

**Original Article**

# Skeletonized Versus Pedicled Internal Mammary Harvest: Relationship of Pain Towards Technique

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## Abstract

**Objective** Purpose of this study is to compare skeletonized versus pedicled internal mammary harvest. **Introduction** One of the commonly used procedures for multi-vessel and left main coronary artery disease is Coronary Artery Bypass Grafting (CABG with fewer and recurrent complication i.e. Post procedure pain that is an outcome of mechanical, thermal or ischemic injury to the inter-costal nerves during Internal Thoracic Artery (ITA) harvesting. **Methodology** This study is being done to examine whether skeletonized or pedicle harvesting results in lesser occurrence and intensity of post-CABG pain with aim to identify which one is the better of the two techniques that can be used in future for patients planned with CABG. 63 consecutive patients were recruited at Tabba Heart Institute who underwent median sternotomy for CABG with Internal Thoracic Artery harvest were included. Group A went harvesting through skeletonization whereas patients in group B underwent harvesting by Pedicle ITA. This initial screening was done with the help of pre designed questionnaire. The data Statistically analyzed by SPSS. **Results** The results of study concluded that skeletonization of ITA does not reduce post coronary artery bypass graft surgery pain at the end of one month intervals. It is suggested that that skeletonized ITA is only beneficial when bilateral ITA are used. **Conclusion** It was concluded that skeletonization of ITA does not reduce post coronary artery bypass graft surgery pain at the end of one month intervals. We suggest that that skeletonized ITA is only beneficial when bilateral ITA has been used.

## Keywords

Skeletonization, Coronary Artery Bypass Grafting, Internal Thoracic Artery, Pedicled Internal Mammary Harvest, Internal Thoracic Artery Harvesting

## Introduction

Coronary Artery Bypass Grafting (CABG), one of the universally commonest procedure being done for multi-vessel and left main coronary artery disease, has a weakly accepted but frequent complication i.e. Post procedure pain. The prevalence of post-CABG pain lies between 30% and 60% (Eisenberg, E., et al. 2001). It is principally assumed that the pain is neurogenic in nature (Mailis, A., et al. 2000) and has been claimed that pain can be instigated or at least contributed to by injury (mechanical,

thermal or ischemic) to the inter-costal nerves during Internal thoracic artery (ITA) harvesting (Mailis, A., et al. 1989) due to the close proximity of the nerves to the ITA. The two techniques of ITA harvesting are in routine clinical use including the conventional technique, pedicled harvesting in which the ITA is harvested with a sheath of perivascular tissue comprising the internal thoracic veins, the peri-vascular fat pad, and a strip of endo-thoracic fascia. Usually, cautery is used to divide the arterial branches, potentially producing thermal

injury to the inter-costal nerves. While in the skeletonized technique the artery is harvested in isolation, with minimal use of cautery, leaving peri-vascular tissue largely intact (Keeley, S. B. 1987; Markman, P. L., et al. 2010). The incidence and character of post-CABG pain among skeletonized and pedicled Internal thoracic artery (ITA) grafted patients is not well known. As Skeletonized harvesting of the ITA has been proposed as a potential solution to some of the problems associated with ITA harvesting with some of the proposed benefits include increased conduit length (Calafiore, A. M., et al 1999) increased conduit blood flow (Bawany, F. I., et al. 2014; Deja, M. A., et al. 1999) reduced sternal hypoperfusion (Kamiya, H., et al. 2008; Cohen, A. J., 1999) reduced sternal wound infection (Calafiore, A. M., et al 1999; Bawany, F. I., et al. 2014) such as mediastinitis (Sá, M. P., et al. 2011) and reduced postoperative bleeding (Calafiore, A. M., et al 1999) additionally, several studies have also suggested that skeletonization reduces post-CABG pain (Bawany, F. I., et al. 2014; Wimmer-Greinecker G et al. 1999; Bawany, F. I., et al. 2014). VAS pain score at the end of 30 days was  $30.4 \pm 4.0$  and  $55.0 \pm 5.7$  in skeletonized versus pedicled harvesting technique respectively (Bawany, F. I., et al. 2014).

As the data on this topic is inadequately available internationally therefore this study is being done to investigate whether skeletonized or pedicle harvesting results in lesser occurrence and intensity of post-CABG pain. The better of the two techniques will be used in future in patients planned for CABG.

### **Methodology**

A total of 63 consecutive patients recruited for between January 2015 to April 2015 at Tabba Heart Institute. All Patients who

underwent median sternotomy for Coronary Artery Bypass Grafting with Internal Thoracic Artery harvest were included. Patients who will have neurologic complications i.e. altered sensorium, Stroke, paraplegia and hemiplegia, Redo CABG and Patients with history of rib fracture secondary to trauma were excluded from the study. Patients meeting the inclusion criteria admitted in Tabba Heart Institute fulfils the CABG criteria were included in the study. Prior to inclusion informed consent were taken after explaining the risk, benefits, purpose and procedure of the study. Permission from the institutional ethical review committee was obtained prior to conduct of the study. Two groups were divided on the basis of randomization in which Group A went harvesting through skeletonization whereas patients in group B underwent harvesting by Pedicle ITA. Patients were managed as per the declaration of Helsinki ethical principles and standard clinical guidelines. The cases were followed as hospital policy and Postoperative CABG pain was assessed at the end of 30 days of surgery on visual analogue scale (VAS) of 0-10. This initial screening was done with the help of pre designed questionnaire. The data was Statistically analyzed will be done by SPSS software version 17.0 for Windows. Mean and standard deviation calculated for age, height, weight, BMI and pain scores. Frequencies and percentages were calculated for gender DM, HTN, smoking status and obesity and the two groups were compared in terms of mean pain scores at the end of 30 days postoperatively.

### **Results**

Out of all 63 patients 32 (50.7%) patients underwent Skeletonization ITA technique and 31 (49.2) patients underwent pedicle ITA technique. Mean age was  $56.5 \pm 7.39$  in

Skeletonization ITA group and  $56.23 \pm 6.95$  in pedicle ITA group. Patients > 50 years of age was 26 (81.3%) and 25 (80.6%) in Skeletonization and pedicle ITA group respectively. In gender distribution, males were 29 (90.6%) and females were 3 (9.4%) in Skeletonization ITA group and in pedicle ITA group male were 26 (83.9%) and females were 5 (16.1%).

Pre-operative risk factors were presented between two groups, which included diabetes, hypertension, smoking, height, weight and Obesity. Patients with diabetes was 18 (56.3%) and 19 (61.3%) in Skeletonization and pedicle ITA group respectively. The presence of hypertension in skeletonization group was 24 (75%) and in pedicle ITA group was 21 (67.7%). Mean BMI was  $26.76 \pm 3.75$  in Skeletonization ITA group and  $27.02 \pm 3.82$  in pedicle ITA group. Obesity was only 18.8% in Skeletonization ITA group and 22.6% in pedicle ITA group. Patients with smoking habit was 11 (34.4%) in Skeletonization ITA group and 7 (22.6%) in pedicle ITA group.

Pain was assessed at the end of 30 days of surgery on visual analogue scale, overall mean pain score was  $2.78 \pm 1.33$ , in Skeletonization ITA group mean pain score was  $2.69 \pm 1.49$  and in pedicle ITA group mean pain score was  $2.87 \pm 1.15$  (P value 0.648).

In table 2 pain experience and management of patient is presented. Almost 75% patients in both groups get pain relieved by taking medicine. In Skeletonization ITA group 25% and in pedicle ITA group 32% patients made changes in their lifestyle due to pain. Thinking of non-specific pain reason was 68.8% and 80.6% in Skeletonization and pedicle ITA group respectively. Pain medications was taken only when pain observed was 56% and 58 % in Skeletonization and pedicle ITA group respectively. Pain site was 28% at surgical site, 28% was limb pain, 31% was diffuse and 13% was left side chest pain in skeletonization group and 13% at surgical site, 22% was limb pain, 58% was diffuse and 7% was left side chest pain in pedicle ITA group.

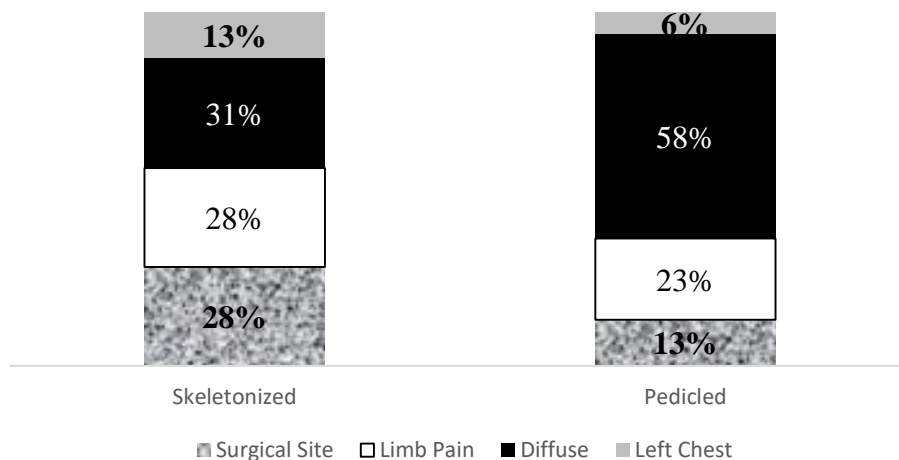
**Table 1: Baseline Characteristics by Skeletonization and Pedicle ITA Group.**

Risk Factor	Skeletonization	Pedicle ITA	Total	P Value	Test
	n=32	n=31	n=63		
Age in Years	$56.5 \pm 7.39$	$56.23 \pm 6.95$	$56.37 \pm 7.12$	0.880	T-Test
Age <= 50 years n (%)	6 (18.8%)	6 (19.4%)	12 (19%)	0.951	Chi Sq
Age >50 Years n (%)	26 (81.3%)	25 (80.6%)	51 (81%)		
Weight in (Kg)	$74.14 \pm 11.86$	$73.39 \pm 10.31$	$73.77 \pm 11.04$	0.789	T-Test
Height in (cms)	$166.47 \pm 8.08$	$164.97 \pm 5.92$	$165.73 \pm 7.09$	0.405	T-Test
BMI (kg/m <sup>2</sup> )	$26.76 \pm 3.75$	$27.02 \pm 3.82$	$26.89 \pm 3.76$	0.784	T-Test
Obesity: (BMI>30kg/m <sup>2</sup> ) no. (%)	6 (18.8%)	7 (22.6%)	13 (20.6%)	0.707	Chi Sq
Male n (%)	29 (90.6%)	26 (83.9%)	55 (87.3%)	0.474	Fisher's Ex
Female n (%)	3 (9.4%)	5 (16.1%)	8 (12.7%)		
Diabetes n (%)	18 (56.3%)	19 (61.3%)	37 (58.7%)	0.685	Chi Sq
Hypertension n (%)	24 (75%)	21 (67.7%)	45 (71.4%)	0.524	Chi Sq
Smoking n (%)	11 (34.4%)	7 (22.6%)	18 (28.6%)	0.300	Chi Sq
Pain Score	$2.69 \pm 1.49$	$2.87 \pm 1.15$	$2.78 \pm 1.33$	0.648	MWhitney

**Table 2: Pain Experience**

Question	Skeletonization n=32	Pedicle ITA n=31
Does the pain get relieved by taking medicine? n (%)		
Yes	24 (75)	23 (74.2)
No	8 (25)	8 (25.8)
Has your pain forced you to make changes in your lifestyle? n (%)		
Yes	8 (25)	10 (32.3)
No	24 (75)	21 (67.7)
What you think causes your pain? n (%)		
Walking	5 (15.6)	2 (6.5)
Exercise	5 (15.6)	4 (12.9)
Non-specific reason	22 (68.8)	25 (80.6)
How often do you take pain medications? n (%)		
4 hourly	- (0)	- (0)
6 hourly	5 (15.6)	3 (9.7)
8 hourly	9 (28.1)	10 (32.3)
Only when I observe pain	18 (56.3)	18 (58.1)
Where is your pain? n (%)		
Surgical Site	9 (28.1)	4 (12.9)
Limb Pain	9 (28.1)	7 (22.6)
Diffuse	10 (31.3)	18 (58.1)
Left Chest	4 (12.5)	2 (6.5)

**Figure 1: Showing The Location of Pain Experienced**



**Discussion**

The skeletonization of internal thoracic artery is postulated to improve graft length,

early blood flow, sternal blood supply, and postoperative respiratory function. Concern exists that skeletonization may injure

internal thoracic artery, precluding good results of surgery. Reports on endothelial function of skeletonized internal thoracic artery are lacking. A prospective assessment of 80 randomized patients were selected undergoing coronary artery bypass grafting was performed in two groups divided 40 patients with skeletonized and 40 with Pedicle group respectively.

Nonanginal chest wall pain is a frequent complication of coronary artery bypass graft (CABG) surgery. The prevalence of post-CABG pain lies between 30% and 60%. ITA can be dissected in two manners, pedicled or skeletonized. The skeletonization technique helps to maintain the sternal blood flow and to preserve the integrity of chest wall. As a result, it helps to reduce postoperative sternal complications. (Matsa, M., et al. 2001; Athanasiou, T., et al. 2004; Wimmer-Greinecker, G., et al. 1999). Furthermore, some studies have also suggested that skeletonization reduces post-CABG pain (Takami, Y., & Ina, H., 2002).

The incidence and character of post-CABG pain among skeletonized and pedicled ITA-grafted patients is not well known. This study was done to investigate whether skeletonized or pedicle harvesting results in lesser incidence and intensity of post-CABG pain.

The benefits of skeletonized harvesting include increased graft flow, (Deja, M. A., et al. 1999). Increased graft length (Calafiore, A. M., et al. 1999; Cameron, A., et al. 1988) and decreased incidence of mediastinitis. (Grondin, C. M., et al. 1984). Another important benefit of skeletonized harvesting is the reduction in postoperative pain (Deja, M. A., et al. 1999). Pain is a subjective sensation and has a major impact on the quality of life of patients. Studies have

shown that persistent pain and dysesthesia lead to a significant reduction in quality of life (Grondin, C. M., et al. 1984).

Internal thoracic artery (ITA) is the conduit of choice in the surgical treatment of coronary artery disease. According to the Coronary Artery Surgery Study results, grafting of the left anterior descending (LAD) coronary artery with the left internal thoracic artery (LITA) has been the independent predictor of survival after coronary artery bypass grafting (Athanasiou, T., et al. 2004). Left ITA grafts when compared with saphenous vein grafts remain patent and free from arteriosclerosis for a longer time (Calafiore, A. M., et al. 1999).

According to generalized Systematic review of Pedicle and skeletonized grafts searching Medline from 1966 to 2003, the weighted mean difference founds 32ml/min (CI 29-36) in favor of skeletonized IMA (Athanasiou, T., et al. 2004) while another retrospective cohort study results showed Pedicle 28/304 (2.5%). Skeletonized 14/842 (1.7%)  $p < 0.005$  that were not similar with the skeletonized group, having a lower ejection fraction and more redo procedures (Calafiore, A. M., et al. 1999; Deja, M. A., et al. 1999) while few study showed the VAS pain score at the end of 30 days was  $30.4 \pm 4.0$  and  $55.0 \pm 5.7$  in skeletonized versus pedicled harvesting technique respectively (Bawany, F. I., et al. 2014). There is thus good evidence that flow and length is increased using a skeletonized technique. In addition, skeletonization is far superior to pedicled harvest for BIMA grafts in diabetics and reduces the sternal infection rate from 10% to around 2% in these patients. However, no significant differences in terms of sternal complications or vascular patency have been shown for LIMA harvest and consistently add 15–20 min to the length

of the operation. We failed to see any difference in post-operative pain or requirement of pain killers or quality of life affected by pain. This point raises a question that whether ischemia is really to blame for this pain and how much is the effect of electrical burn. Since diathermy was hardly used in skeletonized technique.

### Conclusion

Study results concluded that skeletonization of ITA does not reduce post coronary artery bypass graft surgery pain at the end of one month intervals. We suggest that that skeletonized ITA is only beneficial when bilateral ITA has been used.

### Acknowledgement

N/A

### Conflict of Interest

N/A

### References

- Athanasiou, T., Crossman, M. C., Asimakopoulos, G., Cherian, A., Weerasinghe, A., Glenville, B., & Casula, R. (2004). Should the internal thoracic artery be skeletonized? *The Annals of thoracic surgery*, 77(6), 2238-2246.
- Bawany, F. I., Khan, M. S., Khan, A., Kazi, A. N., & Naeem, M. (2014). Using skeletonised grafts for coronary artery bypass grafting. *JPMA. The Journal of the Pakistan Medical Association*, 64(5), 606-610.
- Bawany, F. I., Khan, M. S., Khan, A., & Hussain, M. (2014). Skeletonization technique in coronary artery bypass graft surgery reduces the postoperative pain intensity and disability index. *Journal of cardiac surgery*, 29(1), 47-50.
- Calafiore, A. M., Vitolla, G., Iaco, A. L., Fino, C., Di Giammarco, G.,

Marchesani, F., D'Addario, G., Teodori, G. Mazzei, V. (1999). Bilateral internal mammary artery grafting: midterm results of pedicled versus skeletonized conduits. *The Annals of thoracic surgery*, 67(6), 1637-1642.

- Cameron, A., Davis, K. B., Green, G. E., Myers, W. O., & Pettinger, M. (1988). Clinical implications of internal mammary artery bypass grafts: The Coronary Artery Surgery Study experience. *Circulation*, 77(4), 815-819.
- Cohen, A. J., Lockman, J., Lorberboym, M., Bder, O., Cohena, N., Medalion, B., & Schachner, A. (1999). Assessment of sternal vascularity with single photon emission computed tomography after harvesting of the internal thoracic artery. *The Journal of thoracic and cardiovascular surgery*, 118(3), 496-502.
- Deja, M. A., Woś, S., Gołba, K. S., Żurek, P., Domaradzki, W., Bachowski, R., & Spyt, T. J. (1999). Intraoperative and laboratory evaluation of skeletonized versus pedicled internal thoracic artery. *The Annals of thoracic surgery*, 68(6), 2164-2168.
- Eisenberg, E., Pultorak, Y., Pud, D., & Bar-El, Y. (2001). Prevalence and characteristics of post coronary artery bypass graft surgery pain (PCP). *Pain*, 92(1), 11-17.
- Grondin, C. M., Campeau, L., Lesperance, J., Enjalbert, M., & Bourassa, M. G. (1984). Comparison of late changes in internal mammary artery and saphenous vein grafts in two consecutive series of patients 10 years after operation. *Circulation*, 70(3 Pt 2), I208-12.
- Kamiya, H., Akhyari, P., Martens, A., Karck, M., Haverich, A., & Lichtenberg, A. (2008). Sternal microcirculation after skeletonized versus pedicled harvesting of the internal thoracic artery: a

- randomized study. *The Journal of thoracic and cardiovascular surgery*, 135(1), 32-37.
- Keeley, S. B. (1987). The skeletonized internal mammary artery. *The Annals of thoracic surgery*, 44(3), 324-325.
  - Mailis, A., Chan, J., Basinski, A., Feindel, C., Vanderlinden, G., Taylor, A., Flock, D. and Evans, D. (1989). Chest wall pain after aortocoronary bypass surgery using internal mammary artery graft: a new pain syndrome? *Heart & lung: the journal of critical care*, 18(6), 553-558.
  - Mailis, A., Umana, M., & Feindel, C. M. (2000). Anterior intercostal nerve damage after coronary artery bypass graft surgery with use of internal thoracic artery graft. *The Annals of thoracic surgery*, 69(5), 1455-1458.
  - Markman, P. L., Rowland, M. A., Leong, J. Y., Van Der Merwe, J., Storey, E., Marasco, S., Negri, J., Bailey, M. & Rosenfeldt, F. L. (2010). Skeletonized internal thoracic artery harvesting reduces chest wall dysesthesia after coronary bypass surgery. *The Journal of thoracic and cardiovascular surgery*, 139(3), 674-679.
  - Matsa, M., Paz, Y., Gurevitch, J., Shapira, I., Kramer, A., Pevny, D., & Mohr, R. (2001). Bilateral skeletonized internal thoracic artery grafts in patients with diabetes mellitus. *The Journal of Thoracic and Cardiovascular Surgery*, 121(4), 668-674.
  - Sá, M. P. B. D. O., Soares, E. F., Santos, C. A., Figueiredo, O. J., Lima, R. O. A., Escobar, R. R., Rueda, F. G. D. & Lima, R. D. C. (2011). Risk factors for mediastinitis after coronary artery bypass grafting surgery. *Revista Brasileira de Cirurgia Cardiovascular*, 26(1), 27-35.
  - Takami, Y., & Ina, H. (2002). Effects of skeletonization on intraoperative flow and anastomosis diameter of internal thoracic arteries in coronary artery bypass grafting. *The Annals of thoracic surgery*, 73(5), 1441-1445.
  - Wimmer-Greinecker, G., Yosseef-Hakimi, M., Rinne, T., Buhl, R., Matheis, G., Martens, S., ... & Moritz, A. (1999). Effect of internal thoracic artery preparation on blood loss, lung function, and pain. *The Annals of thoracic surgery*, 67(4), 1078-1082.