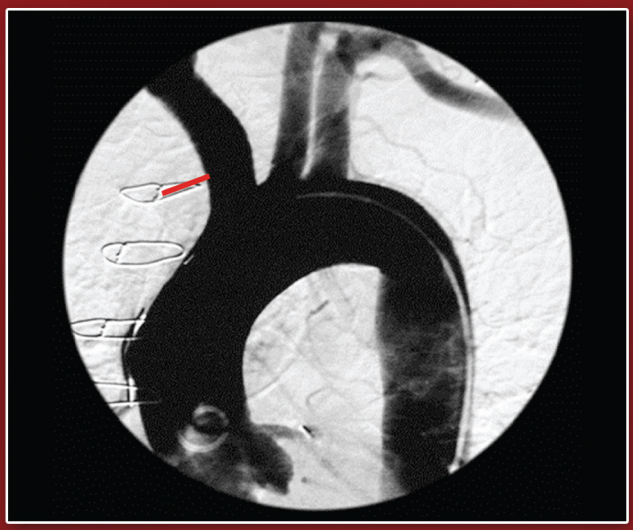
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NIC Handbook of Interventional Cardiology



Praveen Chandra
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JAYPEE

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2

Coronary Guidewires

Rajeev Rathi

Guidewires have been in the picture since the founding days of angioplasty back when Grüntzig used a short guidewire attached to the tip of balloon in 1977. Improving over this large non-maneuverable guidewire, Simpson et al. brought in the concept over-the-wire balloon, which had an independently movable, flexible tipped guidewire installed inside the balloon dilation catheter. Since then rapid advancements have been made in this field. Today, there is a huge array of guidewires to choose from; these guidewires are made of variety of materials each with their own pros and cons.

NEED FOR A CORONARY GUIDEWIRE

Before jumping into the build, make, material and technique of using a guidewire, the interventionalist must first know the true need for it.

- To access all the lesions of coronary artery that includes tortuous arteries, calcified arteries, recent and chronic total occlusions.
- To deliver all the interventional devices inside coronary artery without causing any trauma.

EXPECTED CHARACTERISTICS IN A CORONARY GUIDEWIRE

Torque control	The ability to transmit rotational force from proximal end to distal end of guidewire.
Trackability	The ability of wire to follow the wire tip around curves and bends without buckling or kinking.
Steeribility	The ability of guidewire tip to be delivered to the desired position in a vessel.
Flexibility	The ability to bend with direct pressure.
Prolapse tendency	Tendency of the body of a wire not to follow tip around the bends.

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Tactile feedback	The tactile sensation on proximal end of a guidewire that tells the physician, what the distal end of guidewire is doing.
Crossing	The ability of a guidewire to cross lesion with little or no resistance.
Support	The ability of a guidewire to support a passage of device or system over it

COMPONENTS OF GUIDEWIRE

Core element (usually stainless steel/or nitinol):

- Gives the stability and steerability to the guidewire
- Affects the flexibility, support, steering and trackability of the wire
- Tapers at variable points towards wire tip to impart differential stiffness along wire's length.

Distal tips, coil, and covers segment (often 30 mm length; usually radio-opaque material, e.g. platinum/iridium alloys): Gives flexibility and allows wire tip to be shaped per operator requirements.

Coating: Most wires—silicone/Teflon outer coating to aid easy advancement. Some coated with a hydrophilic polymer coating that turns into gel when wet, to reduce surface friction and increase wire "slipperiness".

Core Element

It can be of stainless steel, durasteel, nitinol or composite.

Stainless steel (Table 1)

Durasteel: High tensile strength than stainless steel, better tip shape retention and durability

Nitinol (BMW) (Table 2)

Composite core design: Terumo Runthrough (prox stainless steel and distal nitilol)

The core of a guidewire usually is tapered along its length. The tapering may have variable length, and it may be either continuous or segmental (Figs. 1A and B).

Distal Tip

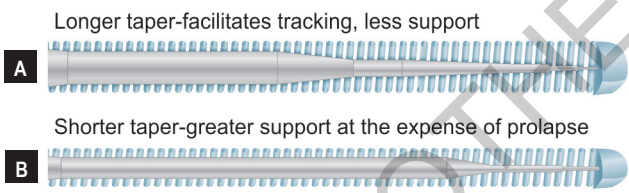
Tip is the distal end of a guidewire. The most commonly used wires have a *one-piece core or core-to-tip design* (Fig. 2A).

TABLE 1: Stainless steel

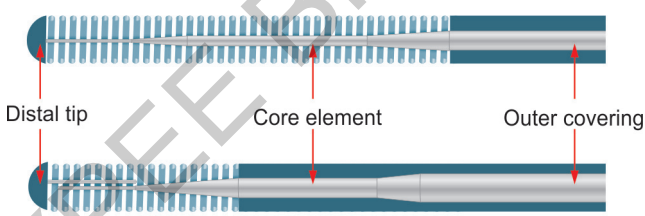
Pros	Cons
1. Superior torque characteristics, can deliver more push, provides good shapeability of tip in core-to-tip design wires. 2. Provide excellent support, transmission of push force and torque characteristics.	1. Less flexible in comparison to newer core materials. 2. More susceptible to kinking.

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TABLE 2: Nitinol (BMW)	
Pros	Cons
1. Super-elastic alloy of nickel and titanium designed for resiliency and kink resistance 2. Pliable but supportive 3. Generally considered kink resistant & have a tendency to return to their original shape, potentially making them less susceptible to deformation during prolonged use. 4. Can be used for treatment of multiple lesions and lesions with tortuous anatomy.	1. Provides less torque control than stainless steel.



Figures 1A and B: Core element tapering



Figures 2A and B: Different Distal tip design

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These wires have precise steering and tip control, a soft tip to minimize vessel trauma and necessary stiffness for crossing resistant lesions.

In a *two-piece or shaping ribbon design*, the core stops just short of the distal tip. A small piece of metal (a shaping ribbon) bridges the gap between the end of the core and the distal tip (Fig. 2B). This results in a very flexible, soft, atraumatic tip with easy shaping and good shape retention. Compared to other designs, these wires have less reliable torque control and higher the likelihood to prolapse.

Coating

Coating is the outer covering on the core that keeps overall diameter consistent and influences the wire performance. It affects the lubricity and tracking of guidewire.

Most often coating is applied to the distal 30 cm of the wire.

Two types of coatings are used:

Hydrophilic coatings: These upon contact with liquids, such as saline or blood transform into a slippery gel-like surface that provides the advantage of

- ↓friction ($^{1/6}$ V/S no coating) →glide through tortuous
- ↑trackability
- ↓Thrombogenic
- ↓Tactile feel ↑risk of dissection, subintimal tracking, perforation.

Hydrophobic coatings: These are silicone-based coatings, which repel water and are applied on the working length of the wire, except the distal tip.

- ↓ Friction (to ½ V/S no coating)
- ↑ Trackability
- Preserves tactile feel, allows easier anchorability/parking especially CTO

GUIDEWIRE PERFORMANCE

The suitability of a particular wire to different clinical situations depends on its performance characteristics, which are determined by variations in the guidewire components. The main performance characteristics of the guidewires are flexibility, torque control, steerability, trackability, crossing, radiopacity, lubricity, lubricity retention, tip shape retention, support, tactile feedback, pushability and prolapse tendency.

GUIDEWIRE CLASSIFICATION

Guidewires are classified based on various properties:

- *Tip flexibility*: It is determined by force needed to bend a wire when exerted on a straight guidewire tip, at 1 cm from the tip (tip load).
  - Floppy (soft) <0.5 g
  - Balanced 0.5–0.9 g
  - Stiff - >0.9 g
- Shaft support
  - Light
  - Moderate
  - Extra
- Coating
  - No coating
  - Hydrophilic
  - Hydrophobic
- Clinical situations
  - Workhorse wire (Frontline)
  - Cases requiring extra support
  - For CTO

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- Others Pressure wire
  - Marker wire
  - Rotablator wire
  - Wiggle wire

SELECTION OF A GUIDEWIRE

Guidewire selection is influenced by:

- Vessel anatomy
- Lesion morphology and
- Devices to be used.

But in real life scenario, the guidewire selection is based upon operator's experience and preference.

COMMONLY USED GUIDEWIRES

Workhorse or Frontline Guidewire

It is a good general practice to use the same coronary guidewire for majority of cases, which is fondly called the workhorse guidewire. In doing so, the operator becomes very familiar with the characteristics of the wire, and becomes very sensitive to any changes in the behavior of the wire. In general, a flexible wire with a floppy tip that does not have a hydrophilic coating is a good choice as a workhorse guidewire. One should be able to cross 90% of lesions with such a workhorse guidewire (Fig. 3).

Frontline or workhorse wires:

- BMW/BMW Universal
- ATW/ATW Marker
- Stabilizer
- Zinger
- Cougar XT
- Asahi Light/Medium
- Asahi Standard
- Choice Floppy

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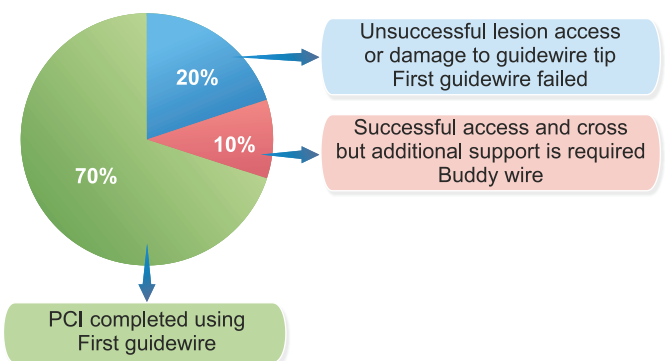


Figure 3: Percentage of PCI completed using 1st guidewire selected

- Luge
- Forte Floppy
- Runthrough NS
- Galeo

Floppy Guidewires

- Whisper
- Pilot
- Wizdom/Wizdom ST
- Reflex
- Cougar LS
- Zinger Light/Zinger Marker
- In - Silk
- Rinato
- Wiggle

Guidewires with Extra Support

Extra Support Guidewire	*Super Extra Support Guidewire*
• BHW • Stabilizer Plus/Stabilizer XS • Zinger Support • Thunder • Choice Extra support • Forte Extra support • All Star	• Asahi Grand Slam • Iron Man • Mail Man • Platinum Plus

Guidewires for CTO

Desired features in a CTO guidewire:

- Penetration force for penetrating proximal fibrous cap and advancing into true lumen.
- Pushability for crossing chronic occlusions and complex lesions with heavy calcifications and tough fibrous tissues (Table 3).

TABLE 3: Guidewires used for crossing chronic total occlusion lesions

Guidewires for Approaching Micro-channels	*Guidewires for Drilling Strategy*	*Guidewires for Penetrating Strategy*	*Guidewires for Retrograde Technique*
Crosswire NT Whisper/Pilot Rinato Shinobi/Shinobi Plus ChoICE PT/ ChoICE PT ES PT Graphix PT2	Persuader Miracle Bros Cross-IT	Cross-IT Conquest Pro Liber 8	Fielder/Fielder FC X-treme Whisper ChoICE PT2 Runthrough/ Runthrough Hypercoat

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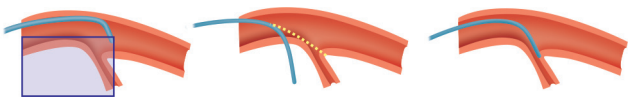


Figure 4: CTO, the lumen diameter = 0 mm. For CTO lesion, guidewire-tip curve should be very small. Large curve may hurt the vessel wall during direction control.

- Steerability for easy manipulation in various directions with good torque transmission.
- Shaping memory of the tip.

GUIDEWIRE MANIPULATION: A 2-STEP PROCESS

Shaping the Wire Tip

A bend at the tip of guidewire allows it to be manipulated atraumatically. The shaping can be done either by index finger and thumb or with the help of guidewire introducer or a needle. It should be done using minimal force in order to avoid damaging the structure of guidewire. Shaping the guidewire tip is important for both steering into the vessel/branch that is to be accessed and for visualization of torquing efforts. Tip curve should be just larger than lumen diameter. If the distal bend is too small, steerability will be limited. On the other hand, if the distal bend is too large, the wire will have tendency to prolapse.

Steering the Wire through the Vessel

Small clockwise and anticlockwise turns of proximal end of guidewire result in left and right movement of distal tip. With this technique, one can direct the wire tip away from unwanted side branches and remain within the main branch. The ideal wire can maintain 1:1 torque response. Torque response is especially important in tortuous vessels.

Free wire tip movement indicates that the wire is in the lumen of vessel. However, excessive rotations should be avoided to prevent wire tip fracture (Fig. 4).

Box 1: Strategies that can be used if the guidewire fails to cross the lesion

- Adjust the guide so that it is more coaxial with the lumen of the artery.
- Use a balloon, transit, ultrafuse or twin pass catheter to direct the wire in a more favorable direction.
- Modify the bend at the tip of the wire. In tortuous segments, a more proximal secondary bend approximating shape the artery may be required.
- Change the wire.

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Box 2: Important tips in advancing the coronary guidewire

- Avoid bending or buckling the wire. Buckling or bending of the wire can be a sign of a subintimal position.
- Never push a wire if undue resistance is felt.
- A ventricular premature beat could be a suggestion that the wire is too distal or has perforated the artery. Check the position of the wire in the presence of Ecotopic beat.
- Be vigilant for coronary perforation when hydrophilic wires are used.
- Once one crosses the lesion with the hydrophilic wire, consider switching out for a non-hydrophilic wire.
- If there is a suspicion of a perforation, then an emergent Echo should be performed immediately while the patient is on the table.

CONCLUSION

Handling of guidewire is a crucial step for successful angioplasty. Understanding of basic structure of wire helps the interventionalist in selection of wire. It is more rational to

TABLE 4: List of some wires from different companies

ABBOTT WIRES	CORDIS WIRES
Asahi Family of Wires • Asahi by Abbott vascular • ASAHI Confianza Coronary Guide Wires • ASAHI Grand Slam Coronary Guide Wires • ASAHI Light Coronary Guide Wires • ASAHI Medium Coronary Guide Wires • ASAHI Miracle Bros Coronary Guide Wires (3g, 4.5g, 6g and 12g) • ASAHI Prowater Coronary Guide Wires • ASAHI Prowater Flex Coronary Guide Wires • ASAHI Standard Coronary Guide Wires • Balance Wires by Abbott Vascular • BALANCE (HI-TORQUE BALANCE Coronary Guide Wire) • BALANCE (HI-TORQUE BALANCE MIDDLEWEIGHT UNIVERSAL Coronary Guide Wire) • HI-TORQUE CROSS-IT XT Coronary Guide Wires by Abbott vascular • 100 XT • 200 XT • 400 XT	• ATW™ All Track Wire • ATW™ Marker Wire • WIZDOM® Steerable Guidewires • WIZDOM® ST Steerable Guidewires • STABILIZER® Balanced Performance Steerable Guidewires • STABILIZER® Plus Steerable Guidewires • STABILIZER® XS Steerable Guidewires • STABILIZER® Marker Wire • SHINOBI® Steerable Guidewires • SHINOBI® Plus Steerable Guidewires • REFLEX® Steerable Guidewires **BOSTON WIRES** • Choice PT • Choice PT extra support • Luge **MEDTRONIC WIRES** • Cougar • Zinger • Persuader • Thunder

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focus on a few selected guidewires and to understand their properties rather than trying to use all of them or one might end up being jack of all and master of none.

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NIC Handbook of Interventional Cardiology

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