Value of MSCT in CTO PCI

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What’s the role of coronary CT before CTO PCI?

CT tells **something** more than CAG!
Invasive CAG - predictors of CTO PCI success

**Favorable**
- Tapered stump
- Functional (or short) occlusion
- Not at branching site
- No bridging collaterals
- ... and, occlusion length

**Unfavorable**
- No stump
- Complete and long occlusion
- At branching site (= no stump, ostial location)
- Bridging collaterals
- Tortuous vessel
- Severe calcification
- Poor distal vessel...
CTO - Information available from coronary CT

Ostial size and location

Lesion length

Intramural or extramucual calcification

Stump morphology

Calcification at entry

Calcification in CTO

Distal vessel shrankage

Presence of good collateral vessel for retrograde approach

Modified from Feyter, Niemann, EuroPCR 2011

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1. Relatively short CTO
2. Focal calcification at myocardial side of CTO entry
3. Ostium is relatively small and upward → Judkin Rt GC and large-bore GC would be NOT adequate
Guiding catheter: XB 2.0 6Fr.

The guidewire at outer curvature could enter distal true lumen

The guidewire course was predictable from CT

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Remodeling pattern of CTO plaque

Positive remodeling

Neutral

Negative remodeling

<table>
<thead>
<tr>
<th></th>
<th>CTO ≤ 1 yr</th>
<th>CTO &gt; 1 yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>35.4%</td>
<td>16.5%</td>
</tr>
<tr>
<td>Neutral</td>
<td>7.6%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Negative</td>
<td>57.0%</td>
<td>78.5%</td>
</tr>
</tbody>
</table>

Choi, Circ J 2011

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3D radiologic density analysis of CT

Mean radiologic density (HU) of each segments

- Proximal reference
- Proximal
- Mid
- Distal
- Distal reference
- All segment
- Maximal HU

* P < 0.05 by paired t-test

Anterograde approach ➔

Retrograde approach

Choi, Circ J 2011

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Beyond anatomical stenosis:
Evaluation of myocardial ischemia by CT

Myocardial perfusion

Computational fluid dynamics

Attenuation gradient

Koo, JACC 2011

Choi, JACC Img, in press
Chow, JACC 2010
Steigner, Circ Img 2009

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Concept of CT-gradient in CTO

Normal
Major epicardial coronary artery

CTO with inter-arterial anterograde collateral flow

Choi, Int J Cardiovasc Imaging, 2010
Choi, JACC Img in press
CT-gradient in CTO

Choi, JACC Img in press
CT-gradient shows the degree and direction of collateral flow

Rentrop collateral flow classification

Anterograde vs. retrograde collateral flow

TAG_{distal} (HU/mm)

p <0.05 between all

TAG_{distal} (HU/mm)

p <0.05 between two groups

Choi, in submission
# Prediction of CTO PCI success by pre-procedural CT

<table>
<thead>
<tr>
<th>Study</th>
<th>N of CTO</th>
<th>Success (%)</th>
<th>CT predictors</th>
<th>Independent predictors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mollet, Am J Cardiol 2005</td>
<td>45</td>
<td>53%</td>
<td>Calcification &gt; 15 mm Blunt stump</td>
<td>Calcification &gt; 15 mm Blunt stump</td>
</tr>
<tr>
<td>Soon, J Interv Cardiol 2007</td>
<td>43</td>
<td>56%</td>
<td>Transluminal calcification &gt; 50% Blunt stump (by CAG)</td>
<td></td>
</tr>
<tr>
<td>Otsuka, Int J Cariovasc Imaging 2008</td>
<td>26</td>
<td>100%</td>
<td>None (100% success)</td>
<td></td>
</tr>
<tr>
<td>Cho, Int J Cardiol 2009</td>
<td>72</td>
<td>76%</td>
<td>Length Regional calcium scores % Ca area/CSA</td>
<td>% Ca area/CSA</td>
</tr>
<tr>
<td>Garcia, Eurointervention 2009 (CTTO registry)</td>
<td>139</td>
<td>63%</td>
<td>CSA &gt; 50% Angulation Calcium at entry &gt; 15 mm</td>
<td>CSA &gt; 50%</td>
</tr>
<tr>
<td>Ehara, J Inv Cardiol 2009</td>
<td>110</td>
<td>85%</td>
<td>Bending, Shrinkage, Calcium</td>
<td></td>
</tr>
<tr>
<td>Choi, Circ J 2010</td>
<td>186</td>
<td>77%</td>
<td>Length &gt; 18 mm Density&gt; 139 HU</td>
<td>CTO &gt; 1 year</td>
</tr>
<tr>
<td>Araki, EuroPCR 2011</td>
<td>114</td>
<td>82%</td>
<td>Intramural calc</td>
<td>Intramural calc</td>
</tr>
<tr>
<td>Jen, Int J Cardiol 2010</td>
<td>82</td>
<td>81%</td>
<td>Calcium length ration &gt; 0.5 Calcium at proxiam distal stump</td>
<td></td>
</tr>
</tbody>
</table>

**Most accepted predictors:** severity of calcification and lesion length
Effect of preoperative evaluation by multidetector computed tomography in percutaneous coronary interventions of chronic total occlusions

Koji Ueno a, Akio Kawamura a,*, Takeshi Onizuka a, Takashi Kawakami a, Yuji Nagatomo a, Kentaro Hayashida a, Shinsuke Yuasa a, Yuichiro Maekawa a, Toshihisa Anzai a, Masahiro Jinzaki b, Sachio Kuribayashi b, Satoshi Ogawa a

CTO PCI with or without pre-PCI CT

<table>
<thead>
<tr>
<th></th>
<th>CT (+)</th>
<th>CT (-)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>40</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Success (%)</td>
<td>77.5%</td>
<td>80.0%</td>
<td>NS</td>
</tr>
<tr>
<td>Complication (%)</td>
<td>7.5%</td>
<td>23.3%</td>
<td>0.039</td>
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<tr>
<td>coronary perforation</td>
<td>0%</td>
<td>10%</td>
<td>0.039</td>
</tr>
<tr>
<td>AMI</td>
<td>5%</td>
<td>12%</td>
<td>NS</td>
</tr>
</tbody>
</table>

Ueno, Int J Cardiol 2010

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CTO PCI with or without pre-PCI CT

e-CTO: Korean multicenter CTO registry

N=3436 (age 63+/-11 year, male 74%), unadjusted data

Success = 75.3% (492/653)
Success = 83.3% (2321/2783)

Choi and e-CTO investigators, abstract submitted to KSC 2011
Summary

1. CT can evaluate detailed anatomy of whole vessel, lesion characteristics (especially calcification), and physiological function of collaterals and myocardium.

2. CT can predict procedural success mainly based on the severity of calcification and lesion length.

3. However, these potential values of CT has not been reflected in real-world clinical practice (e.g. CTO PCI success). We need more sophisticated investigation.