

Circumflex coronary artery revascularization at the proximal atrioventricular groove

Proksimal atriyoventriküler olukta sirkumfleks koroner arter revaskülarizasyonu

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ABSTRACT

Proximal circumflex coronary artery in the atrioventricular groove usually has large diameters. Arterial diameters in this region vary from 2.5 to 5 mm. Revascularization of this part of the circumflex artery allows good distal anastomosis configuration and better long-term patency rate.

Keywords: Atrioventricular groove, circumflex artery, coronary artery bypass grafting, graft patency rate.

The circumflex (Cx) coronary artery begins from the left main coronary artery at an angle of approximately 90 degrees and has two courses. In type one, the Cx artery mostly courses laterally beneath the coronary sinus and enters the left atrioventricular (AV) sulcus after branching left main coronary artery. The Cx coronary artery is dominant in 7% of patients that gives off the posterior descending coronary artery which supplies the left ventricle and part of the right ventricle wall, as well as AV node artery. In type second, the Cx artery early leaves from AV groove and courses the left side of the left ventricle as a one or two large obtuse marginal artery.^[1] Complete coronary revascularization can be achieved in second type Cx artery anatomy, as there are obtuse marginal branches arteries larger than type-one obtuse marginal arteries. Proximal Cx arteries in the AV groove usually have large diameters. Revascularization of this part of the Cx artery allows good distal anastomosis configuration and better long-term patency rate.^[2] In this article, we aimed to encourage surgeons to perform proximal Cx artery revascularization to obtain complete myocardial revascularization.

ÖZ

Atrioventriküler oluktaki proksimal sirkumfleks koroner arter genellikle daha büyük çaptadır. Arter çapı bu bölgede 2.5 ila 5 mm arasında değişkenlik gösterir. Sirkumfleks arterin bu bölgesine yapılan revaskülarizasyon daha iyi anastomoz konfigürasyonu ve daha iyi uzun dönem açıklık oranlarına sahiptir.

Anahtar sözcükler: Atrioventriküler oluk, sirkumfleks arter, koroner arter baypas greftleme, greft açıklık oranı.

SURGICAL TECHNIQUE

Median sternotomy is performed with routine single two stage atrium cannulation and cardiopulmonary bypass. The left ventricle is decompressed with a vent. It is of utmost importance to correctly place the vent cannula to the left atrium which is placed through left superior pulmonary vein. If the vent is advanced too far, it may perforate the left atrium during the displacement of the heart. The right mediastinal pleura is incised to allow displacement of the cardiac apex into the right hemithorax, thus aiding the exposure during the anastomosis. The Cx is identified just distal to the bifurcation of the left main coronary artery.^[3] It is consistently found in the epicardial fat, inferior to the AV groove, adjacent to the appendage of the left atrium. Whereas distally the Cx lies beneath the coronary sinus, at the level of the left atrial appendage the artery is proximal to the formation of the coronary sinus by the great and left marginal cardiac veins.^[4] In most instances, there is 8 to 12-mm length Cx artery section, before the artery deep into left atrial wall/left atrial appendage and coronary sinus. This area is

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Figure 1. Preoperative angiography: Severe left main coronary artery lesion at the before of left main coronary artery. Circumflex artery gives off only one distal posterolateral branch which is in smaller size. The size of circumflex artery in the atrioventricular groove is 4 mm.

chosen in the Cx artery for revascularization. The vessel is mobilized with sharp or blunt dissection. A vessel loop is placed carefully about the proximal portion, thus allowing the artery to be gently retracted out of the epicardial fatty bed and away from its

relationship with the coronary sinus. If there are traversing superficial venous tributaries (mostly great cardiac vein and left marginal cardiac veins) to the coronary sinus in the area, they are ligated carefully with fine silk ties prior to division. If the coronary sinus is inadvertently entered during the dissection or if a major venous channel is interrupted without ligation, air would appear in the venous return of the cardiopulmonary circuit. Once the artery is lifted out of the epicardial fat, an 8-mm arteriotomy is made in the dissected segment and the distal anastomosis of the vein graft is sutured in an end-to-side fashion by using running continuous 7-0 prolene sutures. Patency of the anastomosis is confirmed by passing the appropriate size of coronary artery (Parsonnet) probe across the suture line before completing the anastomosis. It is remarkable how often the artery is free of significant disease in this position. A routine distal anastomosis can be performed easily. Hemostasis must be meticulous, as this area is difficult to visualize after cardiopulmonary bypass has been discontinued. Vein grafts are carried anterior of pulmonary artery or right ventricular outflow tract and proximal anastomosis are made to the ascending aorta after cross-clamp removal. Some surgeons carry Cx grafts behind the heart through the transverse sinus to the proximal anastomotic site on the right lateral curvature of the ascending aorta. Appropriate size obtuse marginal branch of may not be found in some of left main coronary artery lesions (Figure 1). Proximal Cx bypass is much more suitable for these cases. So far, we have performed

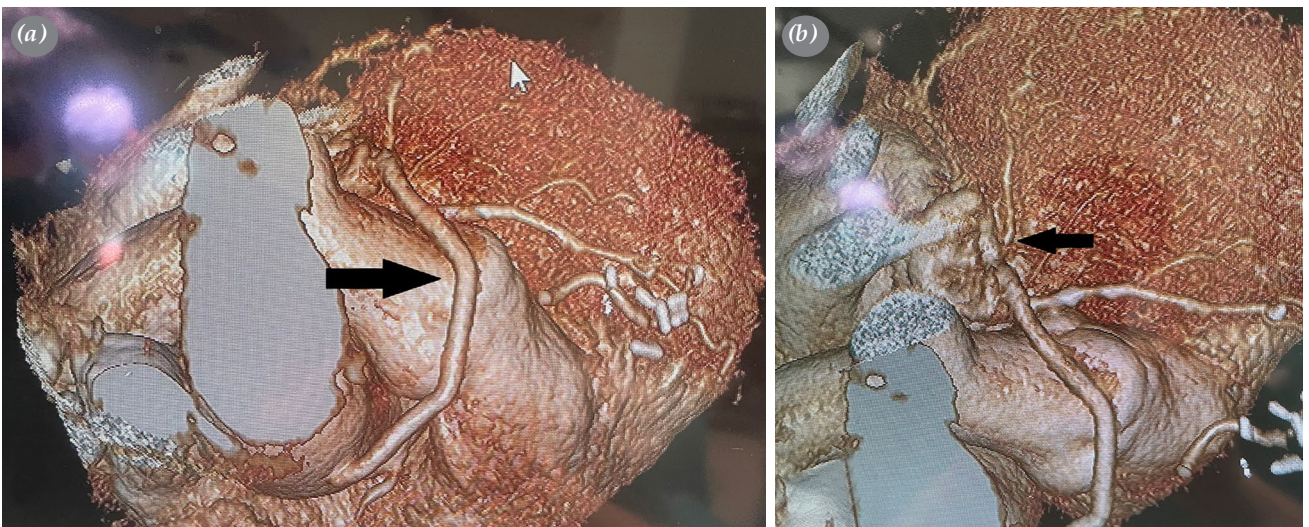


Figure 2. (a) Saphenous vein is anastomosed to proximal circumflex region in the atrioventricular groove. Graft is positioned over the main pulmonary artery and is anastomosed to the ascending aorta (black arrow). (b) Distal anastomosis side. Proximal circumflex region almost equal size with saphenous vein (black arrow).

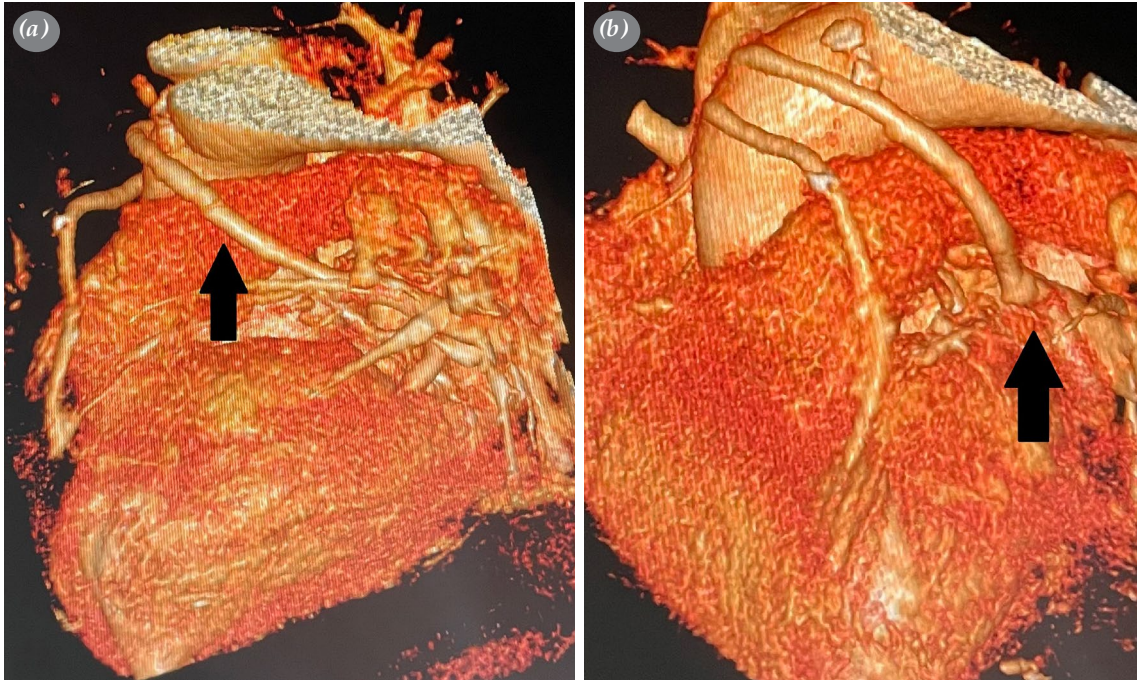


Figure 3. (a) Saphenous vein is anastomosed to proximal circumflex region in the atrioventricular groove. Graft is positioned over the main pulmonary artery and anastomosed to the ascending aorta (black arrow). (b) Distal anastomosis side. Proximal circumflex artery diameter is more than saphenous vein graft (black arrow).

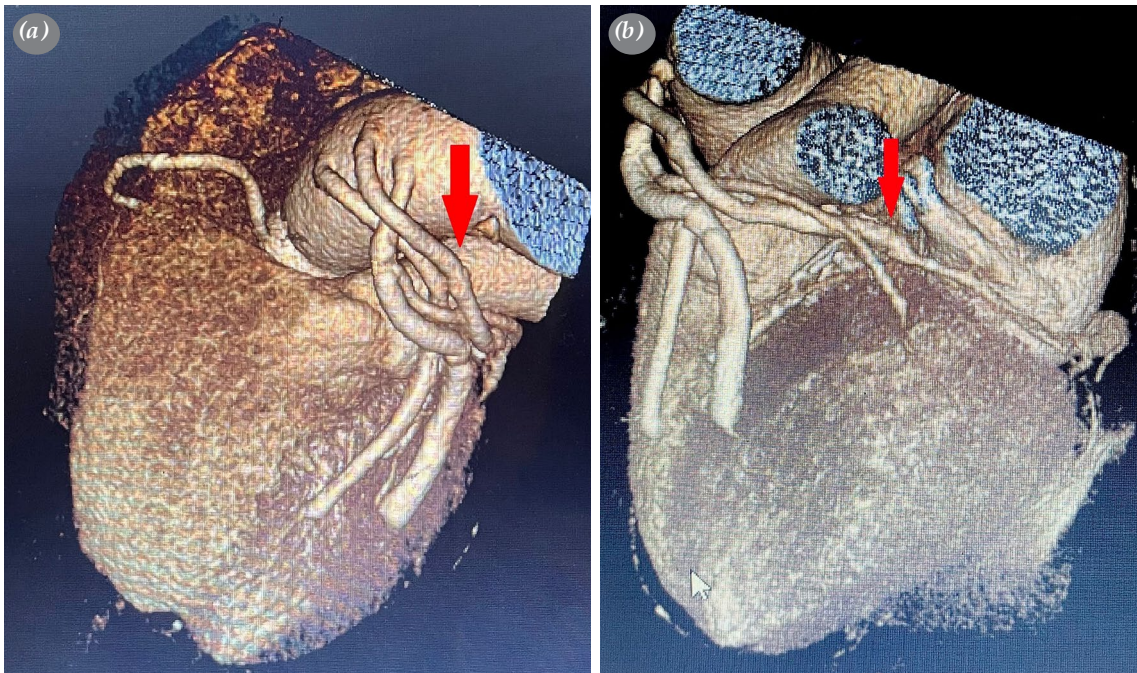


Figure 4. (a) Saphenous vein is anastomosed to proximal circumflex region in the atrioventricular groove. Graft is positioned over the main pulmonary artery and anastomosed to the ascending aorta (red arrow). (b) Distal anastomosis side. Proximal circumflex artery diameter is relatively smaller than saphenous vein graft (red arrow).

distal anastomosis to the proximal Cx artery at the AV groove in 23 patients. Coronary computed tomography (CT)-angiography is performed between three to seven years after surgery to all patients and all proximal Cx grafts were found to be patent (Figures 2-4).

DISCUSSION

Saphenous vein grafts patency rates mainly depend on distal arterial runoff, diameter of vessel, and quality of coronary arteries. Grafts to Cx marginal arteries had a significantly lower patency rate than grafts to left anterior descending and right coronary arteries.^[5] Higginbotham et al.^[5] reported that graft patency rate in vessels with a larger diameter (>2 mm) had almost 100% patency rates, 78% for 1.5 to 2.0-mm vessels, and 50% for less than 1.0-mm vessels. Distal to the origin of the obtuse marginal, there are a variety of branches coursing through the posterolateral left ventricular surface, which frequently are less than 1.5 mm in diameter and most often less than 1 mm. Revascularization of vessels of this caliber is not only technically quite difficult on the posteroinferior aspect of the heart, but also the restricted runoff reduces long-term patency. The posterior descending branch of the Cx usually is greater than 1.5 mm in diameter, but it also has the propensity for occlusive processes at its origin at the crux cordis, which negates its potential for retrograde flow into the AV groove segment of that same artery. Inadequate blood flow groove segments may cause postoperative angina and may also cause less recovery of left ventricular function. Proximal Cx arteries in the AV groove usually have large diameters. Diameters vary from 2.5 mm to 5 mm in the proximal AV groove. Revascularization of this part of the Cx artery allows good distal anastomosis configuration and better long-term patency rate.^[2] Pellegrini et al.^[2] reported 100% graft patency (12 grafts to proximal Cx region) rate in proximal Cx artery region and 20% ejection fraction improvement after surgery. The most optimal strategy in the Cx region is single or additionally proximal-Cx revascularization. Previously, surgeons were reluctant to revascularize the segment of the Cx coronary artery lying in the AV groove, due to the difficulty involved in obtaining exposure of the vessel. Dissection in the area under the coronary sinus has the potential for major injury to that venous structure. Cheung et al.^[6] advocated the use of proximal Cx region even in reoperative surgery with left thoracotomy, due to favorable early and long-term results for graft patency. Currently, surgeons

are mostly aware of beneficial effects of proximal Cx revascularization. However, the number of distal anastomoses at proximal Cx region has not increased due to same hesitations of past surgeons. There are a few instances that may constitute relative contraindication for proximal Cx artery bypass in AV groove. A hypertrophied left ventricular myocardium as seen in aortic stenosis or systemic vascular hypertension does not lend itself to the ease of retraction of the heart required for adequate exposure and revascularization of this particular artery. An excessively large heart, which does not become adequately flaccid and contractile on the administration of cardioplegia, would compromise visualization in this area. Sternal deformities, including pectus excavatum or pectus carinatum, and sternal immobility from advanced osteoarthritis may also complicate AV groove bypass.^[2,3] In our practice, we performed 23 AV groove proximal Cx artery bypass procedures with saphenous vein graft and all grafts were patent at three to seven years control CT-angiography. We believe that we should encourage our colleagues to use proximal Cx bypass techniques.

In conclusion, proximal circumflex artery bypass should be performed directly to proximal circumflex artery stenosis or additionally to obtuse marginal artery graft bypass to achieve complete myocardial revascularization. We mainly advocate proximal circumflex artery revascularization not only to obtain complete revascularization, but also to increase graft patency. We cannot find circumflex artery beyond the proximal part of the circumflex system, as it is embedded in the myocardium and coronary sinus.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept: E.O.; Design, control/supervision, analysis and/or interpretation, writing the article, references and fundings, materials: E.K.; Data collection and/or processing, literature review, critical review: M.A.Ş.

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