



## Editorial

## Language of CTO interventions – Focus on hardware



## A B S T R A C T

*Keywords:*

CTO  
PCI  
Hardware  
Guidewire  
Tip load  
Sion  
Fliedler  
Gaia  
Miracle  
Conquest  
RG3  
Finecross  
Corsair  
Tornus  
Crusade  
Turnpike  
CrossBoss  
Stingray  
Navifocus  
Opticross

The knowledge of variety of chronic total occlusion (CTO) hardware and the ability to use them represents the key to success of any CTO interventions. However, the multiplicity of CTO hardware and their physical character and the terminology used by experts create confusion in the mind of an average interventional cardiologist, particularly a beginner in this field. This knowledge is available but is scattered. We aim to classify and compare the currently used devices based on their properties focusing on how physical character of each device can be utilized in a specific situation, thus clarifying and simplifying the technical discourse.

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**1. Introduction**

Interventions in chronic total occlusion (CTO) represent a niche area of percutaneous coronary interventions (PCI). The essential difference lies in the character of the lumen which is occluded in CTO PCI (versus patent in a garden variety of PCI). This difference culminates into not only increased complexity and difficulty of the procedure but also makes it more prone to complications. Clearly the niche area requires an optimal utilization of a broader range of hardware. Thus for a regular PCI only few hardware and their use need to be known. On the other hand if CTO PCI is to be undertaken, Knowledge of a whole gamut of accouterment need to be acquired (both their characteristics and utilization) and their use mastered. In general guidewires are the key to success of any CTO procedure but additionally knowledge and handling of several other devices needs to be perfected.

**2. Guidewires**

Depending on its construction guidewires have different properties which can be used to an advantage in different situations.<sup>1,2</sup>

**2.1. Penetrability**

Penetrability is the ability to puncture a lesion, the stiffer the lesion the more penetrability is required; wire in the

lumen < micro-channel < lipid plaque < proteoglycan < collagen/elastin < calcium. The penetrability depends on:

- (1) Tip load
- (2) Tapered tip
- (3) Wire support (micro-catheter/OTW Balloon, anchoring techniques, child-in-mother catheter)
- (4) Lateral support of the wire

**2.2. Pushability**

Pushability is the amount of force needed to advance the wire or the ease of advancing the wire once it has penetrated a lesion. Pushability depends on (a) the characteristic of the tissue a wire has to traverse as well as the (b) length of the tissue to be traversed along the CTO. This feature is determined by the lateral support provided by the wire.

**2.3. Trackability**

Trackability is the ability of the device to track over a guidewire during insertion especially around bends. This feature is determined by the lateral support provided by the wire.

**2.4. Torquability**

1:1 transmission of bend.

**Table 1**  
Properties of guidewires.

Wire	Core	Tip	Tip coat	Tip dia	Tip load (g)	Polymer coating	Radio-opaque length (mm)	Lat supp at 155 mm	Penetrating power: tip load/area of tip (kg/m <sup>2</sup> )	Comments
Sion Blue	High tensile steel	Dual-core coil, 200 mm	Hydrophilic	O14	0.5	No	30			Lowest tip load
Sion Black	High tensile steel	Dual-core coil, 200 mm	Hydrophilic	O14	0.8	Yes, 200 mm	30			Dual-core, polymer coated
Gaia First	Stainless steel	Composite core, Micro-cone tip	Hydrophilic	O10		No	150			Torqueable wire, main feature is composite coil with a central core wire, wrapped by six acetone wires, with spring coil in periphery
Gaia Second	Stainless steel	Composite core, Micro-cone tip	Hydrophilic	O11		No	150			
Gaia Third	Stainless steel	Composite core, Micro-cone tip	Hydrophilic	O12		No	150			
Whisper MS	High tensile steel (Durasteel)	45 mm coil	Hydrophilic	O14	1	Yes, 290 mm	30			
Pilot 150	High tensile steel (Durasteel)	45 mm coil	Hydrophilic	O14	2.7	Yes, 290 mm	30	8 (9)		
Pilot 200	High tensile steel (Durasteel)	45 mm coil	Hydrophilic	O14	4.1	Yes, 290 mm	30	8 (9)		
Fielder FC	Stainless steel	110 mm spring coil	Hydrophilic	O14	0.8	Yes, 220 mm	30	9 (15)		
Fielder XT	Stainless steel	110 mm spring coil	Hydrophilic	O09	0.8	Yes, 220 mm	160	9 (15)	19	
Fielder XT-R	Stainless steel	Composite coil, 160 mm	Hydrophilic	O10	0.6	Yes, 170 mm	160			Fielder family but composite coil
Fielder XT-A	Stainless steel	Composite coil, 160 mm	Hydrophilic	O10	1	Yes, 170 mm	160			Fielder family but composite coil
Crosswire NT	Nitinol	Polyurethane + tungsten in polymer coil	Hydrophilic	O14	4	Yes	40			
Choice PT	Unibody stainless steel	No coil	Hydrophilic	O14	2.1	Yes, 380 mm	350	Light		
PT Graphix	Unibody stainless steel	No coil	Hydrophilic	O14	1.7	Yes	30			
Cross IT 100	Stainless steel	300 mm coil	Hydrophilic	O105	1.7	No	30	24 (30)	20	
Cross IT 200	Stainless steel	300 mm coil	Hydrophilic	O105	4.7	No	30	24 (48)	54	
Cross IT 300	Stainless steel	300 mm coil	Hydrophilic	O105	6.2	No	30	24 (40)	72	
Cross IT 400	Stainless steel	300 mm coil	Hydrophilic	O105	8.7	No	30	18 (64)	101	
Miracle Brothers 3	Stainless steel	110 mm spring coil	Hydrophobic	O14	3.9	No	110	23 (60)	32	
Miracle Brothers 4.5	Stainless steel	110 mm spring coil	Hydrophobic	O14	4.4	No	110	23 (60)	36	
Miracle Brothers 6	Stainless steel	110 mm spring coil	Hydrophobic	O14	8.8	No	110	23 (60)	106	
Miracle Brothers 12	Stainless steel	110 mm spring coil	Hydrophobic	O14	13	No	110	23 (60)		
Conquest 9	Stainless steel	200 mm coil	Hydrophobic	O09	8.6	No	200	7 (10)	135	
Conquest 12	Stainless steel	200 mm coil	Hydrophobic	O09	12	No	200	7 (10)		
Conquest Pro 9	Stainless steel	200 mm coil	Hydrophilic	O09	9.3	No	200	7 (10)	146	Distal most 1 mm of tip is uncoated
Conquest Pro 12	Stainless steel	200 mm coil	Hydrophilic	O09	12	No	200	7 (10)	195	Distal most 1 mm of tip is uncoated
Conquest Pro 8-20	Stainless steel	200 mm coil	Hydrophilic	O08	20	No	200			Highest penetrating wire
RG3	Stainless steel	80 mm platinum coil	Hydrophilic	O10	3	No	30			For externalization

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