

## A Comparison of Short Term Outcome between Two Groups - Off- pump and On-Pump Coronary Artery Bypass Grafting in Left Main Coronary Artery Stenosis

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### Abstract

**Introduction:** Coronary artery bypass surgery both conventional method (Conventional Coronary Artery Bypass surgery-CCAB) and off-pump method (Off-pump Coronary Artery Bypass Surgery-OPCAB) are frequently performed operation especially in our National Institute of Cardiovascular Disease and Hospital.

**Objective:** To assess the Compare of short term outcome between Two Group off- pump and on pump coronary artery bypass grafting in left main coronary artery.

**Patients and Methods:** The study was conducted in the department of Cardiovascular Surgery, National Institute of Cardiovascular Disease (NICVD), Dhaka, Bangladesh. A Prospective Non-randomized clinical study From January 2006 to November 2007. Study population the patients with ischemic heart disease with left main coronary artery disease who underwent off pump and on pump CABG in NICVD. Non probability sampling technique. Total Sample Size number of selected patients was sixty. Thirty patients in each group.

**Results:** Among 60 patient the mean age group I was  $51.5 \pm 7.3$  and that of group II patient was  $54.7 \pm 6$  years. This study was performed in NICVD, Dhaka, Bangladesh which included 60 patients of coronary artery disease with left main stem stenosis. In group I age range from 40 to 70 years with a mean  $\pm$  SD of  $51.5 \pm 7.3$  years. The majority of the patients are in age group 45 - 50 years. In group II the age ranged from 40 to 70 years with a mean  $\pm$  SD of  $54.7 \pm 6$  years, majority of the patients are in 51 - 55 years. The mean age difference was not statistically significant ( $p > 0.05$ ) in unpaired t test.

**Conclusion:** In our institution more than a decade has almost over since the start of OPCAB surgery with gradual success and integrity.

**Keywords:** CCAB; OPCAB; Risk Factors

### Introduction

Coronary artery bypass surgery both conventional method (Conventional Coronary Artery Bypass surgery-CCAB) and off-pump method (Off-pump Coronary Artery Bypass Surgery-OPCAB) are frequently performed operation especially in our National Institute of Cardiovascular Disease and Hospital. So far there are several other modern techniques regarding coronary artery bypass surgery are emerging throughout the world, our aim is to practice those side by side with the developed world even within our limited resources and keep ourselves up to date. We should always consider the greater benefit of our patients in respect of economy, time and quick post-operative recovery. Coronary Artery Bypass Graft (CABG) surgery is an well-established treatment modalities in patients with Coronary Artery Diseases (CAD) refractory to medical therapy or when intervention cardiologic procedures (PTCI) are not feasible [1]. Studies during the 1970s and 1980s showed significant survival benefit in patient with left main coronary artery stenosis randomized to coronary artery bypass grafting compared with medical therapy. Surgical revascularization is, therefore the preferred treatment for the patients with LMCA stenosis. LMCA stenosis has been recognized as a risk factor for early death among patient undergoing CABG. In a report from the Cleveland clinics in 1982, left main disease as an independent risk factor for operative mortality after CABG. In agreement with this report, several centers have recorded early survival in patients with LMCA stenosis compared with that in other patients undergoing CABG [2]. The prognostic indications for coronary artery bypass surgery in the present of critical left main stem stenosis are well-established. Medical therapy alone confers a poor survival advantage when compared to surgical revascularization, and percutaneous revascularization techniques for critical left main stem stenosis are at present generally consider unsafe. Recently, there has been renewed interest in potential benefits of off-pump coronary artery bypass surgery with encouraging reports of clinical, angiographic and economic superiority when compared to conventional coronary artery bypass surgery using cardiopulmonary bypass. Even more encouraging are the findings that high risks and elderly patients benefit most from heart surgery in which cardiopulmonary bypass is not used [3]. Significant narrowing of the left main coronary artery puts the patients at high risk, since occlusion of this vessel if unprotected by collateral flow or a patent bypass graft either the left anterior descending or circumflex artery, compromises flow to approximately 75 percent of the left ventricle. Some similar considerations in terms of ischemic burden apply to left main equivalent disease, which is defined as severe (> 70%) proximal LAD and proximal LCX disease. However, the left ventricular mass jeopardized by occlusion of a single vessel in such patients is far less than with a true left main lesion [4]. In Bangladesh, a study of left main coronary artery disease was conducted by Ahsan., *et al.* [5] shows the rationale and effectiveness of off pump CAB surgery over conventional methods and found promising results of former technique. So, this study is to reiterate the further effectiveness and safety of off pump method side by side with the CCABG surgery in our country context.

### Objective of the Study

To assess the Compare of short term outcome between Two Group off- pump and on pump coronary artery bypass grafting in left main coronary artery.

### Patients and Methods

#### Place of study

The study was conducted in the department of Cardiovascular Surgery, National Institute of Cardiovascular Disease (NICVD), Dhaka, Bangladesh.

#### Study design

Prospective Non-randomized clinical study.

#### Period of study

From January 2006 to November 2007.

#### Ethical consideration

Prior to the study research protocol was approved by the institutional protocol committee and patients had explained about the purpose and importance of the study. Informed and written consent was taken from the participants.

### Study population

Study population the patients with ischemic heart disease with left main coronary artery disease who underwent off pump and on pump CABG in NICVD.

### Sampling techniques

Non probability sampling technique.

### Sample size

Total number of selected patients was sixty. Thirty patients in each group.

**Population group:** The total number of study population was divided into two groups based on the procedure of surgery. Each group has thirty populations:

1. Group I: CABG under cardiopulmonary bypass (On-Pump).
2. Group II: CABG without cardiopulmonary bypass (Off-Pump).

### Selection criteria of the patients

#### a) Inclusion criteria:

- Patients with LEFT MAIN Coronary Artery Disease undergoing CABG both off pump and on pump.

#### b) Exclusion criteria:

- Patient having coronary artery disease other than left main disease
- Patients having EF < 35%
- Patients with unstable angina, MI, and other significant ischemia events within 1 1/2 month.
- Concomitant procedures including valvular operations.
- Has history of renal, respiratory or hepatic failure, stroke/TIA or coagulopathy.

### On-pump technique

After cardioplegic arrest dissected LIMA was brought into the surgical field, then the LAD was opened usually through a wide incision in the pericardium. The LIMA was cut obliquely at the site of anastomosis and freed from adjacent tissue for a short distance. It was then incised at the bottom of the bevel for the appropriate distance to correspond to the size of the opening in the artery. It was then anastomosed to the LAD with continuous 7-0 polypropylene suture. The LIMA was not dilated or otherwise manipulated and only the adventitia was grasped with forceps. After anastomosis was completed, the pedicle was tracked to the epicardium with a fine suture on both side of the artery. In cardioplegic arrested heart the epicardium was incised over the area of a coronary artery to which a venous graft was planned to anastomose. The anterior surface of the artery was cleared by gentle brushing with the scalpel blade. Careful inspection revealed the thin central line that is red or translucent, indicated location of the lumen. Anterior wall of the artery was opened longitudinally in this area with a pointed scalpel to avoid injury to the posterior wall. The incision was extended up to 4 to 6 mm and the artery was sized by passing probe into it and patency of the proximal and distal segment assessed. The end of the vein was being prepared for the most distal anastomosis, it was beveled so that the circumference of the opening was slightly larger than the opening of the artery and it was anastomosed with the artery as end to side technique by 7-0 polypropylene suture.

### Off-pump technique

Off pump method is almost same as on pump method except it was done in beating heart without any cardioplegic arrest. Suction stabilizer like Octopus and apical stabilizer like Star fish was used and myocardial protection was made by intra-coronary shunts. First the LIMA was dissected as before described, LAD was identified and exposed properly. The area was observed minutely and the proper site for the placement of graft was selected then the octopus stabilizer was placed to minimize movement and cleaned off for incision. An incision of 4 - 6 mm was made in previous methods. A proximal stitch in the epicardium was taken to occlude the artery temporarily before inser-

tion of intra-coronary shunt. Then a 1.5 mm intra-coronary shunt was inserted into the lumen of the artery. Then anastomosis was done with 7-0 polypropylene suture as previously described technique. For posterior vessel graft self-retaining apical suction device named Starfish was placed in the apex of the heart and 300 mm Hg vacuum pressure applied pulling the apex away from the base and pivoting the cardiac axis achieve excellent exposure with little impact on the left ventricular geometry and LVEDV then posterior vessel anastomosis with saphenous vein conduit was made [6].

**Follow up**

All patients had been followed up after one moth of discharge from hospital and subsequent two months in every one moth interval. In follow up period thorough clinical assessment, and Echocardiographic findings were checked to evaluate patient’s post-operative cardiac function and surgical outcomes.

**Data collection**

All relevant data for each participant where collected on redesigned Questionnaire (Appendix B).

**Statistical analysis**

Data were collected by personal interview and hospital records. The collected data were compiled and a data file was constructed. This data were analyzed by unpaired student t test and Chi square test ( $X^2$ ) using SPSS (Statistical Program for Social Science). The analyzed data were presented by crossing of variables in the form of tables, and graph etc. A p value equal to or less than .05 was considered significant.

**Results**

Among 60 patient the mean age group I was  $51.5 \pm 7.3$  and that of group II patient was  $54.7 \pm 6$  years. This study was performed in NICVD, Dhaka, Bangladesh which included 60 patients of coronary artery disease with left main stem stenosis. In group I age range from 40 to 70 years with a mean  $\pm$  SD of  $51.5 \pm 7.3$  years. The majority of the patients are in age group 45 - 50 years. In group II the age ranged from 40 to 70 years with a mean  $\pm$  SD of  $54.7 \pm 6$  years, majority of the patients are in 51 - 55 years. The mean age difference was not statistically significant ( $p > 0.05$ ) in unpaired t test. Depicts the occurrence of low output syndrome after off-pump and on-pump CABG. It shows that there were 8 patients (26.7%) in group I and 26 (86.7%) in group II suffered post-operative low output syndrome after post-operative period in ICU. When Chi square test is performed it reveals that there is statistically significant difference ( $P < .05$ ) between groups which means off pump group suffered less low output syndrome than on pump group.

Age in years	Group I		Group II		P Value
	N	%	N	%	
45-50	20	66.7	10	33.3	
51-55	4	13.3	12	40.0	
56-60	2	6.7	0	0.0	
61-65	0	0.0	8	26.7	
>65	4	13.3	0	0.0	
Mean age (yrs)	51.5	$\pm 7.3$	54.7	$\pm 6.0$	0.063

**Table 1:** Age distribution of the patients between the groups.  
*t value = 1.89, df^58, p = 0.063.*

Group I: Off-pump CABG in left main coronary artery Disease. Group II: On-pump CABG in left main coronary artery Disease, p value reached from unpaired t test  $p = 0.063$  ( $p > 0.05$ ). Unpaired t test performed for statistical analysis. Among 60 patients 52 patients were male and 8 patients were female the percentages were 83.3% and 16.7% in group I and 90.0% and 10.0% in group II respectively. Male female ratio is 6.5:1. The male female differences was not statistically significant ( $p > 0.05$ ) in chi square test.

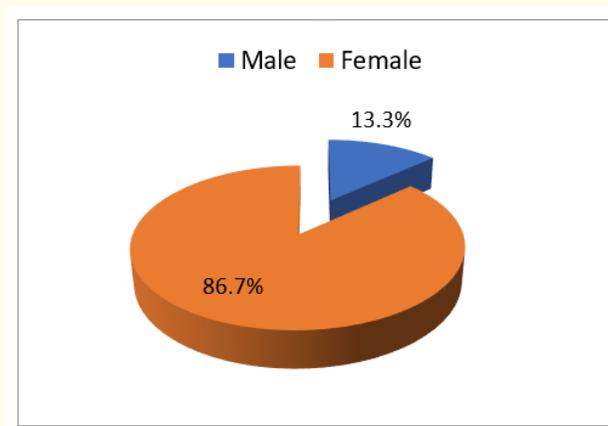


Figure 1: Distribution of sex.

Chi value = 0.58, df = 1, p = 0.353 Male female ratio: 6.5:1. Group I: Off-pump CABG in left main coronary artery Disease. Group II: On-pump CABG in left main coronary artery Disease, p value reached from chi square test p = 0.353 (p > 0.05). Chi square test is performed for statistical analysis.

LOS	Group I		Group II		value	df	P Value
	N	%	N	%			
Yes	8	26.7	26	86.7	21.99	1	0.001
No	22	73.3	4	13.3			

Table 2: Low output syndrome between groups.

Group I Off Pump CABG In Left Main Coronary Artery Disease. Group II On Pump CABG In Left Main Coronary Artery Disease. Chi Square test performed. df degree of freedom. P < 0.05 considered as statistically significant. Following table shows that median value of ventilation time in hour in group I is 10.0 ± 5.7 hr. and in group II is 17.2 ± 2.6 hr. in unpaired t test revealed that this value is statistically significant (p < .05) in two group which means off pump patients' needs less mechanical ventilation than on-pump conventional CABG. Where as in case of ICU stay median value in hour in group I patient is 32.4 ± 7.0 hr and in group II is 51.2 ± 5.5 hr and unpaired t test signified that this value is statistically significant (p < .05) in groups of off pump and conventional CABG patients with left main coronary artery disease, which means off pump patients require less ICU stay than conventional patient.

Post-operative variables	Group I (Mean ± SD)	Group II (Mean ± SD)	t value	df	P-value
Ventilation time (hour)	10.0 ± 5.7	17.2 ± 2.6	6.32	58	0.001 <sup>s</sup>
ICU stay (hours)	32.4 ± 7.0	51.2 ± 5.5	2.85	58	0.006 <sup>s</sup>

Table 3: Post-operative observation of ventilation time and ICU stay in hour between groups

Group I Off Pump CABG In Left Main Coronary Artery Disease. Group II On Pump CABG In Left Main Coronary Artery Disease. S = Significance; P-value < 0.05 was considered significant (Student's t-test).

Following table depicts the post-operative length of hospital stay between groups. The mean value in group I is  $8.3 \pm 3.4$  days and in group II is  $13.6 \pm 4.2$  days. When unpaired t test is performed, it reveals that there is statistically significant ( $<.05$ ) difference among groups in respect to post-operative hospital stay which means off pump group needs less post-operative hospital stay than on pump CABG groups.

	<b>Group I Mean <math>\pm</math> SD (range)</b>	<b>Group II Mean <math>\pm</math> SD (range)</b>	<b>t value</b>	<b>df</b>	<b>P-value</b>
Hospital stay (days)	$8.3 \pm 3.4$ (5,13)	$13.6 \pm 4.2$ (9,18)	5.372	58	0.001 <sup>s</sup>

**Table 4:** Hospital stay between groups.

Group I off Pump CABG in Left Main Coronary Artery Disease. Group II on Pump CABG in Left Main. Coronary Artery Disease. Unpaired t test performed. df degree of freedom.  $P < 0.05$  considered as statistically significant.

Following table shows the post-operative NYHA changes among CABG patients between two groups. When chi square test is performed there is no statistically significant ( $p > .05$ ) changes between groups observed in 1<sup>st</sup> month, 2<sup>nd</sup> month and third month respectively.

NYHA Class	Group I (n = 28)		Group II (n = 29)		value	df	P Value
	n	%	n	%			
<b>1 month</b>							
Class I	18	64.0	13	46.4			
Class II	12	40.0	17	56.6	1.67	1	0.196 <sup>ns</sup>
<b>2 months</b>							
Class I	18	64.0	14	46.7			
Class II	12	40.0	16	53.3	1.07	1	0.300 <sup>ns</sup>
<b>3 months</b>							
Class I	19	63.3	14	46.7			
Class II	11	36.7	16	53.3	1.68	1	0.194 <sup>ns</sup>

**Table 5:** Change in NYHA functional Class post operatively.

Group I Off Pump CABG In Left Main Coronary Artery Disease. Group II On Pump CABG In Left Main Coronary Artery Disease. Chi Square test performed. ns not significant, S significant,  $p > 0.05$ .

Following table depicts the post-operative echocardiographic changes in between two groups of CABG patients in three successive months. These are LVIDd, LVIDs, EF and wall motion abnormality. Unpaired t test is performed for LVIDd, LVIDs, EF value and Chi square test is performed for wall motion abnormality value. No statistically significant ( $p > .5$ ) difference is found among two groups in successive three months which means either off pump or on pump technique of CABG do not cause any effect on LVIDd, LVIDs, EF and wall motion abnormality change post operatively in CABG patients.

Group I Off Pump CABG In Left Main Coronary Artery Disease. Group II On Pump CABG In Left Main. Coronary Artery Disease. Chi Square test performed. Unpaired t test performed. df degree of freedom, Chi square test,  $p > 0.05$ .

## Discussion

Pre-operative angiographic data was evaluated among two groups of patients. All patients had significant left main coronary artery disease. Significant means  $> 50\%$  stenosis in the lumen. And all patients had multi vessel disease along with left main disease. Out of them LAD main trunk involvement in group I were 18 and in group II 17 patients, the branches of LAD D1 and D2 respectively also involves in

Variables	Group I	Group II	t/chi value	df	P-value
<b>1 month</b>					
LVIDd (mm)	47.5 ± 1.1	47.1 ± 1.7	1.08	58	<sup>a</sup> 0.319 <sup>ns</sup>
LIVDs (mm)	30.3 ± 1.4	31.1 ± 1.8	1.92	58	<sup>a</sup> 0.061 <sup>ns</sup>
LVEF (%)	59 ± 2	58 ± 2	1.94	58	<sup>a</sup> 0.058 <sup>s</sup>
Wall motion abnormality	2 (6.7%)	3 (10.2%)	0.22	1	<sup>a</sup> 0.500 <sup>ns</sup>
<b>2 month</b>					<sup>a</sup> 0.379 <sup>ns</sup>
LVIDd (mm)	47.2 ± 1.2	46.9 ± 1.4	0.89	58	<sup>a</sup> 0.080 <sup>ns</sup>
LIVDs (mm)	30.1 ± 1.3	30.8 ± 1.7	1.79	58	<sup>a</sup> 0.058 <sup>ns</sup>
LVEF (%)	60 ± 2	59 ± 2	1.94	58	<sup>a</sup> 0.500 <sup>ns</sup>
Wall motion abnormality	1 (3.3%)	2 (6.7%)	0.35	1	
<b>3 months</b>					
LVIDd (mm)	46.9 ± 1.1	46.6 ± 1.3	0.96	58	<sup>a</sup> 0.341 <sup>ns</sup>
LIVDs (mm)	30.0 ± 1.4	30.5 ± 1.6	1.29	58	<sup>a</sup> 0.198 <sup>ns</sup>
LVEF (%)	62 ± 2	61 ± 2	1.94	58	<sup>a</sup> 0.058 <sup>ns</sup>
Wall motion abnormality	1 (3.3%)	1 (3.3%)	-	-	-

**Table 6:** Changes in Echocardiographic variable between groups.

two groups, LCX main trunk involvement were in group I and II 8 and 7 patients respectively and its branches OM1 and OM2 also involved, RCA involvement in two groups were 6 and 5 patients and PDA involvement were 4 and 3 patients respectively in between two groups. The involvements of disease in the coronary arteries were not statistically significant in both groups. Most of the stenosed vessels were graftable, but few had diffuse disease without any scope of placement of a graft. In pre-operative echocardiogram study there is mean value of LVIDd in group I is 47.5 ± 1.1 mm and in group II 47.1 ± 1.7 mm, LIVDs in group I is 30.3 ± 1.4 mm and in group II 31.1 ± 1.8 mm, LVEF in group I 59 ± 2% and in group II 58 ± 2% respectively. There is no statistically significant difference between groups. Wall motion abnormality also predicted by the Echo which shows only 6 (20%) of patients in group I and 8 (26.7%) of patients in group II patients possess it which is also statistically not significant. In our study we did not include those patients whose preoperative EF < 35%. In two study lower limit of EF was 40% [7]. But several other study included even < 30% ejection fraction [2,8-11]. In this study total cross clamp time and extracorporeal circulation time in on pump group was 90 ± 10 minutes and 144 ± 12.8 min respectively. Total operation time and number of graft given has been calculated and compared between groups. The mean operation time in group I is 137 ± 30.7 min and in group II 241 ± 21.6. Which signifies this value between two group statistically, means off pump CABG in left main coronary artery disease less time consuming than its counterpart on-pump CABG. Several other studies also support this observation [3,6,8,12,13]. Number of graft was quiet less in case of OPCAB group i.e. mean graft number in group I is 2.6 ± .9 and in case of group II 3.3 ± .5, when unpaired t test is performed it reveals statistically significant difference between two group, which means in conventional CABG more graft can be given and a little bit good revascularization can be done. This is a drawback of OPCAB surgery. Several other study articles have the same observation result [7,8,10,12,14-16]. But some studies show different results in which number of graft was not significantly different in between two group [11,17]. Post-operative blood loss is a dire consequence of coronary artery bypass surgery, especially in case of on-pump CABG. In our study there is mean blood loss in group I patients is 446.7 ± 197.4 ml and in group II 1199.3 ± 218.0 ml respectively. There is statistically significant difference in two groups, which means that post-operative blood loss through IT tube is less in off pump CABG patients than on pump group. Other studies reiterate the same observation. One study done by Raghuram., *et al.* [18] out of 64 patients underwent OPCAB in left main coronary artery disease and IT tube blood loss only 356 ± 254 ml which value is almost similar to our study value. In another study by Saba., *et al.* [8] the mean value of blood loss in OPCAB group is 415 ± 231 and in on pump group is 589 ± 344 respectively, which is statistically significant value and supports our current study. Similar results were found in other studies [8,19]. As discussed by Woodman and Marker [20] in their article that cardiopulmonary bypass causes significant bleeding tendency both in peri and post operatively

due to some mechanisms, which can be obviously avoided by the OPCAB technique. Post-operative Echo cardigraphic changes and wall motion abnormality changes were observed for three successive months. There are also some changes observed between two groups, but statistical analysis could not reveal any significant differences between two groups. However preoperatively in group I mean value of LVIDd was  $47.5 \pm 1.1$  mm which reduces to  $47.5 \pm 1.1$  mm in 1<sup>st</sup> month,  $47.2 \pm 1.2$  mm in 2<sup>nd</sup> month and  $46.9 \pm 1.1$  mm in 3<sup>rd</sup> month, which is not significant. Also, in case of LVIDs which mean value preoperatively was  $30.3 \pm 1.4$  mm and with no change to  $30.3 \pm 1.4$  in 1<sup>st</sup> month,  $30.1 \pm 1.3$  in 2<sup>nd</sup> month and  $30.3 \pm 1.4$  in 3<sup>rd</sup> month. Whereas pre-operatively in group II mean value of LVIDd was  $47.1 \pm 1.7$  mm with no changes to  $47.1 \pm 1.7$  mm in 1<sup>st</sup> month,  $46.9 \pm 1.4$  mm in 2<sup>nd</sup> month and  $46.6 \pm 1.3$  mm in 3<sup>rd</sup> month, which is also not significant. Same is the case of LVIDs, mean value preoperatively was  $31.1 \pm 1.8$  mm and with no change to  $31.1 \pm 1.8$  in 1<sup>st</sup> month,  $30.8 \pm 1.7$  in 2<sup>nd</sup> month and  $30.5 \pm 1.6$  in 3<sup>rd</sup> month. One study conducted by Sansano, *et al.* [21] depicts improved EF with coronary bypass surgery. This correlates with improved LV function, thus, improvement in cardiac symptoms such as dyspnea, reduced exercise capacity, fatigue and weakness. Chronic LV dysfunction due to viable but hibernating myocardium in patients with severe multiple disease is relatively common. This explains the improvement in 78% of the study population. Here in our study pre-operative EF was in group I  $59 \pm 2$  and in group II  $58 \pm 2$ . But in post-operative follow up this value changes to in group I  $59 \pm 2$  and in group II  $58 \pm 2$  in 1<sup>st</sup> month,  $60 \pm 2$  in group I and  $59 \pm 2$  in group II in 2<sup>nd</sup> month,  $62 \pm 2$  in group I and  $61 \pm 2$  in group II in 3<sup>rd</sup> month respectively. Pre-operative wall motion abnormality was observed in echocardiogram in group I 6 patients and in group II 8 patients. In first month 2 patients in group I and 3 patients in group II, in 2<sup>nd</sup> month 1 patient in group I and 2 patient in group II, in 3<sup>rd</sup> month 1 patient in group I and 1 patient in group was recorded.

### Conclusion

In our institution more than a decade has almost over since the start of OPCAB surgery with gradual success and integrity. However, development of new technology and strategy for off pump bypass surgery eliminated few obstacles in the pathway of progress. Moreover, our surgeon's confidence and skilled manipulation enhance the tremendous success regarding off pump technique which superseded the conventional technique in everyday practice. Most of the surgeons are now performing this technique with appreciable success and outcome.

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