

# Evaluation of Early Changes in Troponin Levels During Dental Surgery in Patients with a History of Ischemic Heart Disease

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## Abstract

**Background and Aim:** Dental treatments may have adverse effects on patients with a previous history of coronary heart disease and lead to cardiac complications. Different biomarkers have been investigated to assess the relationship between dental treatments and cardiovascular complications. The present study was conducted to evaluate the troponin changes before and after dental surgery in patients with a history of ischemic heart disease.

**Materials and Methods:** This cross-sectional study was conducted on 25 patients referred for dental surgery with a history of ischemic heart disease. The patients' demographic information including their age and gender was collected, and serum levels of troponin were measured before surgery and at 4 hours after surgery, and the results were compared. The study data were entered into SPSS version 23 and analyzed by the Student t-test and McNemar test.

**Results:** In the present study, 25 patients including 11 males and 14 females with a mean age of 44.78 years were evaluated. The mean level of troponin was  $8.01 \pm 5.94$  before surgery and  $6.16 \pm 4.84$  after surgery. Statistically, no significant difference was found between troponin levels before and after surgery in patients ( $P=0.274$ ).

**Conclusion:** based on the results of the present study, no significant change was noted in troponin levels of patients with a previous history of ischemic heart disease at 4 hours after dental surgery.

**Key Words:** Dentistry; Myocardial Ischemia; Troponin

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## Introduction

Cardiovascular disease is the leading cause of death worldwide.[1] Atherosclerosis is the leading cause of coronary heart disease.[2] Even minor myocardial damage caused by treatments can exacerbate myocardial ischemia and cause angina pectoris, cardiac

arrhythmia, and heart failure. Cardiac ischemia can increase the blood troponin levels.[3-6] The importance of this issue is so high that even death due to cardiac ischemia has been reported in patients undergoing dental procedures.[7] An epidemiological study also reported an association between dental

procedures and an increased risk of cardiovascular events, although that study did not report the main mechanism of this association, and studies on finding the roots of this association are in the early stages.[8] Also, dental surgery can cause acute pain, stress, and anxiety. The human body responds to stress by releasing catecholamines from the adrenal glands, which increase the heart rate and the heart's demand for oxygen, and can be dangerous in patients with hypertension and ischemic heart disease.[9] In a study conducted by Mesgarzadeh et al, (10) 3.9% of dental patients had ischemic heart disease. Cardiac troponin is a cardiac biomarker that is released into the bloodstream by the cardiac muscle cells when a cardiac muscle cell is damaged and it is used to assess myocardial damage. The specificity of serum troponin for detection of myocardial ischemic damage is 90%.[11-13]

Temporary increase in cardiac troponin levels following dental surgery may be due to a temporary increase in the permeability of the cardiac muscle cells, similar to what occurs in ischemia or following heavy exercise, or due to breakdown of the myocyte membrane after myocardial ischemia in heart attack.[14-16] Temporary increase in troponin levels occurs sharply and returns to normal levels after 72 hours; whereas, in the case of cellular necrosis, this increase will be very high and lasts for 4 to 7 days.[17-21] The results of a study conducted by Devereaux et al.[20] showed that an increase in troponin level above 5 ng/mL was associated with an increased risk of mortality one month after surgery. The risk of serious heart problems in patients with a history of ischemic heart disease in minor oral surgical procedures is less than 1%.[13,21] In a study conducted by Habbab et al,[19] serum levels of troponin T were evaluated 24 hours after dental procedures and an increase was observed in troponin levels in both groups of patients with a history of coronary artery

disease and those with no such a history. Given the importance of dental surgery in patients with ischemic heart disease, and as previous studies have not evaluated early changes in troponin levels after dental surgery, the present study was conducted to evaluate the changes in troponin levels 4 hours after dental surgery.

### Materials and Methods

After approving the research project by the Research Deputy of the School of Dentistry, Isfahan University of Medical Sciences and obtaining the ethical approval code (IR.MUI.RESEARCH.REC.1398.560), 25 patients who met the inclusion criteria were selected, briefed about the study, and written informed consent was obtained from them. This cross-sectional (descriptive-analytical) study was conducted on 25 patients referred to the dental treatment center of the School of Dentistry of Isfahan University of Medical Sciences in 2019 who had a previous history of ischemic heart disease including stable angina, history of coronary artery surgery, and history of coronary artery stent placement, and were candidates for dental surgery. The patients were enrolled by convenience sampling until the sample size was reached. The inclusion criteria were age over 40 years, history of ischemic heart disease including stable angina, history of coronary artery surgery, and history of coronary artery stent placement, being a candidate for dental surgical procedures such as surgical extraction of impacted teeth or those fractured at the bone level, willingness for participation in the study, and consenting to blood sampling before and after the dental surgical procedure to assess their troponin level. If it was not possible to obtain a blood sample 4 hours after the procedure, the patient would be excluded from the study or the surgical procedure would be rescheduled. In case of any emergency that would necessitate stopping the procedure, the surgery would be

stopped but a blood sample would be obtained from the patient. Demographic information of all patients including their age, gender, and type of cardiovascular disease was recorded in a checklist. After obtaining the above-mentioned information and before the onset of surgical procedure, the patients' vital signs were measured and recorded. In case of systolic blood pressure above 140 mmHg and diastolic blood pressure above 85 mmHg, having chest pain, shortness of breath, or cardiac arrhythmia, the patient would be excluded from the study. Then, blood sampling was performed to assess the serum troponin T levels. Next, the patients underwent dental surgery. Local anesthesia was induced by injection of two cartridges of lidocaine plus 1:100,000 epinephrine (Darou Pakhsh, Tehran, Iran), and if further local anesthetic injection was needed, Prilocaine (Darou Pakhsh, Tehran, Iran) would be used. Also, all surgical procedures were performed by one surgeon. Finally, after completion of dental procedure, blood samples were taken again from all patients after 4 hours to check the postoperative level of troponin T. At this time, presence of cardiac symptoms such as chest pain, chest heaviness, chest burning, cold sweats, shortness of breath, and vomiting was asked and recorded. It should be noted that all blood samplings were performed by an experienced nurse. At all stages of the study, the resuscitation trolley was present at the patient's bedside in case of emergency. The patients' blood samples were placed in an ice container immediately after collection and were all transferred to a laboratory. The obtained data were entered into SPSS version 23. Descriptive data were reported as mean, standard deviation, percentage, and absolute frequency. The Student's t-test and McNemar test were used to analyze the data. P-values less than 0.05 were considered significant.

## Results

In the present study, 25 patients including 11 males (44%) and 14 females (56%), were evaluated. The mean age of patients was  $44.78 \pm 0.84$  years and the age range of them was 40 to 57 years. The mean troponin level of patients was  $8.01 \pm 5.94$  before and  $6.16 \pm 4.84$  after the dental procedure. Comparison of serum troponin levels before and after dental procedure did not show a statistically significant difference ( $P = 0.274$ ) (Table 1). Comparing the changes in troponin levels based on gender of subjects shows that troponin levels did not differ significantly between males and females before dental surgery ( $P = 0.56$ ). Also, a significant difference was not observed between males and females after dental surgery ( $P = 0.21$ ). Finally, comparison of troponin changes in males and females did not show a statistically significant difference ( $P = 0.56$ ) (Table 2). Examination of troponin levels before and after dental surgery did not show an association with age, as shown in Table 3 ( $P = 0.45$ ) (Table 3).

## Discussion

Cardiac troponin can be elevated in a variety of conditions other than acute myocardial infarction, such as dental procedures. Therefore, an accurate diagnosis in a patient with an elevated troponin level relies heavily on the clinical information of that particular case.[22] In our study, the troponin levels did not change at 4 hours after dental surgery in patients with a previous history of ischemic heart disease.

In a study conducted by Skaar et al,[23] it was reported that due to the increased risk of cardiovascular events following dental procedures, there should be an interval of 30 to 180 days after an acute ischemia and dental procedures. They prohibited dental procedures and even the simplest procedures, such as radiography, dental examination, restoration, crowns, bridges, implant placement, and

**Table 1. Comparison of troponin levels before and after dental surgery**

	before dental surgery	after dental surgery	P-value
<b>troponin levels</b>	8.01±5.94	6.16±4.84	0.274

**Table 2. Comparison of troponin levels before and after dental surgery separately in terms of gender**

Variable	troponin levels		P-value	P-value
	before dental surgery	after dental surgery		
<b>Male</b>	9.76±7.02	8.04±6.58	0.56	0.56
<b>Female</b>	6.58±5.09	3.97±3.48	0.21	

**Table 3. Investigating the relationship between troponin levels and its changes and age of the subjects**

	r	P-value
<b>Troponin before dental surgery</b>	-0.074	0.72
<b>Troponin after dental surgery</b>	0.029	0/82
<b>Troponin changes</b>	-0.15	0/45

orthodontic treatment. Temporary increase in cardiac troponin levels following dental surgery may be due to a temporary increase in permeability of cardiac muscle cells. In fact, temporary increase in serum troponin levels may be due to the release of troponin from the cardiac muscle cells, such as what occurs in ischemia or following heavy exercise. Among patients with coronary heart disease, a rise in the troponin level should be considered as a serious event.[4] If the increase is sharp and sudden, cardiac measures should be taken and it may even be necessary to stop any dental intervention, even minor procedures, and take emergency cardiac measures.[24]

In recent years, a number of studies have shown a significant association between cardiovascular events and dental conditions. [14-16] The process of atherosclerosis has a

significant association with periodontal disease. Also, atherosclerosis has been reported as a major risk factor for cardiovascular disease. Thus, it is crucial to find biomarkers that can show the risk of cardiovascular events in dental procedures.[9] Based on the results of this study, serum troponin levels did not show a significant change in patients with a previous history of cardiovascular disease after dental surgery. In contrast, Habbab et al.[19] revealed that dental procedures significantly increased serum levels of troponin T at 24 hours after dental procedure. However, our results were in line with those of a study conducted by Conrado et al,[25] which reported that troponin levels did not increase following dental procedure. Based on the results of this study, changes in serum troponin levels before and after surgery were

not associated with gender, which is consistent with the results of Habbab et al.[19] Based on the results of this study, changes in serum troponin levels before and after surgery were not associated with age, which is also consistent with the results of Habbab et al.[19] In the study conducted by Habbab et al,[19] serum levels of troponin T were evaluated 24 hours after dental procedure, and an increase in troponin level was observed in both groups of patients with and without a history of coronary artery disease.[19] Lack of a significant increase in troponin level in the study conducted by Conrado et al.[25] might be due to not measuring the highly sensitive troponin.[25,26] Lack of a significant change in troponin levels in the study conducted by Hobbab et al,[19] and in our study might be due to the short measurement time of this biomarker after dental surgery, as in the study conducted by Hobbab et al,[19] the measurements were made 24 hours after dental procedure. Our study found no early changes in cardiac troponin following dental surgery. Considering the controversy in the results of studies, and since some studies have reported possible cardiovascular complications following dental procedures for patients with cardiovascular disease,[13,21] further studies are recommended in this regard.

## Conclusion

Based on the results of the present study, the troponin levels did not change at 4 hours after surgery following dental surgery in patients with a previous history of ischemic heart disease.

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## Conflict of interests

The authors declare that there is no conflict of interests.

## References

1. Roger VL, Go AS, Lloyd-Jones DM, Benjamin EJ, Berry JD, Borden WB, et al. Heart disease and stroke statistics--2012 update: a report from the American Heart Association. *Circulation*. 2012 Jan 3;125(1):e2-e220.
2. Libby P, Ridker PM, Hansson GK. Inflammation in atherosclerosis. *J Am Coll Cardiol*. 2009 Dec 1; 54(23): 2129–38.
3. Saadeddin SM, Habbab MA, Sobki SH, Ferns GA. Biochemical detection of minor myocardial injury after elective, uncomplicated, successful percutaneous coronary intervention in patients with stable angina: clinical outcome. *Ann Clin Biochem*. 2002 Jul;39(Pt 4):392-7.
4. Prasad A, Singh M, Lerman A, Lennon RJ, Holmes DR Jr, Rihal CS. Isolated elevation in troponin T after percutaneous coronary intervention is associated with higher long-term mortality. *J Am Coll Cardiol*. 2006 Nov 7;48(9):1765-70.
5. Sanz M, D'Aiuto F, Deanfield J, Fernandez-Avilés F. European workshop in periodontal health and cardiovascular disease—scientific evidence on the association between periodontal and cardiovascular diseases: a review of the literature. *European heart journal supplements*. 2010;12(suppl\_B):B3-B12.
6. Bouchard P, Boutouyrie P, D'Aiuto F, Deanfield J, Deliargyris E, Fernandez-Avilés F, et al. European workshop in periodontal health and cardiovascular disease consensus document. *European heart journal supplements*. 2010;12 (suppl\_B):B13-B22.
7. Smith MM, Barbara DW, Mauermann WJ, Viozzi CF, Dearani JA, Grim KJ. Morbidity and mortality associated with dental extraction before cardiac operation. *Ann Thorac Surg*. 2014 Mar;97(3):838-44.
8. Minassian C, D'Aiuto F, Hingorani AD, Smeeth L. Invasive dental treatment and risk for vascular events: a self-controlled case series. *Ann Intern Med*. 2010 Oct 19; 153 (8):499-506.
9. Malamed SF. Knowing your patients. *J Am Dent Assoc*. 2010 May;141 Suppl 1:3S-7S.

10. Mesgarzadeh A, Hashemi HM, Sharifi R, Hasheminasab M, Karimi A. A retrospective study of medically compromised patients referred to the Department of Oral and Maxillofacial Surgery, School of Dentistry of Tehran University of Medical Sciences, Iran. *J Craniomax Res.* 2014;1(1):11-6.
11. Little JW, Falace DA, Miller CS, Rhodus NL. *Dental Management of the Medically Compromised Patient.* 8th ed. St. Louis: Elsevier; 2013. 716 p.
12. Shave R, George KP, Atkinson G, Hart E, Middleton N, Whyte G, Gaze D, Collinson PO. Exercise-induced cardiac troponin T release: a meta-analysis. *Med Sci Sports Exerc.* 2007 Dec;39(12):2099-106.
13. Saadeddin SM, Habbab MA, Sobki SH, Ferns GA. Association of systemic inflammatory state with troponin I elevation after elective uncomplicated percutaneous coronary intervention. *Am J Cardiol.* 2002 Apr 15;89(8):981-3.
14. Scherr J, Braun S, Schuster T, Hartmann C, Moehlenkamp S, Wolfarth B, Pressler A, Halle M. 72-h kinetics of high-sensitive troponin T and inflammatory markers after marathon. *Med Sci Sports Exerc.* 2011 Oct;43(10):1819-27.
15. Wu AH, Apple FS, Gibler WB, Jesse RL, Warshaw MM, Valdes R Jr. National Academy of Clinical Biochemistry Standards of Laboratory Practice: recommendations for the use of cardiac markers in coronary artery diseases. *Clin Chem.* 1999 Jul;45(7):1104-21.
16. Mousavi N, Czarnecki A, Kumar K, Fallah-Rad N, Lytwyn M, Han SY, Francis A, Walker JR, Kirkpatrick ID, Neilan TG, Sharma S, Jassal DS. Relation of biomarkers and cardiac magnetic resonance imaging after marathon running. *Am J Cardiol.* 2009 May 15;103(10):1467-72.
17. Ricciardi MJ, Wu E, Davidson CJ, Choi KM, Klocke FJ, Bonow RO, Judd RM, Kim RJ. Visualization of discrete microinfarction after percutaneous coronary intervention associated with mild creatine kinase-MB elevation. *Circulation.* 2001 Jun 12;103(23):2780-3.
18. Loos BG, Craandijk J, Hoek FJ, Wertheim-van Dillen PM, van der Velden U. Elevation of systemic markers related to cardiovascular diseases in the peripheral blood of periodontitis patients. *J Periodontol.* 2000 Oct;71(10):1528-34.
19. Habbab K, D'Aiuto F, Habbab M, Porter S. Molecular markers relevant to myocardial injury following dental extraction in patients with and without coronary artery disease. *BDJ open.* 2019;5(1):1-9.
20. Devereaux P, Biccard BM, Sigamani A, Xavier D, Chan MT, Srinathan SK, et al. Association of Postoperative High-Sensitivity Troponin Levels With Myocardial Injury and 30-Day Mortality Among Patients Undergoing Noncardiac Surgery. *JAMA.* 2017 Apr 25;317(16):1642-1651.
21. Saadeddin SM, Habbab MA, Sobki SH, Ferns GA. Minor myocardial injury after elective uncomplicated successful PTCA with or without stenting: detection by cardiac troponins. *Catheter Cardiovasc Interv.* 2001 Jun;53(2):188-92.
22. Roongsritong C, Warraich I, Bradley C. Common causes of troponin elevations in the absence of acute myocardial infarction: incidence and clinical significance. *Chest.* 2004 May;125(5):1877-84.
23. Skaar D, O'Connor H, Lunos S, Luepker R, Michalowicz BS. Dental procedures and risk of experiencing a second vascular event in a Medicare population. *J Am Dent Assoc.* 2012 Nov;143(11):1190-8.
24. D'Aiuto F, Parkar M, Tonetti MS. Periodontal therapy: a novel acute inflammatory model. *Inflamm Res.* 2005 Oct; 54(10):412-4.
25. Conrado VC, de Andrade J, de Angelis GA, de Andrade AC, Timerman L, Andrade MM, Moreira DR, Sousa AG, Sousa JE, Piegas LS. Cardiovascular effects of local anesthesia with vasoconstrictor during dental extraction in coronary patients. *Arq Bras Cardiol.* 2007 May;88(5):507-13.
26. Morrow DA. Clinical application of sensitive troponin assays. *N Engl J Med.* 2009 Aug 27;361(9):913-5.