Crossing Techniques for Calcified CTOs

Andrew Holden
Auckland, New Zealand
Disclosure

Speaker name:

Andrew Holden

I have the following potential conflicts of interest to report:

☐ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)

☒ I do not have any potential conflict of interest
Calcification in Lower Limb Arterial CTOs

- ~40% of patients treated for PAOD have CTOs\(^1\)
- Nearly 40% of CTOs require adjunctive technology for crossing\(^2\)
- 40-50% of CTOs are associated with significant calcification\(^3\)
- Revascularization of heavily calcified CTOs fails in > 20% of cases
- Calcified CTOs are associated with higher complications – failed procedure, dissection, perforation, distal embolization, inadequate dilatation, stent recoil

2. 2010-2011 Global PI Tracking Study; US physicians
Calcification in Lower Limb Arterial CTOs

- Successful endovascular treatment of calcified CTOs requires 2 important steps:
  - Crossing the CTOs
  - Re-entry into the distal true lumen

- Both steps are influenced by the type of calcification
Types of Calcification in PAOD

- Classified as intimal and medial calcification but often mixed

- Intimal calcification is much more common, strongly associated with atherosclerosis, eccentric and often bulky

- Medial calcification often concentric and linear, may be idiopathic but also associated with diabetes mellitus, CRI. Tibial medial calcification associated with 3 fold increased risk of amputation!
Crossing Calcified CTOs

- Antegrade *sub-intimal* hydrophilic guidewire crossing should be initially attempted in patients with extensive *intimal* calcification

- The sub-intimal space is relatively healthy and a hydrophilic guidewire will usually pass into it

- Successful crossing often required support catheter and balloon dilatation

- Use robust 0.035” guidewires and 5F catheters!
Antegrade *intraluminal* crossing should be initially attempted in patients who have failed a sub-intimal approach and patients with dominant *medial* calcification.

- Hydrophilic guidewires are unlikely to cross the fibro-calcific proximal cap in these calcified CTOs.
- Weighted tip CTO wires and support catheters are usually required.
Crossing Calcified CTOs

- Many CTO wires with various weighted tips and support catheter combinations available
- Important to gain experience with 1-2 systems

**CTO Guidewires**
- Victory (Boston Scientific)
- Miracle (Asahi)
- Winn (Abbott)

**Support Catheters**
- Rubicon (Boston Scientific)
- Quick Cross (Spectranetics)
- CXI (Cook)
- Seeker (Bard)
- Trailblazer (Covidien)
- NaviCross (Terumo)
Intraluminal Recanalization Devices

- Multiple devices are available
- All devices perform less well in heavy calcification and none are specifically designed for the calcified CTO

Wildcat Catheter (Avinger)

Crosser™ CTO Catheter (Bard)

TruePath™ CTO Device (Boston Scientific)

Excimer Laser (Spectranetics)
Multiple devices are available

All devices perform less well in heavy calcification and none are specifically designed for the calcified CTO

Incomplete List:
- Crossing Technologies (Cordis Frontrunner, Covidien Viance, Endocross)
- Cutting Balloons
- Excisional Atherectomy (eg Turbohawk)
- Orbital Atherectomy (eg Diamondback)
- Jetstream Aspiration Thrombectomy
Wildcat CTO Device

- 0.035” hydrophilic coated catheter (Kittycat 0.014” version)
- Rotatable tip has both passive and active configurations
- Active mode used for fibro-calcific occlusions
- Ocelot device incorporates real time OCT
- In the CONNECT Trial\(^1\), ~50% of lesions were calcified with an overall technical success of 89.3%

TruePath™ CTO Device

- Diamond coated rotating tip creates micro-dissection through the occlusion
- Designed to cross fibro-calcific proximal cap
- Shaping tip and using steerable support catheters useful
- 85 patient ReOpen Study included 41.2% moderate and 38.8% severe calcification
- Successful crossing in 76.5% of cases
Crosser CTO Device

- Crosser catheter connected to a generator and creates high frequency vibrations that facilitate penetration of hard and calcified lesions

- The PATRIOT Trial\(^1\) included 75% of lesions with moderate to severe calcification

- Technical success of 84% achieved

1. Joye, J. Am J Cardiol 2007;100 (suppl 1):S24
Excimer Laser Device (Spectranetics)

- Used to cross and debulk calcific CTOs, especially in the tibial arteries
- Laser catheter activated and advanced, followed by supporting guidewire\(^1\)
- In the LACI 2 Trial 177 infra-popliteal lesions were treated with 93% limb salvage at 6 months

Re-entry in Calcified CTOs

- Sub-intimal entrapment occurs in 20-30% of CTO recanalizations
- Entrapment is more likely in severe initial calcification and re-entry is more challenging
- Looped hydrophilic guidewire with a loop diameter approximately the distal artery diameter is worth trying initially
- Over-aggressive attempts risk perforation
Re-entry in Calcified CTOs

- If hydrophilic guidewire re-entry is not successful, one cheap but often effective method of re-entry in calcified CTOs is sharp micro-dissection, usually with the stiff end of a guidewire!

- Use a shaped catheter to direct the guidewire towards the lumen on 2 planes
Re-entry Devices in Calcified CTOs

- Medtronic Pioneer and Cordis Outback can be used in significant intimal calcification
- Try to select least calcified site for re-entry
- Inject needle with some force to penetrate calcium
- Don’t over-dilate the sub-intimal tract
Cordis Outback

• 91 patients treated with 93% technical success

• 7 cases filed due to severe calcification

Positioning balloon and micro-catheter lancet

Allows reasonable force to be applied to re-entry

Re-ROUTE Trial 92 patients with 53.2% moderate-severe calcification. Technical success 84.8%
Retrograde Crossing Techniques

• These should be considered when problems with antegrade crossing and re-entry occur

• Retrograde guidewire passage is often more straightforward, even in calcified CTOs

• Retrograde approaches include femoral, popliteal, tibial, pedal and trans-collateral

• Ancillary techniques include double-balloon technique
81 year old male, forefoot ulceration
Unsuccessful antegrade crossing
Conclusions

• Crossing heavily calcified CTOs is challenging
• Understand the type of calcification as this can influence the approach
• Need robust catheters and guidewires if attempting sub-intimal crossing
• Intra-luminal crossing and re-entry devices are less successful in calcified CTOs but many work
• Retrograde approaches used as bail out
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