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# 관상 동맥 만성 완전 폐쇄 병변에 대한 관상동맥 중재시술이 건강과 관련된 삶의 질에 미치는 영향에 대한 DECISION-CTO 사후 분석 연구

# Effect of PCI on health-related quality of life in patients with chronic total occlusion; a post hoc analysis from the DECISION-CTO trial

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# Effect of PCI on health-related quality of life in patients with chronic total occlusion; a post hoc analysis from the DECISION-CTO trial

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A Master's Thesis

Submitted to

the Graduate School of the University of Ulsan

for the Degree of

Master of Medicine

by

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August 2022

박영선의 의학석사학위 논문을 인준함

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2022년 8월

## ABSTRACT

### BACKGROUND

The Drug-Eluting stent implantation versus optimal medical treatment in patients with ChronIc Total OccluSION (DECISION-CTO) trial showed no significant difference in the quality of life (QoL) measures between the CTO-PCI and no CTO-PCI strategy. Because the study patients were not restricted to those who had isolated CTO disease, PCI for non-CTO lesions may have considerably influenced this result.

### METHOD

We performed a QoL analysis to assess the effect of CTO-PCI by stratifying patients who were enrolled in the trial into isolated CTO disease group and multivessel coronary artery disease (CAD) accompanied by CTO group. Health status was assessed at baseline and 1, 6, 12, 24, and 36 months with the Seattle Angina Questionnaire (SAQ) and visual analogue scale of European Quality of life-5 Dimensions (EQ-5D) score. In SAQ subscales, a change of more than 8 points on physical limitation, 20 points on the angina frequency, and 16 points on the quality of life was considered clinically meaningful improvement.

### RESULTS

A total of 214 patients with isolated CTO disease (111 in the CTO-PCI group, 103 in the no CTO-PCI group) and 590 patients with multivessel CAD (302 in the CTO-PCI group, 288 in the no CTO-PCI group) were included in the analysis. At 1 month, the scores on all domains of the QoL questionnaire had generally increased to a larger extent from baseline in the CTO-PCI arm than in the no CTO-PCI arm in the isolated CTO group, but not in the multivessel CAD group. The improvements in scores were largely maintained by 12 and 36 months. In the between-group analysis for the isolated CTO group, the CTO-PCI strategy had higher mean scores on the SAQ subscales for physical limitation, angina frequency, and QoL than the no CTO-PCI strategy in the early post-PCI period. However, these differences were no

longer apparent at later time points. In isolated CTO group, the proportion of patients with clinically meaningful increases in these SAQ domain scores was greater among those treated with CTO-PCI than those without CTO-PCI, particularly at 1 and 6 months.

**CONCLUSIONS**

CTO-PCI effectively relieved symptoms and improved quality of life at the early post PCI period in patients with isolated CTO.

**Key Words**: Atherosclerosis, coronary artery disease, chronic total occlusion, percutaneous coronary intervention, quality of life

# Contents

## INTRODUCTION

Percutaneous coronary intervention (PCI) effectively relieves ischemia and improves symptom in patients with coronary artery disease (CAD) (1, 2) . Likewise, PCI for chronic total occlusion (CTO) has achieved an important role in reducing symptom and improving quality of life (QoL) based on the results of several randomized and observational studies (3-6). However, the recently published Drug-Eluting stent implantation versus optimal medical treatment in patients with ChronIc Total OccluSION (DECISION-CTO) trial demonstrated somewhat conflicting result, as there was no significant difference in QoL between the CTO-PCI and no CTO-PCI strategy (7). This observation was likely due to the specific design of the trial, as randomization and baseline QoL assessments were done before any intervention including PCI for obstructive non-CTO lesions. Although the observed promising effect of PCI for non-CTO lesions on QoL is of clinical value and may have a practical implication for patients with CTO, it was difficult to assess the contribution of CTO-PCI itself on symptom improvement among the study population. To address this issue, we performed a post hoc analysis of the QoL outcomes from the DECISION-CTO trial after stratifying patients into those who had isolated CTO disease and multivessel CAD accompanied by a CTO.

## METHODS

The design and the enrollment criteria of the DECISION-CTO trial have been described previously(7). Briefly, the trial randomly assigned 834 patients from 19 sites in Korea, India, Indonesia, Thailand, and Taiwan to determine whether no CTO PCI strategy is noninferior to CTO PCI strategy in terms of the composite risk of death from any cause, myocardial infarction, stroke, or any revascularization. Regardless of the total number of diseased coronary artery, patients with a de novo CTO in a proximal to mid- epicardial coronary artery with a reference diameter of ≥2.5 mm were included. Patients with ST- segment elevation myocardial infarction requiring primary PCI were excluded.

Randomization was done after the severity or distribution of CAD was confirmed by diagnostic coronary angiography in each patient. Patients were randomized to either PCI or no PCI for the qualifying CTO lesion. For patients with multivessel CAD, PCI was recommended for all obstructive non-CTO lesions (diameter stenosis≥50% for left main and ≥70% for non-left main CAD) within a vessel diameter ≥2.5mm. All patients in both groups were to receive guideline directed medical therapy including aspirin and a P2Y12 receptor inhibitor for at least 12 months in those who underwent stent implantation(8, 9).

Health-related quality of life were assessed with the use of visual analogue scale of European Quality of life- 5 Dimensions score and the Seattle Angina Questionnaire at baseline and 1, 6, 12, 24 and 36 months(10-12). Seattle Angina Questionnaire is a 19- item self-administered questionnaire that estimate five clinically important domains of health status in patients with coronary artery disease – physical limitations, angina stability, angina frequency, treatment satisfaction and quality of life. The higher score means better health status that ranges from 0 to 100. It was regarded as clinically significant if the score changed more than 8 points in physical limitations, 20 points in angina frequency and 16 points in

quality of life(13). These health status questionnaire data were analyzed only for whom had data at baseline and each time of interest.

**Statistical Analysis**

A total of 804 randomized patients were stratified into isolated CTO disease group (n=214) and multivessel disease group (n=590). Descriptive statistics for continuous variables are presented as median (interquartile range [IQR]) and were compared with Wilcoxon rank-sum test; categorical variables are presented as percentages and were tested using the chi-square test. Baseline characteristics were compared between CTO-PCI and no CTO-PCI strategy within patients with isolated CTO and multivessel CAD accompanied by CTO lesion. To evaluate the changes in QoL, within-group comparisons for each health status scale were performed between baseline and each follow-up time point using paired Student t-tests. The proportion of clinically meaningful increases in SAQ scores were analyzed between CTO-PCI and no CTO-PCI strategy using the chi-square test. All analysis was based on the intention-to-treat population. The p value less than 0.05 was considered statistically significant. All analyses were performed with the use of R software version 3.2.2 13.

## RESULTS

Among 214 patients with isolated CTO disease, 111 were assigned to CTO-PCI and 103 to no CTO-PCI. Among 590 patients with multivessel CAD accompanied by a CTO, 302 patients were assigned to CTO-PCI and 288 patients to no CTO-PCI. As mentioned in the previous article, a high crossover rate persisted in the current post hoc analysis. The numbers of patients who crossed over from no CTO-PCI to CTO-PCI strategy were 23 (22.3%) and 55 (19.1%) in the isolated CTO disease group and the multivessel CAD group, respectively. Baseline clinical characteristics were largely similar in both CTO-PCI and no CTO-PCI arm, except for body mass index (25.2 vs. 26.4, P=0.01) and previous PCI (15.3% vs. 28.2%, p=0.03) in the isolated CTO disease group (**Table 1**), and for body mass index (25.7 vs. 25.1, p= 0.04) and hypercholesterolemia (61.3% vs. 52.1%, p= 0.03) in the multivessel CAD group (**Table 2**).

The difference in mean scores on SAQ subscales between CTO-PCI and no CTO-PCI in the isolated CTO disease group are summarized in **Table 3** and **Figure 1**. At 1 month, PCI generally provided a larger improvement of scores on all SAQ domains in the CTO-PCI arm than in the no CTO-PCI arm, and this improvement largely sustained for 12 and 36 months. At 1 month, the mean scores on physical limitation and angina frequency were significantly higher in the CTO-PCI arm than in the no CTO-PCI arm (88.43 vs. 86.49, p = 0.01 and 94.51 vs. 90.00, p = 0.01, respectively). At 6 months, the mean angina frequency and treatment satisfaction scores were significantly higher in the CTO-PCI arm than in the no CTO-PCI arm (97.26 vs. 95.31, p = 0.02 and 87.89 vs. 82.78, p = 0.03, respectively). In addition, the CTO-PCI arm showed a more considerable improvement in the quality-of-life subscale at 12 months. However, there was no statistical difference in the mean scores of the angina stability and visual analogue scale of EQ-5D between CTO-PCI and no CTO-PCI arm during 36

months.

In patients with multivessel CAD, the CTO-PCI strategy showed no statistically significant advantage on all SAQ subscales compared with the no CTO-PCI strategy throughout 36 months (**Table 4**). **Figure 2** shows that CTO-PCI and no CTO-PCI strategy had similar improvement on all SAQ domains at 1 month compared with baseline scores. CTO-PCI arm had a higher score than the no CTO-PCI arm in mean scores of the visual analogue scale of EQ-5D at 12, 24 and 36 months ($p = 0.047$, $p = 0.005$ and $p = 0.03$, respectively).

The proportion of patients with clinically meaningful increases in SAQ- physical limitation, angina frequency, and quality-of-life domain scores was significantly higher among those treated with CTO-PCI than those with no CTO-PCI strategy at 1 and 6 months in the isolated CTO disease group (**Figure 3**). During the 36 months, the proportion of patients who achieved these clinically meaningful increases was generally higher in the CTO-PCI arm than in the no CTO-PCI arm. However, in the multivessel group, there was no consistent increase in the proportion of patients with clinically meaningful increases in the early post-PCI period in the CTO-PCI arm than no CTO-PCI arm (**Figure 4**).

Table 1. Baseline characteristics of patients with isolated CTO lesion

| | | CTO-PCI (n=111) | No CTO-PCI (n=103) | P value |
|---|---|---|---|---|
| Age | | 61.9(11.1) | 61.5 (10.5) | 0.80 |
| Sex(male) | | 89(80.2%) | 80(77.7%) | 0.78 |
| Body mass index, kg/m$^2$ | | 25.2(3.0) | 26.4(3.4) | 0.01 |
| Hypertension | | 70(63.1%) | 62(60.2%) | 0.77 |
| Diabetes mellitus | | 28(25.2%) | 33(32.0%) | 0.34 |
| Hypercholesterolemia | | 64(57.7%) | 67(65.0%) | 0.33 |
| Smoking | | 32(28.8%) | 26(25.2%) | 0.66 |
| Previous bypass operation | | 1(0.9%) | 4(3.9%) | 0.32 |
| Previous myocardial infarction | | 11(9.9%) | 14(13.6%) | 0.53 |
| Previous PCI | | 17(15.3%) | 29(28.2%) | 0.03 |
| Previous stroke | | 4(3.6%) | 7(6.8%) | 0.46 |
| Peripheral vascular disease | | 1(0.9%) | 2 (1.9%) | 0.95 |
| Congestive heart failure | | 3(2.7%) | 3(2.9%) | >0.99 |
| Chronic lung disease | | 4(3.6%) | 2(1.9%) | 0.75 |
| Atrial fibrillation | | 3(2.7%) | 5(5.9%) | 0.64 |
| Renal dysfunction | | 1(0.9%) | 3(2.9%) | 0.56 |
| Clinical presentation | Chronic coronary syndrome | 92(82.9%) | 85(82.5%) | >0.99 |
| | Acute coronary syndrome | 19(17.1%) | 18(17.5%) | |
| CTO location | Left anterior descending artery | 65(58.6%) | 53(51.5%) | 0.45 |

| | | |
|---|---|---|
| Left circumflex artery | 11(9.9%) | 9(8.7%) |
| Right coronary artery | 35(31.5%) | 41(39.8%) |

The data are presented as n (%) or means (SD). CTO indicated chronic total occlusion; PCI, percutaneous coronary intervention.

Renal dysfunction was defined as an estimated glomerular filtration rate <60 $mL \cdot min^{-1} \cdot 1.73\ m^{-2}$ of the body surface area.

Table 2. Baseline characteristics of patients with mutivessel coronary artery disease accompanied by chronic total occlusion lesion

| | | CTO-PCI (n=302) | No CTO-PCI (n=288) | P value |
|---|---|---|---|---|
| Age | | 62.3(9.8) | 63.4 (9.6) | 0.18 |
| Sex(male) | | 255(84.4%) | 238(83.0%) | 0.72 |
| Body mass index, kg/m$^2$ | | 25.7(3.7) | 25.1(3.2) | 0.04 |
| Hypertension | | 192(63.6%) | 176(61.1%) | 0.59 |
| Diabetus mellitus | | 104(34.4%) | 101(35.1%) | 0.94 |
| Hypercholesterolemia | | 185(61.3%) | 150(52.1%) | 0.03 |
| Smoking | | 93(30.8%) | 76(26.4%) | 0.28 |
| Previous bypass operation | | 3(1.0%) | 1(0.3%) | 0.65 |
| Previous myocardial infarction | | 34(11.3%) | 20(6.9%) | 0.09 |
| Previous PCI | | 47(15.6%) | 46(16.0%) | 0.98 |
| Previous stroke | | 25(8.3%) | 24(8.3%) | >0.99 |
| Peripheral vascular disease | | 15(5.0%) | 16(5.6%) | 0.90 |
| Congestive heart failure | | 15(5.0%) | 16(5.6%) | 0.89 |
| Chronic lung disease | | 4(1.3%) | 6(2.1%) | 0.69 |
| Atrial fibrillation | | 2(0.7%) | 7(2.4%) | 0.16 |
| Renal dysfunction | | 5(1.7%) | 2(0.7%) | 0.49 |
| Clinical presentation | Chronic coronary syndrome | 208(68.9%) | 208(72.2%) | 0.42 |
| | Acute coronary syndrome | 94(31.1%) | 80(27.8%) | |
| CTO location | Left anterior descending artery | 120(39.7%) | 110(38.2%) | 0.87 |

| | | |
|---|---|---|
| Left circumflex artery | 31(10.3%) | 33(11.5%) |
| Right coronary artery | 151(50.3%) | 145(50.3%) |

The data are presented as n (%) or means (SD). CTO indicated chronic total occlusion; PCI, percutaneous coronary intervention.

Renal dysfunction was defined as an estimated glomerular filtration rate <60 $mL \cdot min^{-1} \cdot 1.73\ m^{-2}$ of the body surface area.

Table 3. Mean scores over time on the five domains of the SAQ and visual analog scale of EQ-5D in the isolated CTO disease group

| | CTO-PCI | | No CTO-PCI | | Difference between Medication and PCI (95% CI) | P |
|---|---|---|---|---|---|---|
| SAQ1 | N | Physical limitation | | | | |
| Baseline | 77 | 76.6 ± 24.47 | 77 | 85.05 ± 19.12 | -8.455 (-15.446 - -1.463) | |
| 1 month | 70 | 88.43 ± 18.6 | 69 | 86.49 ± 18.48 | 7.404 (2.123 - 12.685) | |
| 6 months | 62 | 93.84 ± 11.99 | 64 | 94.8 ± 8.57 | 1.576 (-1.971 - 5.124) | |
| 12 months | 56 | 92.93 ± 9.56 | 60 | 94.1 ± 9.79 | 0.745 (-2.924 - 4.414) | |
| 24 months | 48 | 95.13 ± 11.45 | 49 | 96.47 ± 6.58 | 2.407 (-1.265 - 6.079) | |
| 36 months | 43 | 94.7 ± 12.76 | 37 | 95.76 ± 7.36 | 1.138 (-3.514 - 5.789) | |
| SAQ2 | N | Angina stability | | | | |
| Baseline | 77 | 48.7 ± 22.54 | 77 | 53.57 ± 20.96 | -4.870 (-11.801 - 2.061) | |
| 1 month | 71 | 63.73 ± 23.06 | 69 | 59.06 ± 19.63 | 4.023 (-3.403 - 11.449) | |
| 6 months | 62 | 55.65 ± 15.3 | 64 | 56.25 ± 17.82 | -1.291 (-7.581 - 4.999) | |
| 12 months | 56 | 56.25 ± 16.69 | 60 | 55 ± 15.13 | 1.182 (-5.015 - 7.379) | |
| 24 months | 49 | 56.12 ± 16.56 | 50 | 54 ± 14.6 | 3.106 (-3.698 - 9.909) | |
| 36 months | 43 | 52.91 ± 12.45 | 36 | 52.78 ± 11.62 | 1.320 (-3.094 - 5.735) | |
| SAQ3 | N | Angina frequency | | | | |
| Baseline | 77 | 75.58 ± 24.63 | 77 | 82.47 ± 19.75 | -6.883 (-13.990 - 0.224) | |
| 1 month | 71 | 94.51 ± 10.53 | 69 | 90 ± 17.99 | 6.893 (2.353 - 11.433) | |
| 6 months | 62 | 97.26 ± 6.32 | 64 | 95.31 ± 9.08 | 3.225 (0.440 - 6.011) | |
| 12 months | 56 | 96.79 ± 7.16 | 60 | 94.17 ± 13.57 | 3.771 (-0.070 - 7.612) | |
| 24 months | 49 | 96.73 ± 8.01 | 50 | 97.4 ± 6.64 | 0.795 (-2.495 - 4.084) | |
| 36 months | 43 | 95.81 ± 10.74 | 36 | 96.94 ± 9.51 | 0.746 (-2.438 - 3.930) | |
| SAQ4 | N | Treatment satisfaction | | | | |
| Baseline | 77 | 79.82 ± 14.22 | 77 | 77.75 ± 15.49 | 2.065 (-2.670 - 6.800) | |
| 1 month | 71 | 85.18 ± 14.47 | 69 | 81.2 ± 14.65 | 3.384 (-1.107 - 7.876) | |
| 6 months | 62 | 87.89 ± 12.41 | 64 | 82.78 ± 12.13 | 4.997 (0.586 - 9.409) | |
| 12 months | 56 | 87.82 ± 11.35 | 60 | 84.75 ± 13.69 | 3.084 (-1.499 - 7.668) | |
| 24 months | 49 | 86.15 ± 11.9 | 50 | 81.82 ± 12.83 | 5.347 (0.003 - 10.691) | |
| 36 months | 43 | 88.23 ± 11.6 | 36 | 83.61 ± 12.73 | 5.994 (0.417 - 11.571) | |

| | | | | | |
|---|---|---|---|---|---|
| SAQ5 | N | Quality of life | | | |
| Baseline | 77 | 52.75 ± 20.47 | 77 | 56.96 ± 23.94 | -4.208 (-11.300 - 2.884) |
| 1 month | 71 | 65.35 ± 20.76 | 69 | 63.05 ± 21.58 | 5.673 (-0.726 - 12.071) |
| 6 months | 62 | 72.03 ± 16.93 | 64 | 69.27 ± 18.32 | 4.895 (-1.089 - 10.879) |
| 12 months | 56 | 75.68 ± 16.91 | 60 | 70.25 ± 15.98 | 6.425 (0.292 - 12.558) |
| 24 months | 49 | 74.05 ± 17.94 | 50 | 73.51 ± 16.51 | 3.765 (-3.541 - 11.071) |
| 36 months | 43 | 76.93 ± 16.9 | 36 | 81.03 ± 13.27 | -2.448 (-9.499 - 4.603) |
| EQ-5D | N | Visual analogue scale | | | |
| Baseline | 76 | 67.5 ± 16.51 | 76 | 66.55 ± 18.78 | 0.947 (-4.720 - 6.615) |
| 1 month | 70 | 78.71 ± 12.9 | 68 | 75.01 ± 14.52 | 4.018 (-0.360 - 8.395) |
| 6 months | 61 | 82.11 ± 10.02 | 64 | 79.52 ± 11.82 | 2.181 (-1.576 - 5.938) |
| 12 months | 56 | 82.3 ± 12.4 | 60 | 81.27 ± 10.32 | 1.171 (-3.224 - 5.567) |
| 24 months | 49 | 82.12 ± 14.12 | 50 | 82.2 ± 12.96 | -0.200 (-6.127 - 5.727) |
| 36 months | 43 | 80.86 ± 16.82 | 36 | 84.58 ± 7.11 | 0.493 (-3.892 - 4.877) |

Positive values means better outcomes with CTO-PCI strategy. CTO means chronic total occlusion; EQ-5D, European Quality of Life Dimensions; PCI, percutaneous coronary intervention; and SAQ, Seattle Angina Questionnaire, EQ-5D; European Quality of Life Dimensions and VAS, visual analogue scale.

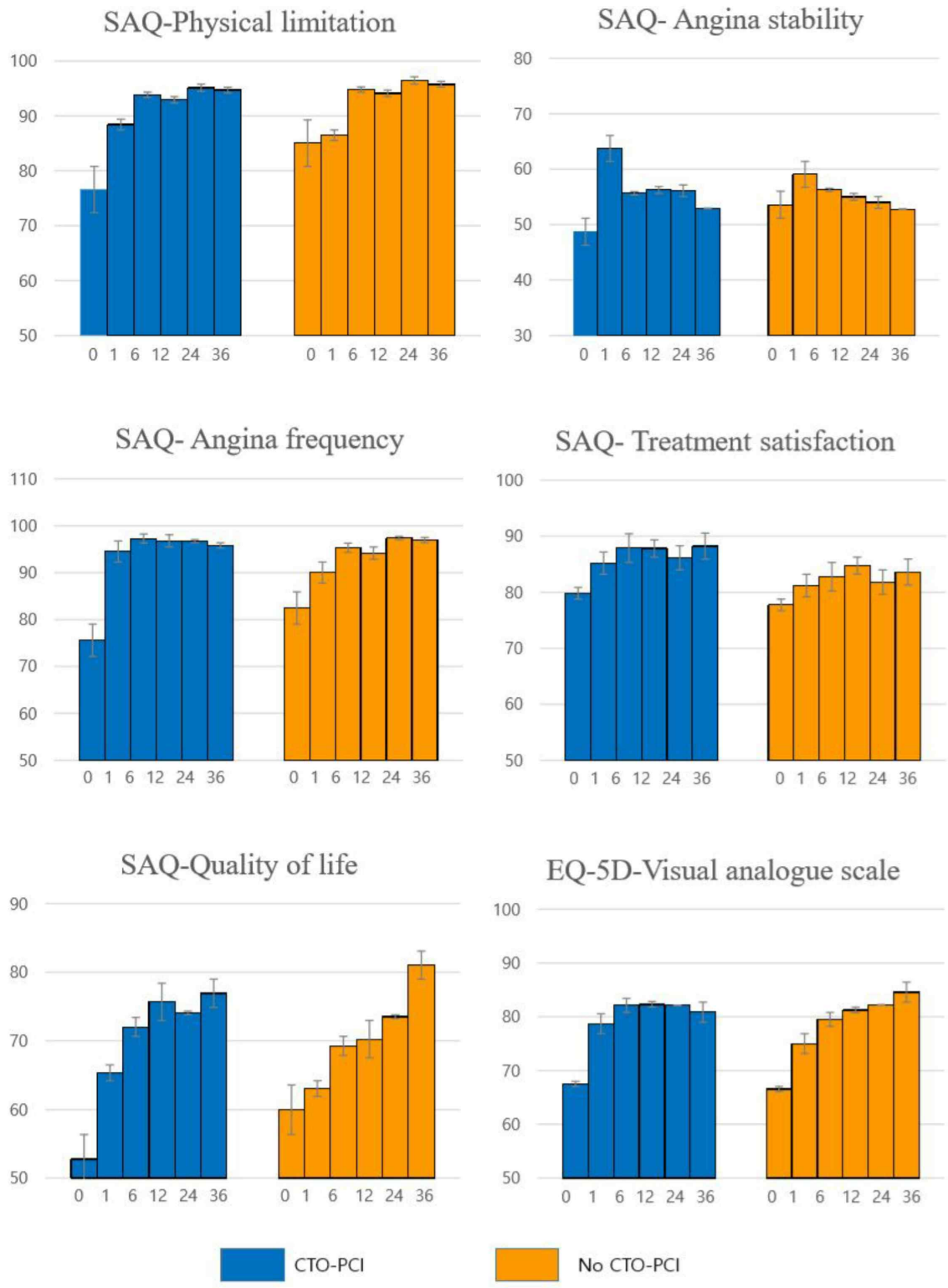
Table 4. Mean scores over time on the five domains of the SAQ and visual analog scale of EQ-5D in the multivessel CAD group

| | CTO-PCI | | No CTO-PCI | | Difference between Medication and PCI (95% CI) | P |
|---|---|---|---|---|---|---|
| SAQ1 | N | Physical limitation | | | | |
| Baseline | 233 | 79.82 ± 21.45 | 227 | 81.33 ± 20.94 | -1.511 (-5.396 - 2.375) | |
| 1 month | 206 | 89.16 ± 16.49 | 197 | 88.61 ± 17.59 | 2.077 (-0.338 - 4.493) | |
| 6 months | 181 | 90.82 ± 15.59 | 179 | 90.59 ± 15.51 | 1.167 (-1.198 - 4.432) | |
| 12 months | 170 | 92.93 ± 9.56 | 173 | 90.69 ± 17.69 | 2.596 (-0.372 - 5.564) | |
| 24 months | 143 | 91.97 ± 16.44 | 142 | 92.56 ± 13.77 | 1.338 (-1.597 - 4.273) | |
| 36 months | 105 | 92.7 ± 15.8 | 142 | 92.31 ± 16.4 | 1.712 (-2.033 - 5.458) | |
| SAQ2 | N | Angina stability | | | | |
| Baseline | 235 | 48.7 ± 22.54 | 227 | 53.57 ± 20.96 | -1.830 (-6.217 - 2.557) | |
| 1 month | 205 | 63.73 ± 23.06 | 197 | 59.06 ± 19.63 | 0.744 (-3.379 - 4.867) | |
| 6 months | 184 | 55.65 ± 15.3 | 181 | 56.25 ± 17.82 | -3.119 (-6.929 - 0.690) | |
| 12smonths | 175 | 56.25 ± 16.69 | 173 | 55 ± 15.13 | 1.148 (-3.129 - 5.425) | |
| 24 months | 145 | 56.12 ± 16.56 | 142 | 54 ± 14.6 | 1.723 (-1.346 - 4.793) | |
| 36 months | 108 | 52.91 ± 12.45 | 121 | 52.78 ± 11.62 | 0.218 (-3.741 - 4.176) | |
| SAQ3 | N | Angina frequency | | | | |
| Baseline | 236 | 78.69 ± 21.39 | 227 | 83.79 ± 18.28 | -5.102 (-8.742 - -1.462) | |
| 1 month | 207 | 94.3 ± 10.67 | 197 | 94.31 ± 11.74 | 1.103 (-1.006 - 3.212) | |
| 6 months | 184 | 95.27 ± 11.01 | 181 | 95.41 ± 10.08 | 0.292 (-2.043 - 2.627) | |
| 12 months | 175 | 93.89 ± 11.78 | 173 | 95.55 ± 8.98 | -1.045 (-3.398 - 1.307) | |
| 24 months | 145 | 97.66 ± 6.46 | 142 | 97.11 ± 7.86 | 0.358 (-1.418 - 2.134) | |
| 36 months | 108 | 98.43 ± 4.57 | 121 | 97.19 ± 7.1 | 1.178 (-0.511 - 2.867) | |
| SAQ4 | N | Treatment satisfaction | | | | |
| Baseline | 236 | 81.29 ± 15.45 | 227 | 80.07 ± 16.11 | 1.226 (-1.656 - 4.108) | |
| 1month | 207 | 82.53 ± 12.21 | 197 | 80.95 ± 15.19 | 1.124 (-1.278 - 3.526) | |
| 6 months | 184 | 82.16 ± 13.06 | 181 | 83.71 ± 14.74 | -2.021 (-4.868 - 0.826) | |
| 12 months | 175 | 82.36 ± 13.47 | 173 | 83.13 ± 14.69 | -0.151 (-3.171 - 2.869) | |
| 24 months | 145 | 83.22 ± 13.83 | 142 | 83.85 ± 13.64 | 0.360 (-2.787 - 3.507) | |
| 36 months | 108 | 85.41 ± 12.71 | 121 | 83.86 ± 11.21 | 2.026 (-1.117 - 5.169) | |

| | | | | | | |
|---|---|---|---|---|---|---|
| SAQ5 | N | Quality of life | | | | |
| Baseline | 236 | 53.47 ± 21.31 | 227 | 56.18 ± 22.29 | -2.706 (-6.688 - 1.276) | |
| 1 month | 207 | 66.49 ± 19.69 | 197 | 64.95 ± 18.93 | 2.189 (-1.300 - 5.677) | |
| 6 months | 184 | 72.61 ± 17.78 | 181 | 69.39 ± 17.22 | 2.839 (-0.812 - 6.490) | |
| 12 months | 175 | 70.88 ± 19.02 | 173 | 72.94 ± 16.8 | -0.244 (-4.132 - 3.643) | |
| 24 months | 145 | 76.33 ± 18.04 | 142 | 76.35 ± 18.09 | 1.670 (-2.494 - 5.834) | |
| 36 months | 108 | 77.32 ± 17.95 | 121 | 76.25 ± 17.24 | 2.286 (-2.215 - 6.787) | |
| EQ-5D | N | Visual analogue scale | | | | |
| Baseline | 232 | 68.34 ± 17.21 | 227 | 68.36 ± 17.15 | -0.021 (-3.173 - 3.131) | |
| 1 month | 207 | 75.82 ± 14.78 | 197 | 76.25 ± 15.55 | 0.537 (-2.135 - 3.210) | |
| 6 months | 183 | 78.69 ± 14.12 | 181 | 77.29 ± 14.73 | 1.292 (-1.604 - 4.187) | |
| 12 months | 175 | 79.21 ± 13.91 | 173 | 77.25 ± 14.35 | 2.936 (0.034 - 5.838) | ( |
| 24 months | 145 | 81.66 ± 12.89 | 142 | 79.14 ± 11.78 | 3.920 (1.208 - 6.631) | ( |
| 36 months | 108 | 81.27 ± 14.19 | 121 | 80.07 ± 11.71 | 4.473 (1.638 - 7.307) | ( |

Positive values mean better outcomes with CTO-PCI strategy. CTO means chronic total occlusion; EQ-5D, European Quality of Life Dimensions; PCI, percutaneous coronary intervention; SAQ, Seattle Angina Questionnaire and EQ-5D; European Quality of Life Dimensions and VAS, visual analogue scale.

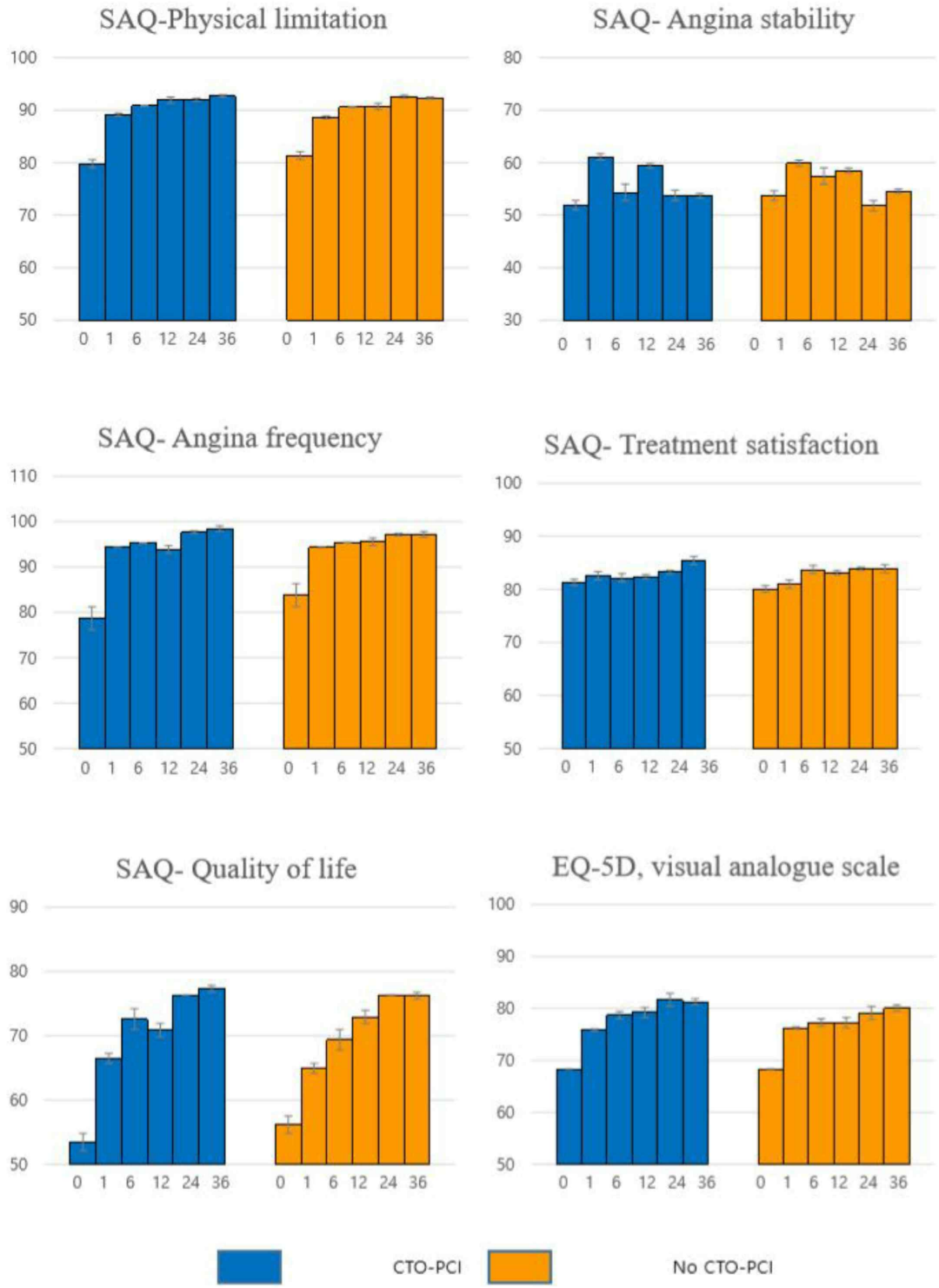
Figure1. Mean scores over time on the visual analog scale of the EQ-5D and five domains of the SAQ in patients with isolated CTO disease




Scores for each scale range from 0 to 100. Higher score means better health status. Error bars indicate 95% confidence intervals. EQ-5D indicated European Quality of Life-5 Dimensions score; CTO,

chronic total occlusion; PCI percutaneous coronary intervention; and SAQ, Seattle Angina Questionnaire.

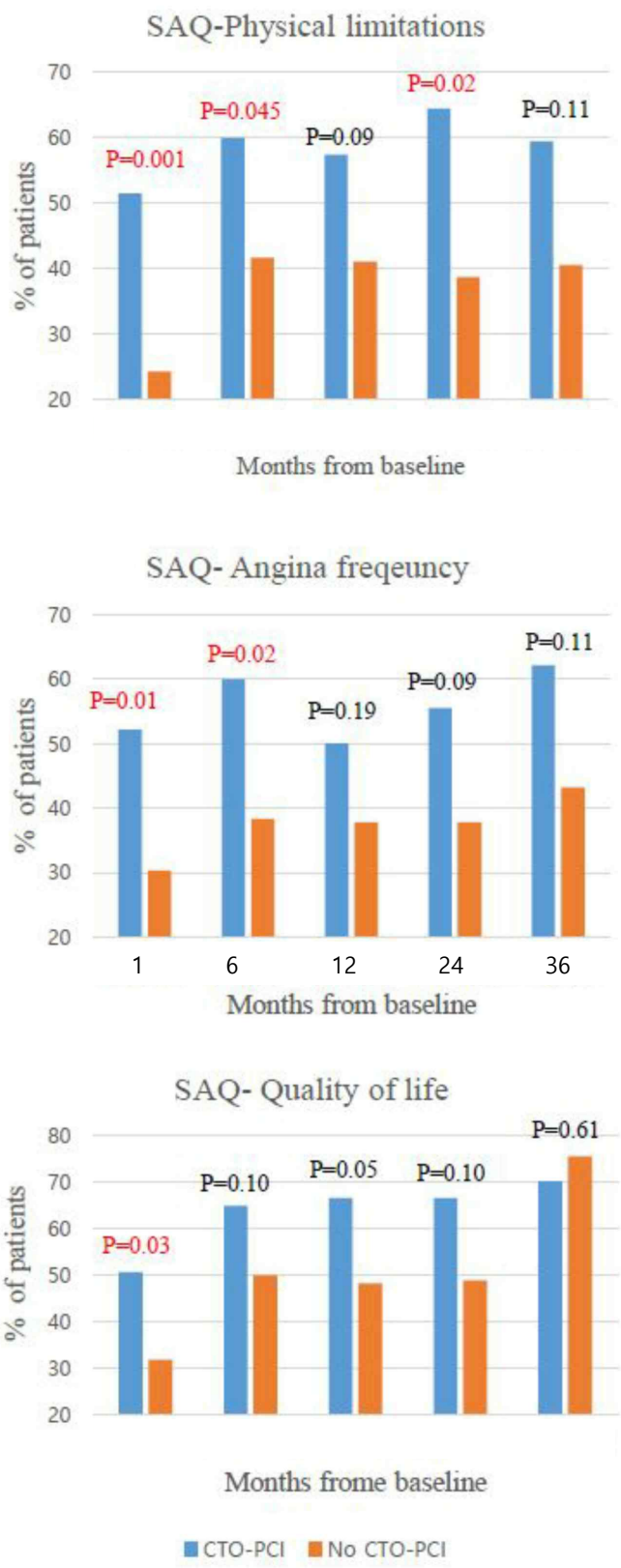
Figure 2. Mean scores over time on the visual analog scale of the EQ-5D and five domains of the SAQ in patients with multivessel CAD accompanied by CTO.




Scores for each scale range from 0 to 100. Higher score means better health status. Error bars indicate 95% confidence intervals. EQ-5D indicated European Quality of Life-5 Dimensions

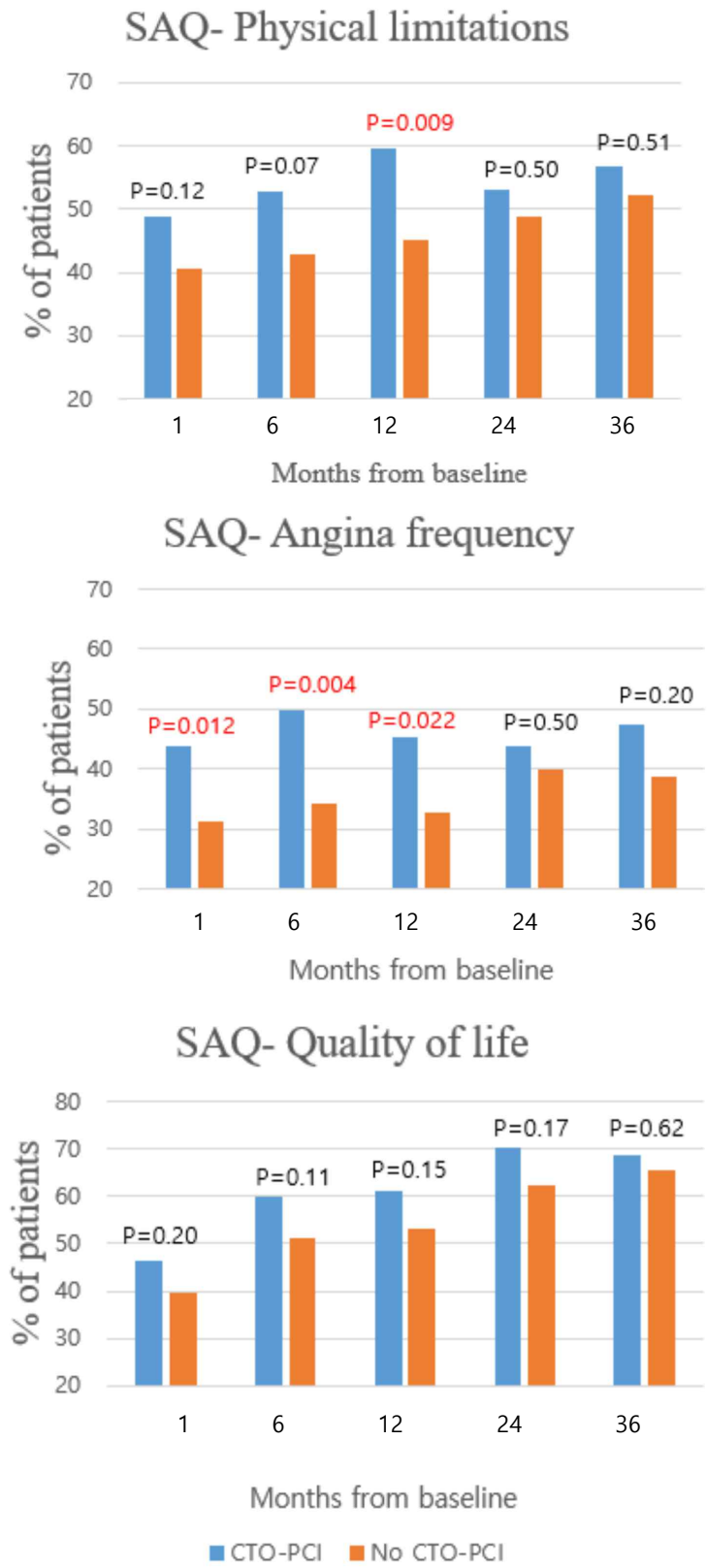
score; CTO, chronic total occlusion; PCI percutaneous coronary intervention; and SAQ, Seattle Angina Questionnaire.

Figure 3. Percentage of patients with clinically meaningful increases in SAQ domain scores in the isolated CTO disease group.



A change of ≥8 points on the physical limitation domain, ≥ 20 on the angina frequency domain, and ≥ 16 on the quality of life domain were considered clinically meaningful. CTO indicates chronic total occlusion; PCI, percutaneous coronary intervention; and SAQ, Seattle Angina Questionnaire.

Figure 4. Percentage of patients with clinically meaningful increases in SAQ domain scores in the multivessel CAD group.




A change of ≥8 points on the physical limitation domain, ≥ 20 on the angina frequency

domain, and ≥ 16 on the quality of life domain were considered clinically meaningful. CTO indicates chronic total occlusion; PCI, percutaneous coronary intervention; and SAQ, Seattle Angina Questionnaire.

## DISCUSSION

The landmark DECISION-CTO trial reported no significant difference between the CTO-PCI and no CTO-PCI strategy regarding the composite endpoint of mortality, MI, stroke, or any revascularization. Of note, the trial revealed an improvement in disease-specific health status in both strategies, resulting in no statistical differences between the two groups(7). This result was inconsistent with several CTO studies, which showed that CTO-PCI effectively improved QoL compared with medical therapy alone(3-6). The study design could explain the discrepancy between the DECISION-CTO trial and other studies. In the DECISION-CTO trial, the baseline health status assessment and randomization were done before intervention for non-CTO and CTO lesions. PCI for obstructive non-CTO lesions might have influenced the quality of life in both the CTO-PCI arm and no CTO-PCI arm.

To assess this hypothesis, we divided the trial subjects into those with isolated CTO disease and multivessel CAD accompanied by a CTO and separately analyzed the effect of CTO PCI. In the isolated CTO disease group, there was a considerable extent of improvement in SAQ key subscales of physical limitation, angina frequency, and QoL with CTO-PCI than with no CTO-PCI strategy in the early period of post PCI. Also, in the same SAQ subscales, the likelihood of clinically meaningful increases was markedly higher in the CTO-PCI group, especially during the first 6 months. Considering that the symptoms are derived from the CTO lesion in patients with isolated CTO disease, these findings suggest that CTO-PCI improves quality of life, at least in the early stage of post PCI. On the other hand, symptoms of multivessel CAD patients are attributed to both non-CTO and CTO lesions. Moreover, the progression of non-CTO lesions mainly contributes to symptoms or left ventricular function in cases where the vessel, including this non-CTO lesion, is the collateral supplier of the CTO vessel. Thus, in patients with multivessel CAD accompanied by a CTO, PCI for non-CTO lesions may significantly improve ischemia in both non-CTO and CTO vessel territories, as

reflected by our analyses. Because patients with multivessel CAD occupied more than 70% of the entire patients in the trial, the effect of CTO-PCI on QoL may have been significantly diluted in the analysis of the original DECISION-CTO article.

Our post hoc analysis may have important clinical implications. CTO is relatively common in patients with CAD, and the success rate of CTO-PCI has increased in the recent decade(14-16). Guidelines recommend CTO-PCI in patients with refractory angina despite medical treatment or with a large area of ischemia in the occluded vessel territory(17, 18). Unlike guidelines and other CTO studies, the DECISION-CTO trial had questionable generalizability in terms of angina relief or QoL despite being the largest randomized trial regarding CTO-PCI. However, this study suggests the positive role of CTO-PCI in improving the patients' QoL, indicating the importance of patient selection for a relatively complex procedure.

This study had several limitations. First, the numbers of patients were relatively small, particularly in the isolated CTO disease group, limiting the statistical power. Second, the questionnaire response rate was low at late periods; thus, the results may have been potentially biased. Third, the continuous crossovers from no CTO-PCI to CTO-PCI over time may have influenced the late results toward narrowing the differences in mean scores on QoL subscales.

## CONCLUSION

In conclusion, our post hoc analysis of the DECISION-CTO showed that CTO PCI effectively relieved symptoms and improved QoL in patients with isolated CTO.

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# 국문요약

배경 : 관상동맥의 만성 완전 폐쇄 병변에 대해 약물 치료 단독군과 약물치료 및 관상동맥 중재술을 비교한 DECISION-CTO 연구에서는 삶의 질에 있어서 양 군에서 차이가 없음을 보여주었다. DECISION-CTO는 만성 완전 폐쇄 단독 병변을 가진 환자 뿐만 아니라 다른 혈관에 협착 병변을 동반한 다혈관 질환 환자들도 포함시킨 연구이고 무작위 배정과 동시에 양군에서 협착 병변에 대한 치료를 시행하였기 때문에 환자의 증상 개선 여부 및 정도가 만성 완전 폐쇄 병변 치료여부가 아닌 협착 병변의 치료에 따라 결정되었을 가능성이 있다.

목적 : 본 연구는 DECISION-CTO에 포함되었던 환자들을 대상으로 만성 완전 폐쇄 병변만 단독으로 가진 환자군과 협착 병변이 동반되었던 다혈관 질환 환자군을 구분하여 증상 개선 여부를 알아보고자 하였다.

방법 : DECISION-CTO에 포함된 전체 환자에서 만성 완전 폐쇄 병변만 단독으로 가진 환자군과 다른 협착 병변이 동반된 다혈관 질환 환자군으로 나누었으며 시애틀 협심증 설문지와 EQ-5D 설문지를 이용하여 삶의 질을 측정하였다. 기준점 및 1, 6, 12, 24, 36개월 동안 평가하였으며 시애틀 증상 협심증 설문지에서 신체적 제한의 점수 변화가 8점 이상 협심증 빈도 점수 변화 20점 이상, 삶의 질 점수 변화가 16점 이상일 때 의미있는 개선으로 평가하였다.

결과 : 214명의 만성 완전 폐쇄 단독 질환 환자군( 관상 동맥 중재 시술군 111명, 약물 치료 단독군 103명) 및 590명의 다혈관 질환 환자군 ( 관상 동맥 중재 시술군 302명, 약물 치료 단독군 288명)을 대상으로 분석하였다. 만성 완전 폐쇄 단독 질환 환자군에서 1개월 째에 모든 삶의 질 항목에서 관상 동맥 중재 시술군이 약물 치료 단독군과 비교하여 기준점보다 더 크게 증가하였으며 다혈관 질환에서 두 군간의 삶의 질 점수 상승 차이는 없었다. 점수 향상은 대체로 12개월 , 36개월 까지 유지되었다. 만성 완전 폐쇄 단독 질환 환자군에서 관상 동맥 중재술 이후 초기 단계 동안 시애틀 협심증 설문지 항목 중

신체적 제한, 협심증 빈도 및 삶의 질 척도에서 관상 동맥 중재 시술군이 약물 치료 단독군보다 평균 점수가 높았으며 후기 단계에서는 그 차이가 명백하지 않았다. 또한, 만성 완전 폐쇄 단독 질환 환자군에서 시애틀 협심증 설문지 항목 중 임상적으로 의미있게 점수가 증가한 환자의 비율이 약물 치료 단독군 보다 관상 동맥 중재 시술군에서 더 높게 나왔으며 1개월과 6개월에서 특히 높았다.

결론 : 만성 완전 폐쇄 단독 질환 환자군에서 관상 동맥 중재술은 시술 후 초기 단계 동안 증상과 삶의 질 개선에 효과적이다.

중심 단어 : 동맥 경화, 관상 동맥 질환, 만성 완전 폐쇄, 경피적 관상 동맥 중재술, 삶의 질