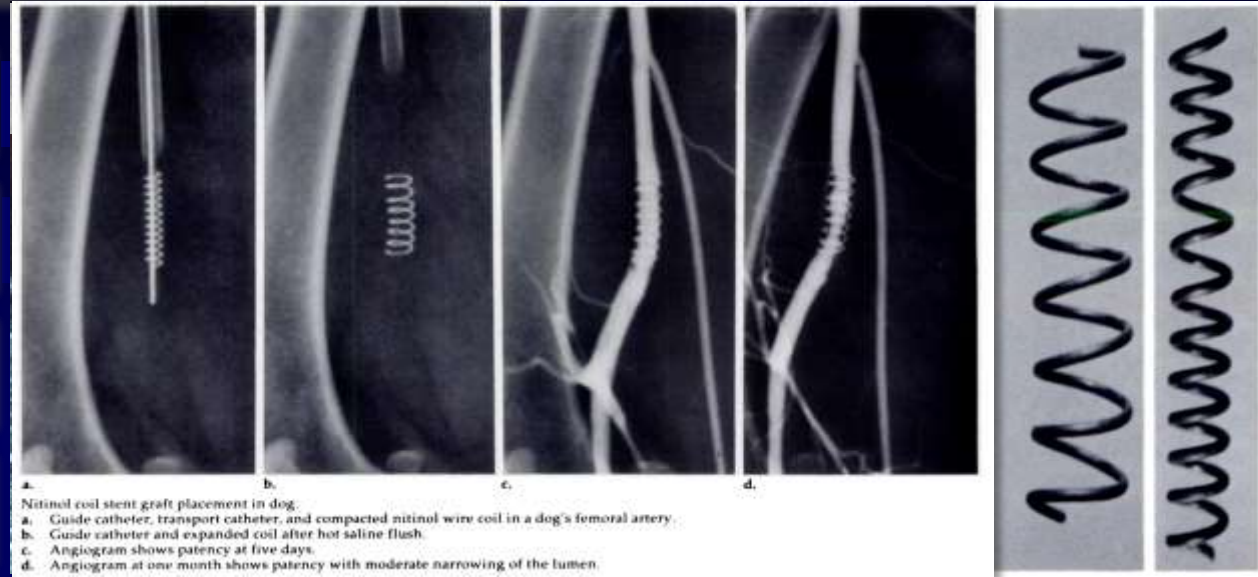
A shared idea

1912 Alexis Carrel

1969 Charles Dotter

1980 Julio Palmaz

1982 Hans Wallsten



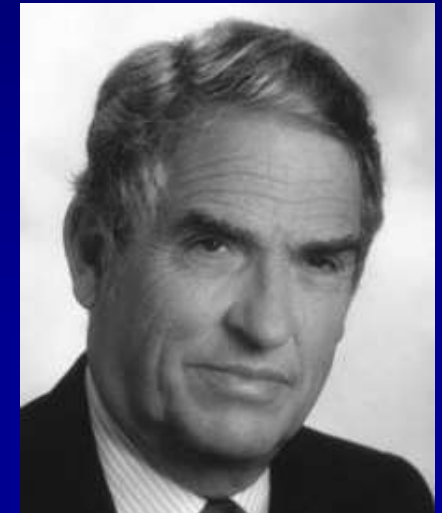
A. Carrel



C. Dotter



J. Palmaz



H. Wallsten

The First Implantations of Coronary Stents

Mar. 28, 1986

Jacques Puel

Restenosis



Jun. 12, 1986

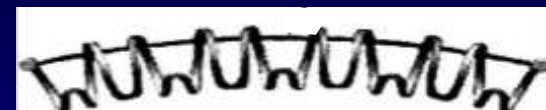
Ulrich Sigwart

Acute occlusion

Sept. 3, 1987

*John Douglas
Gary Roubin*

Bail-out device



Dec. 21, 1987

*Richard Schatz
Julio Palmaz*

Occlusion



J. Puel



U. Sigwart



G. Roubin



R. Schatz

J. Palmaz



Dante
Pazzanese

First Palmaz-Schatz Stent in Human

December 31st, 1987



O paciente:

Jorge Cassiano Jr.

Cardiology team:

Amanda Sousa

J. Eduardo Sousa

Fausto Feres

Julio Palmaz

Ibraim Pinto

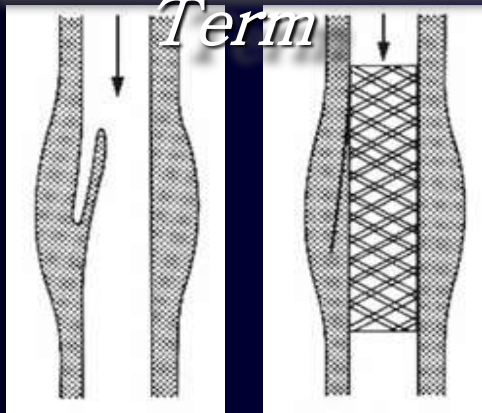
Richard Schatz

Celia Benette

The Bare Metal Stent: To Ensure Coronary Angioplasty

The Short

Term



To avoid dissective occlusion



Risk of sub-acute thrombosis

Full anticoagulation

Arterial access

IVUS

DAPT

Optimal stent implantation



A. Colombo

Ticlopidine



P. Barragan

*Ticlopidine +
Aspirin*



M.C. Morice



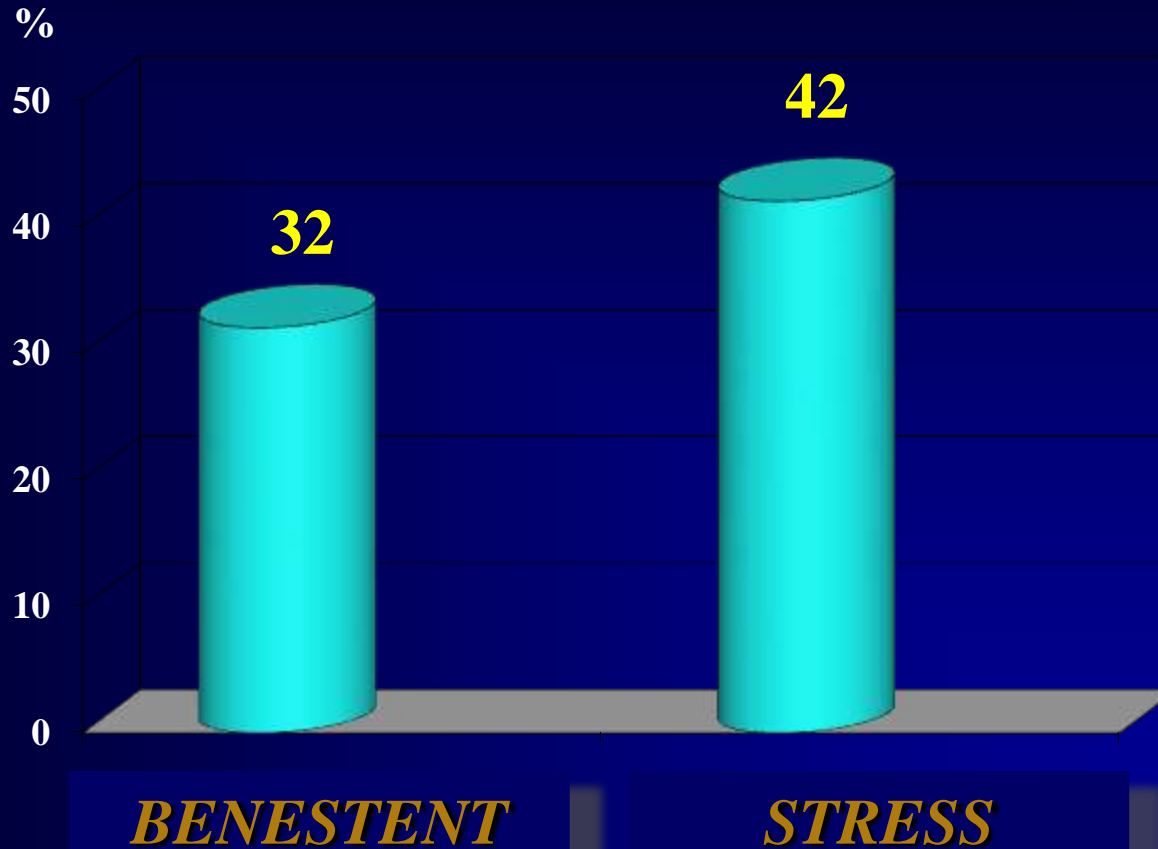
E. Benveniste

The Stent Decreased Restenosis

N = 516

Restenosis at 6 months

N = 407



balloon



P. Serruys



D. Fischman

BELgian NETHERlands STENT study

STent REStenosis Study

Serruys PW. New Engl J Med. 1994;331:489-95.

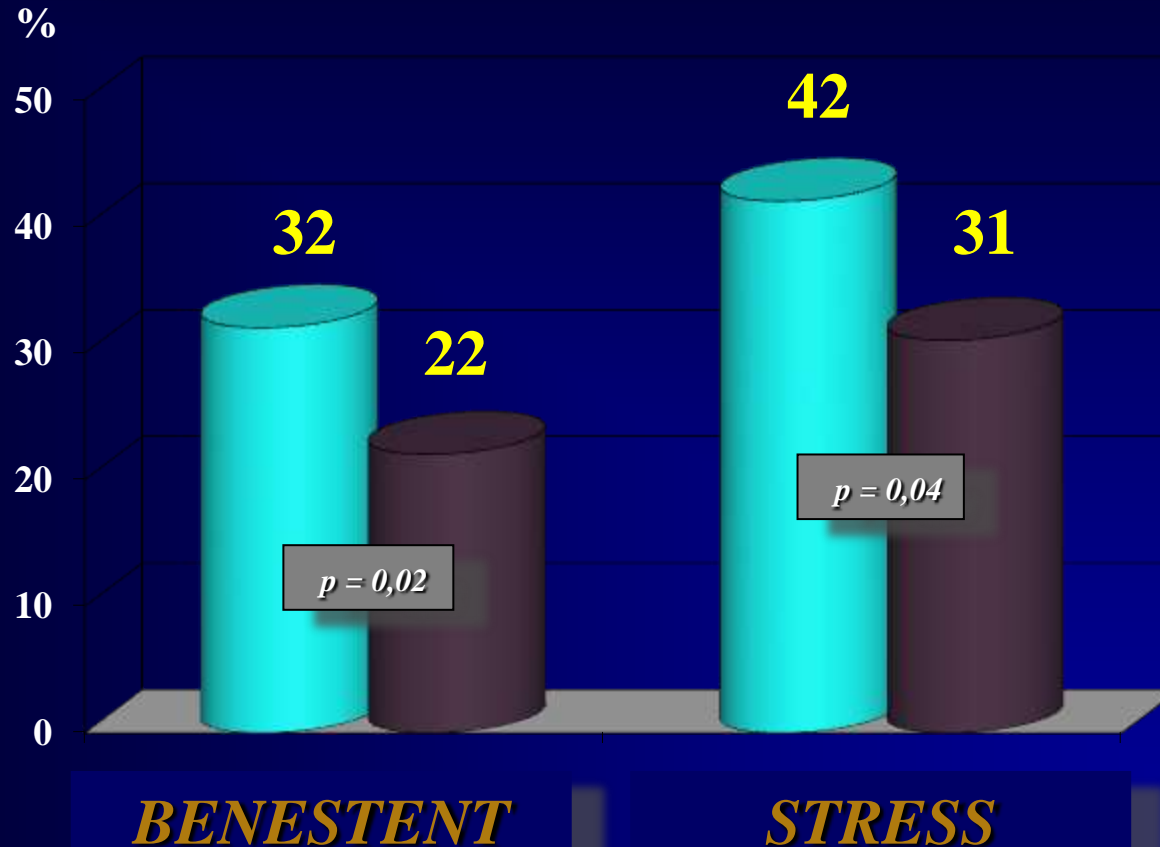
Fischman DL. New Engl J Med. 1994;331:496-501

The Stent Decreased Restenosis

N = 516

Restenosis at 6 months

N = 407



balloon

stent

Palmaz-Schatz



P. Serruys



D. Fischman

BELgian NETHERlands STENT study

STent REStenosis Study

Serruys PW. New Engl J Med. 1994;331:489-95.

Fischman DL. New Engl J Med. 1994;331:496-501

First-In-Man study with the CYPHER stent: Sao Paulo and Rotterdam, 45 pts FUP



The Drug-Eluting Stent Defeated Restenosis

RAVEL

6 months

N = 238



Paolo Uccello

M.C. Morice

*R*andomised study with the sirolimus-coated *Bx-VE*locity balloon-expandable stent in the treatment of patients with *de novo* native coronary artery Lesions.

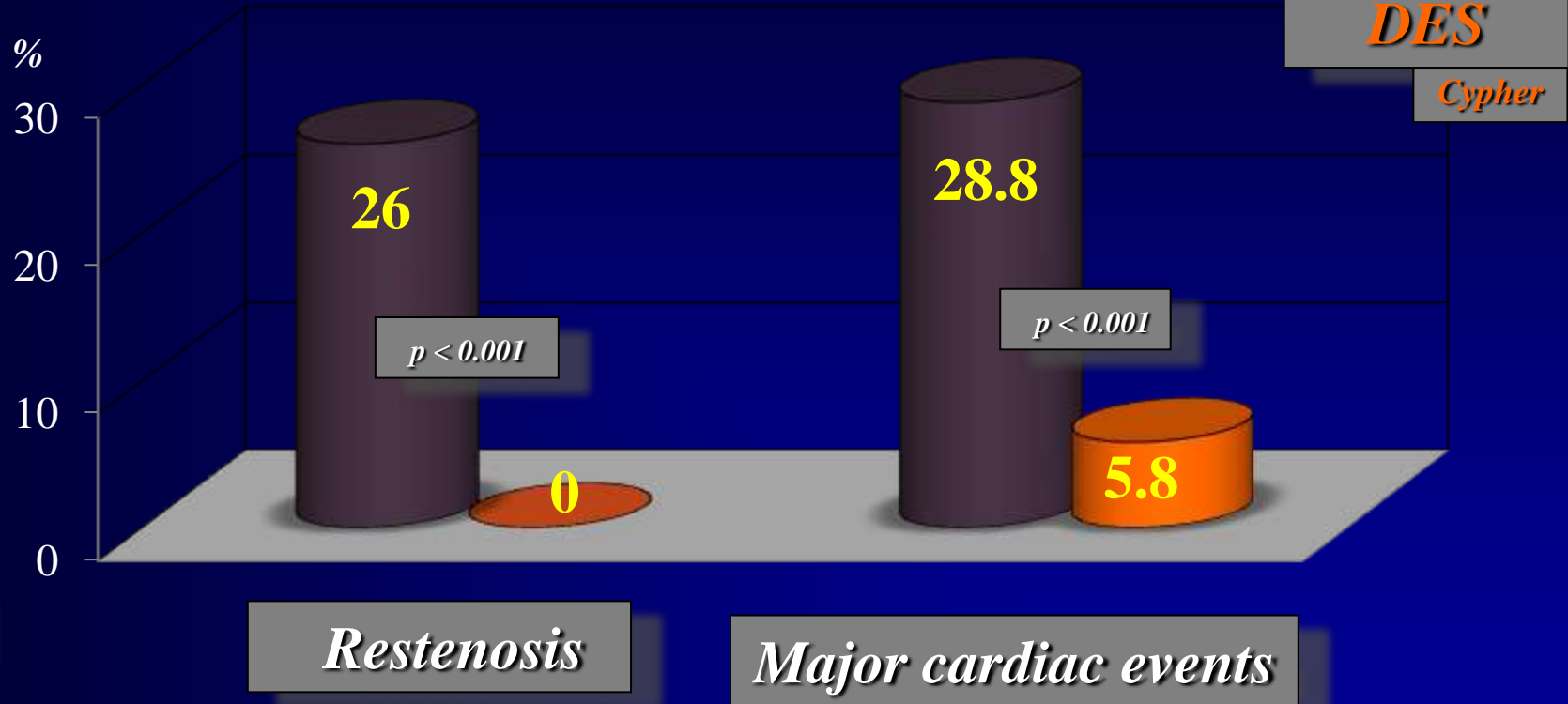
Morice MC Serruys PW. N Engl J Med. 2002;346:1773-80.

The Drug-Eluting Stent Defeated Restenosis

RAVEL

6 months

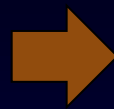
N = 238



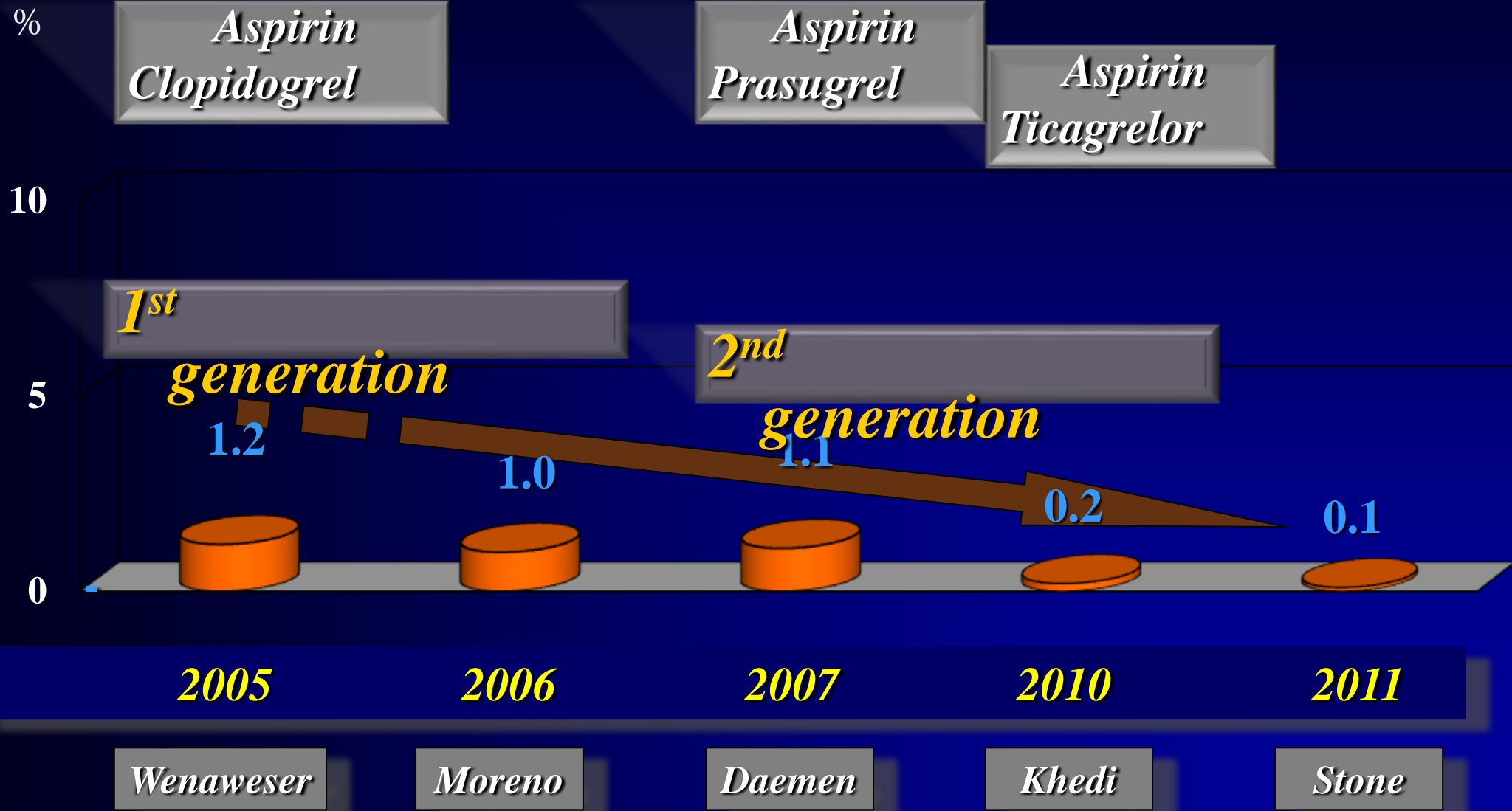
M.C. Morice

RAndomised study with the sirolimus-coated Bx-VELOCITY balloon-expandable stent in the treatment of patients with de novo native coronary artery Lesions.

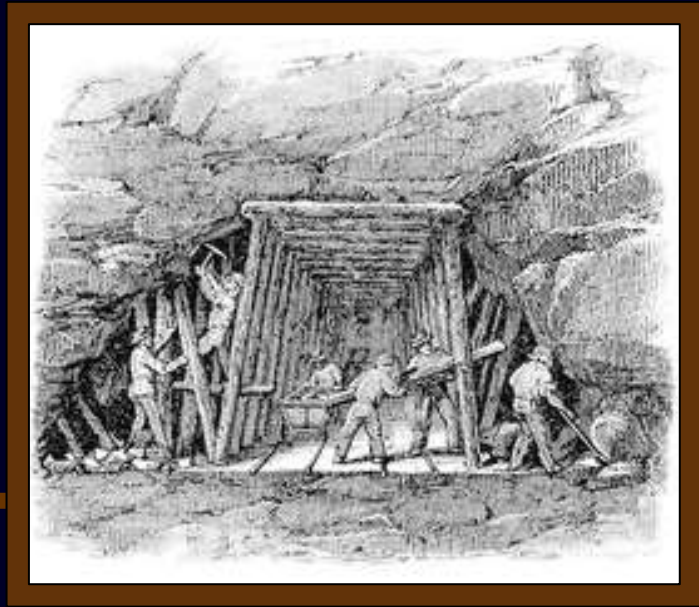
Stent Thrombosis



The Drug-Eluting Stent



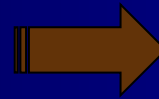
The Bioresorbable Scaffold: the Ultimate Device?



Why a permanent scaffolding?

Uncovering the problem

- *To repair acute dissection*
- *To avoid restenosis*



Scaffold time required

30 mn

6 months

The Bioresorbable Scaffold: the Ultimate Device?



A temporary scaffolding would be preferable



➤ *To eliminate late stent thrombosis*

➤ *To permit shorter DAPT*

➤ *To leave the way open to CABG*

➤ *To reduce iterative revascularization*

which allows recovery of physiological vasomotion of the coronary artery once the healing process is complete

Must be as safe and efficacious as best-in-class DES

The First BRS Implantations

Sept. 1998

First bioresorbable stent

At 5 years

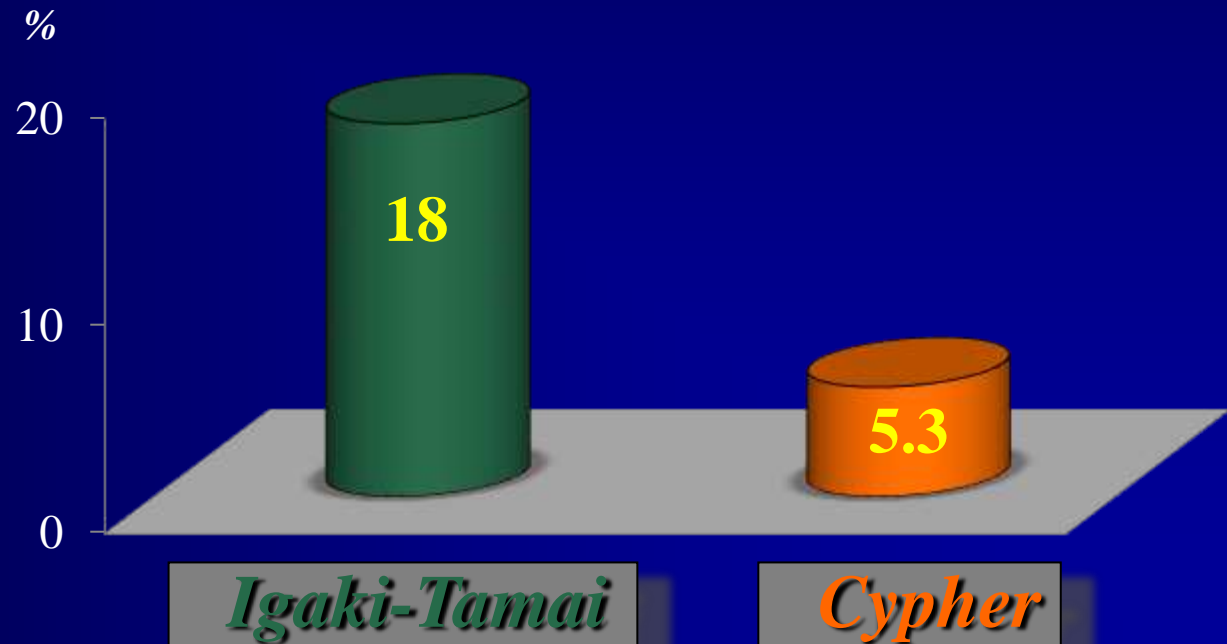
Iterative revascularization



Hideo Tamai

$N = 50$

FIM Cohort



The First BRS Implantations

Sept. 1998

First bioresorbable stent

Mar. 7, 2006

First drug-eluting bioresorbable scaffold



John Ormiston

At 5 years

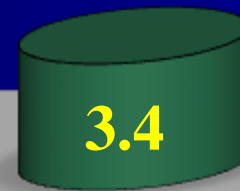
MACE

Thrombosis

%

10

0



3.4

0

Absorb BVS

$N = 30$

ABSORB Cohort A trial

Absorb BVS Failed to Meet Expectations at 3 Years



Xienc

Xienc

N= 166

Target vessel myocardial infarction

Clinically indicated target lesion revascularization

Definitive or probable stent thrombosis

%

8

6

4

2

0

1.2

1.9

0

ABSORB II: Comparison of an everolimus-eluting bioresorbable scaffold with an everolimus-eluting metallic stent for the treatment of coronary artery stenoses

Serruys PW. Lancet. 2016;388:2479-91.

Absorb BVS Failed to Meet Expectations at 3 Years



Xience

N= 166



Absorb

N= 335

Target vessel myocardial infarction

Clinically indicated target lesion revascularization

Definitive or probable stent thrombosis

%

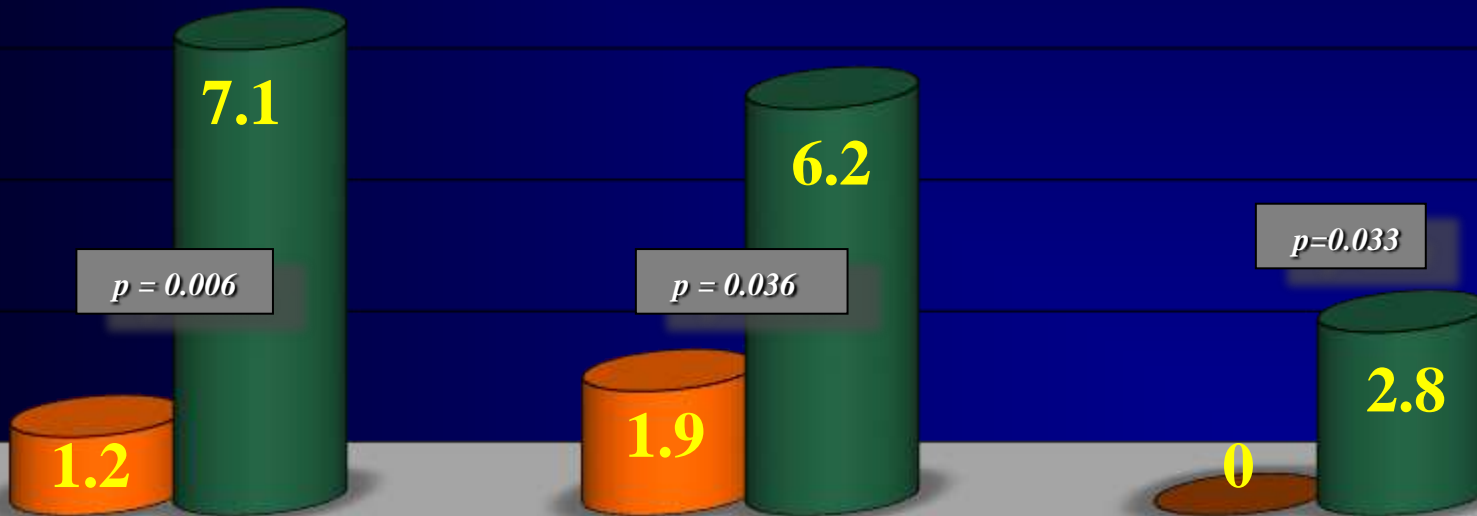
8

6

4

2

0



ABSORB II: Comparison of an everolimus-eluting bioresorbable scaffold with an everolimus-eluting metallic stent for the treatment of coronary artery stenoses

40 Years PTCA – State of the Art

1986

BMS performed better than **balloons** but we still needed balloons to predilate lesions, deliver stents and optimize their implantation



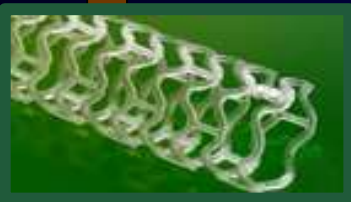
1999

DES performed better than **BMS** for the long term



2006

Although they appear more physiologically appropriate, **BRS** actually do not perform better than **DES**



BRS are currently more difficult to implant with unresolved issues concerning their bioresorption

2017

To treat very complex lesions, we need a perfect device a perfect operator or a perfect **Surgeon**

1977

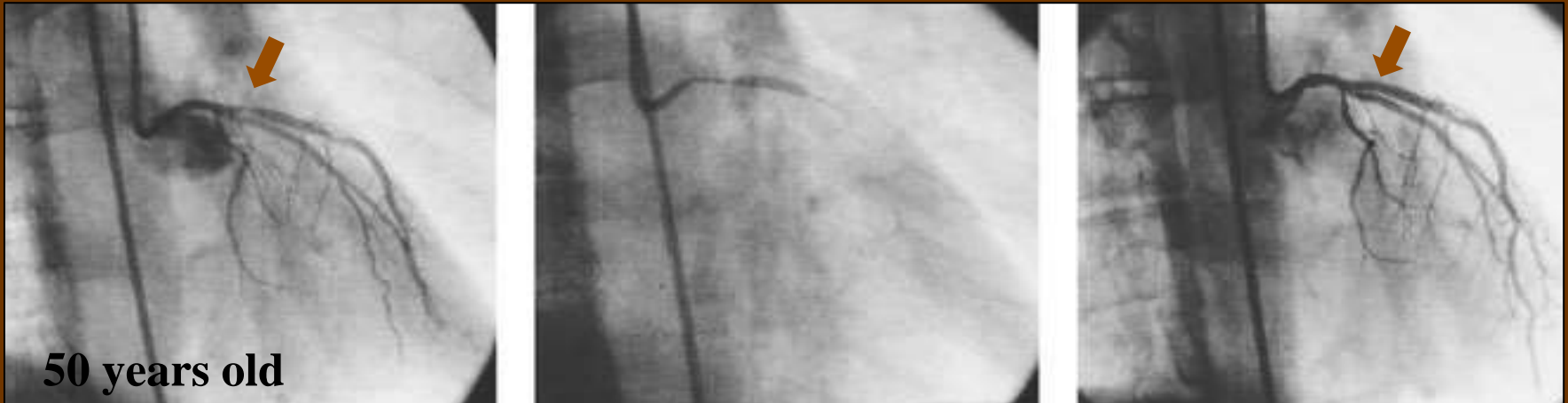


1967

Andreas Grüntzig's Eighth Patient - 24 Year Follow-up



*April
1978*

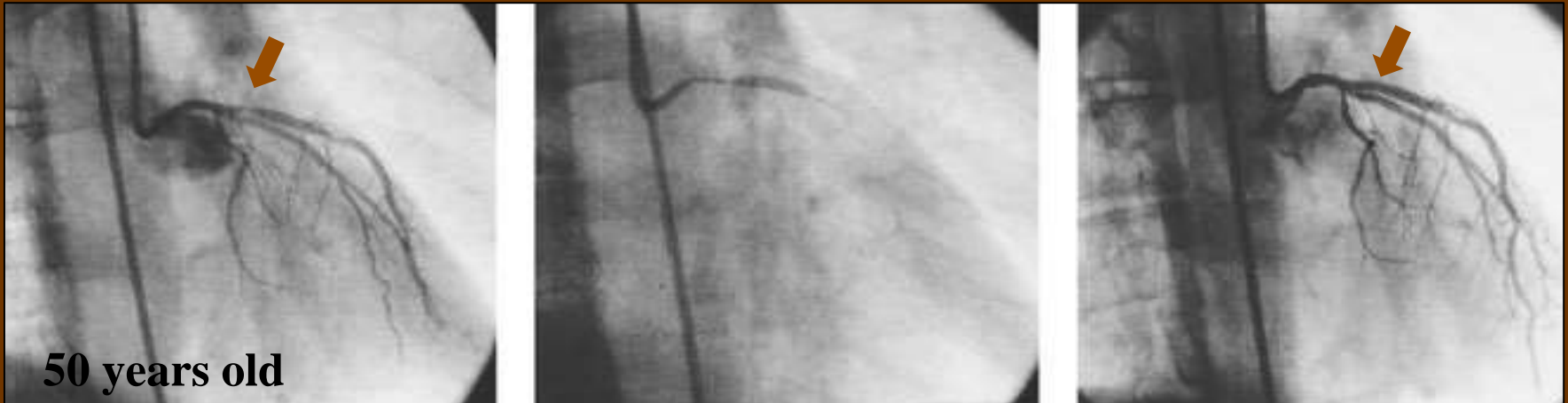


Kapadia SM, Schlumpf M. N Engl J Med. 2004;351:13.

Andreas Grüntzig's Eighth Patient - 24 Year Follow-up

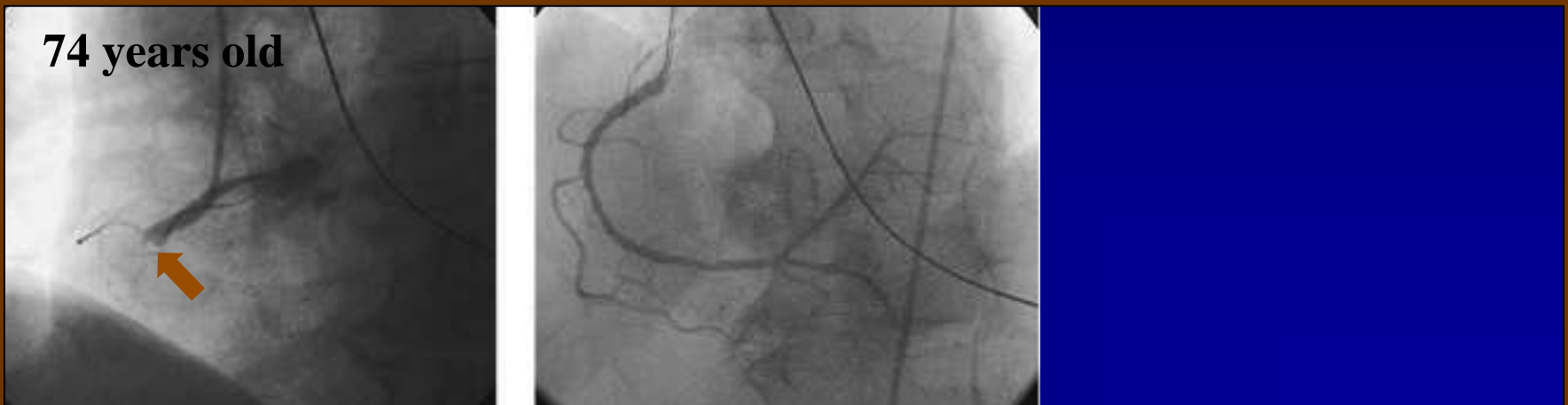


*April
1978*



50 years old

*April
2002*



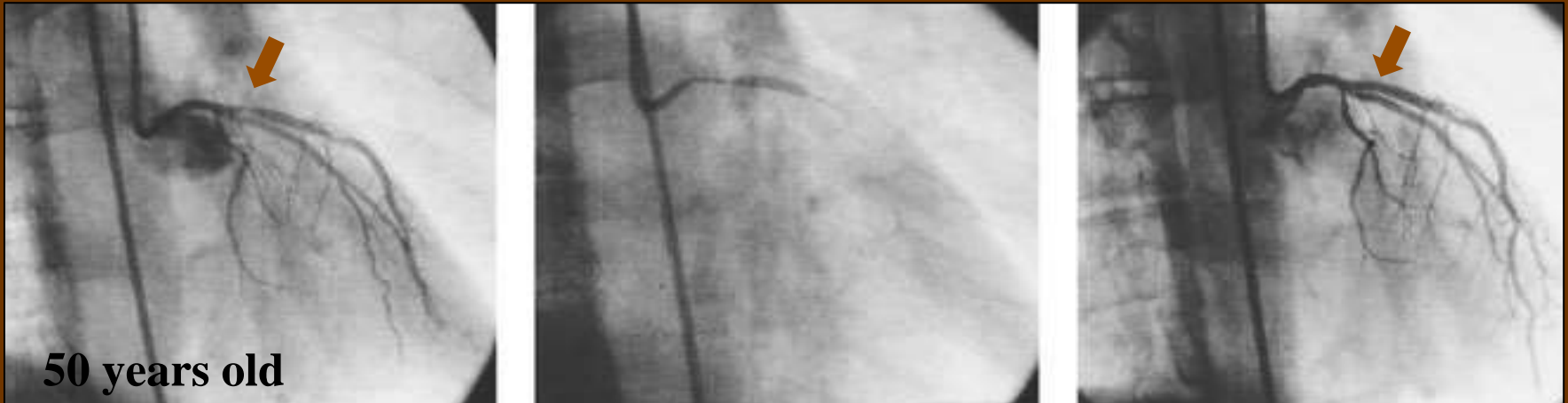
74 years old

Kapadia SM, Schlumpf M. N Engl J Med. 2004;351:13.

Andreas Grüntzig's Eighth Patient - 24 Year Follow-up

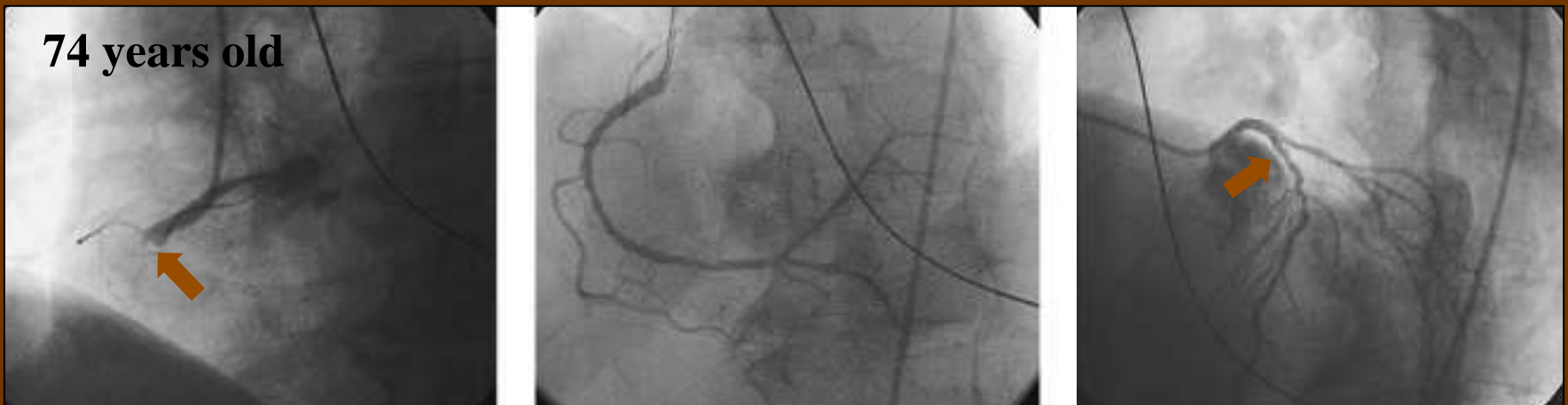


*April
1978*



50 years old

*April
2002*



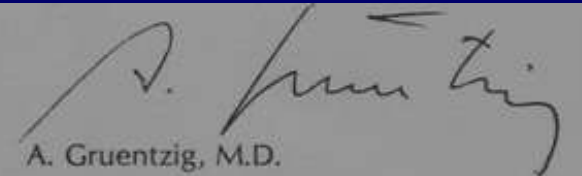
74 years old

Kapadia SM, Schlumpf M. N Engl J Med. 2004;351:13.

Andreas Grüntzig

1939-85

« Whatever becomes of the method, I have left one mark on medicine - I have shown that man can work therapeutically within the coronary arteries in the face of an alert, comfortable patient. »

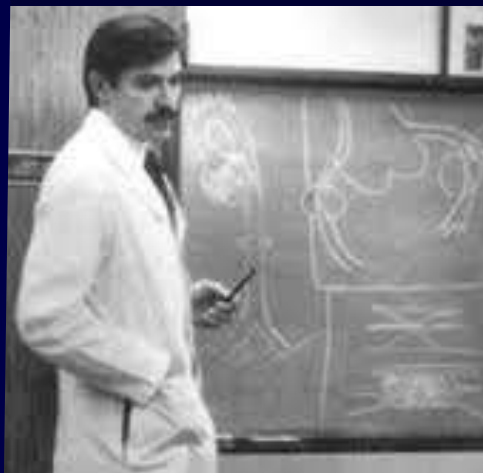

A. Grüntzig, M.D.



*And every time I dilate
a coronary artery,*

I feel like I'm reliving the dream of Andreas...

The Enlightened History of PTCA



A Retrospective Tribute

Andreas Grüntzig (1939-85)



Sep. 16, 1977



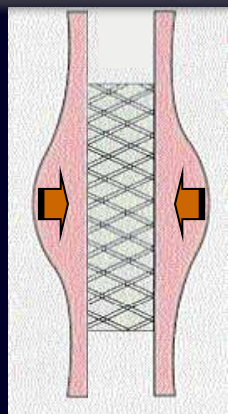
10 years later

The Bare Metal Stent: To Ensure Coronary Angioplasty

The Long Term



To reduce restenosis



Risk of in-stent restenosis

Mechanical treatments

Brachytherapy

Drug-Eluting Stent

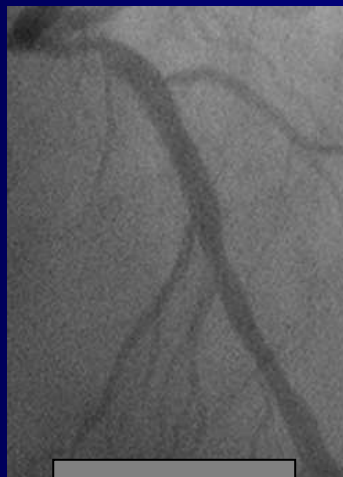
Drug-Coated Balloon



Before



After



10 years

The Drug-Eluting Stent: the end of the restenosis?



E. Sousa

Zurich 1980

The Fall of Icarus



Merry-Joseph Blondel

Pieter Bruegel



*Thank you
for your
attention!*