



# Evaluation of trigeminocardiac reflex during Le Fort I and sagittal split ramus osteotomies

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ARTICLE INFO	ABSTRACT
<p>Article Type: <b>Original Article</b></p> <p>Received: 27 Jan 2015 Revised: 3 Mar 2015 Accepted: 5 May 2015</p> <p><i>*Corresponding author:</i> Moosa Mahmoudi Craniomaxillofacial Research Center, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran.</p> <p>Tel: +98-2184902473 Fax: +98-2184902473 Email: mahmoodimusa@yahoo.com</p>	<p><b>Introduction:</b> The trigeminocardiac reflex (TCR) refers to the sudden development of bradycardia as well as asystole along with arterial hypotension associated with any manipulation of sensory branches of the trigeminal nerve. Clinically, the TCR has been reported to occur during craniofacial surgery. It is crucial to learn about this sudden physiological response during maxillofacial surgery that is likely to happen with any craniofacial surgical procedures.</p> <p><b>Materials and Methods:</b> In this clinical study 44 volunteers without any systemically compromising conditions were divided into 2 groups. The first group underwent Le Fort I osteotomy and the second mandibular osteotomy. Mean arterial blood pressure and pulse rate (MABP1, PR1) values were recorded before down fracture (DF) of maxilla and Sagittal Splitting (SS) of mandible, during DF and SS (MABP2, PR2), and after DF and SS (MABP3, PR3). The data were analyzed using repeated measure ANOVA tests (p = 0.05).</p> <p><b>Result:</b> In Le Fort I group, PR1 and PR3 were significantly higher than PR2 (P &lt; .001). MABP2 was significantly lower compared with MABP1 and MABP3 (P &lt; .001). PR2 and MABP2 showed a mean decrease of 7.4% and 8.9% compared with PR1 and MABP1, respectively. In second group differences on MABP and PR was not statistically significant.</p> <p><b>Conclusion:</b> It is concluded that TCR is triggered by the stimulation of V2 but V3 branch stimulation does not cause such reflex.</p> <p><b>Keywords:</b> Trigemino-cardiac reflex (TCR), Le Fort Osteotomy, Sagittal split ramus osteotomy.</p>

## Introduction

Trigeminocardiac reflex (TCR), previously referred to as oculocardiac reflex is a surgical manipulation of the fifth cranial nerve during surgical procedures that may lead to bradycardia or even asystole as well as arterial hypotension [1]. The authors studied the impact of this reflex on postoperative auditory function in patients undergoing vestibular schwannoma (VS) surgery.

The sensory nerve endings of the trigeminal nerve send neuronal signals via the Gasserian ganglion to the sensory nucleus of the trigeminal nerve, forming the afferent pathway of the reflex arc. This afferent pathway

continues along the short internuncial nerve fibers in the reticular formation to connect with the efferent pathway in the motor nucleus of the vagus nerve [2]. The efferent fibers travel and end in muscarinic receptors of heart causing vagus mediated negative chronotropic and inotropic responses in the heart. The particular efferent nervous system also goes abdomen which increases gastric motility [3]. TCR is in fact the endogenous bodily protective mechanisms mediated simply by mental system against ischemia. This is one of the oxygen saving reflexes. Within seconds of initiation of such reflex, there is activation of sympathetic

nerves which leads to cerebrovascular vasodilatation. These responses may become exaggerated leading to sinus arrest, asystole or ventricular fibrillation [4]. Hypoxemia, hypercarbia, inadequate anesthesia and characteristics of stimulus are classified as predisposing factors. It is more severe in children because of high resting vagal tone. Lubbers et al classified various facial surgery into low risk (TMJ surgeries including Le Fort I osteotomy and elevation of zygoma, medium risk surgeries (skull base procedures) and high risk surgeries (ophthalmic surgeries, orbital exenteration and fracture in children with cardiac disease) for the precipitation of TCR [5]. Due to the fact that this unpredictable phenomenon is often happened during surgical procedures of craniofacial structures in the distribution of trigeminal nerve, maxillofacial surgeons should know about TCR even though it is not common in daily practice. In this context, we aimed to perform this study to evaluate the TCR phenomena in Le Fort I and mandibular sagittal split osteotomy.

### Material and Methods

The clinical study design was approved by local board of Committee of Ethics of Tehran University of Medical Sciences. Informed consent was obtained after providing volunteers with sufficient information about the study. This study consisted of 22 consecutive patients for Le Fort I osteotomy and 22 for bilateral sagittal split osteotomy (BSSO) which were referred to Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran during a 6 month period. Patients with systemic problems, mental or neurologic disorders, history of use of antidepressants, cardiovascular problems, and those with unexpected events during the course of surgery were excluded from the study. The study primarily included 60 patients, 16 of whom were excluded because of uncontrolled mean arterial blood pressure (MABP), administration of excess drugs during surgery, and disconnection of airway.

The study population consisted of 22 Le Fort I and 22 BSSO patients with a mean age of 26.5 years (range, 18-35 years, 20 female and 24 male). Patients were interviewed upon referral and their health status was recorded. All surgeries were performed by an expert oral and maxillofacial surgeon. General hypotensive anesthesia was administered using Propofol and Remifentanyl, which were continued during the

surgery. After general anesthesia was administered, MABP and pulse rate (PR) were constantly monitored by pulse oximetry until down fracture (DF) of maxilla and sagittal splitting (SS) of mandible and the least values were recorded (MABP1 and PR1). These values were also recorded at the time of DF and SS (MABP2 and PR2). Finally, MABP and PR were constantly monitored after DF and SS and the least values were recorded (MABP3 and PR3).

Data were analyzed through SPSS v.16 (SPSS, Chicago, IL). Based on one-sample Kolmogorov-Smirnov test, data had normal distribution. The data were then statistically analyzed using repeated measures analysis of variance (ANOVA) test.

### Results

In the Le Fort I osteotomy group PR1 and PR3 were significantly higher than PR2 ( $P = .001$ ). PR1 and PR3, however, did not show any statistically significant difference ( $P = .682$ ). Patients' age and gender did not seem to influence the results. In the BSSO osteotomy group, there was no statistically significant difference between PR1, 2 and 3. ( $P = .682$ )

MABP followed the same pattern as PR before, during, and after Le Fort I DF and mandibular osteotomy. In Le Fort I osteotomy group MABP2 value was significantly lower compared with MABP1 and MABP3 values ( $P = .001$ ). Similar to PR, no statistically significant differences were found between MABP1 and MABP3 ( $P = .122$ ). In the group receiving BSSO osteotomy, there was no statistically significant difference between MABP1, 2 and 3. ( $P = .682$ ) compared with baseline PR values. In Le Fort I osteotomy group 25% of the patients showed a PR decrease of more than 10% at DF. Also 45% of the patients showed a MABP decrease of more than 10% during DF compared with the baseline values.

### Discussion

The present study showed that DF is associated with significant MABP and PR decrease. This is thought to be attributed to the stimulation of the maxillary branch of the trigeminal nerve that innervates the midfacial structures, but no statistically significant difference was found between PR and MABP changes during ramus sagittal splitting osteotomy ( $P < .0001$ ).

The present study provided further evidence for the complex neurophysiologic mechanism and probable prevention of peripheral TCR. The results of the present study should be further validated through future studies but already provide strong evidence that peripheral and central TCR may act differently based on slightly different pathways [6, 7].

As previously mentioned, the mechanism responsible for such reflex could be the result of stimulation of any branch of the trigeminal nerve or the main nerve trunk. The sensory branches of the trigeminal nerve send signals from the Gasserian ganglion to the sensory nucleus of the trigeminal nerve (the afferent pathway of TCR). The signals are then transferred to the vagus motor nucleus via short nerves and directed to the myocardium via the cardiac branch of the vagus nerve (the afferent pathway of TCR) [1,2].

The literature on the occurrence of TCR in the course of maxillary and mandibular osteotomies is limited to case reports [6]. Surgeries involving other parts of the head are probably more thoroughly studied in terms of TCR incidence and mechanism. Robideaux reported decline of PR from 90 to 54 beat per minute in a 22 years old patient during maxillary fracture reduction surgery [8]. Lang et al reported sudden PR decline up to 30 beats per minute during maxillary advancement surgery in a healthy patient which was acqit immediately after surgery pausing [9].

Additionally, they noted 3 other situations within a year that confirmed bradycardia and ventricular asystole associated with maxillary and mandibular offices associated with trigeminal neurological throughout an osteotomy. According to Skulsky and Precious heart asystole and bradycardia, along with any other dysrhythmias have been fully discussed throughout the ophthalmologic literature, though there are too little facts within the maxillofacial literature. They studied a case series of 8 (1.6%) out of 500 patients during the advancement of maxilla (6 cases) with the occurrence of TCR, and also the manipulation of the temporalis muscle during corrective surgery of the TMJ (2 cases) [10].

The present study takes advantage of 2 concurrent designs. First, a case crossover design is the result of certain maneuvers involving mostly the maxillary bones. Secondly, a double-blind clinical trial design was used to assess the effect of Le Fort I osteotomy on the

occurrence of TCR. The results indicated a statistically significant association between Le Fort I osteotomy and TCR.

### **Conclusion**

The results of the present study was parallel with previous studies regarding the triggering factors, pathways, mechanism, and preventive measures of TCR. According to findings of the present study, it is concluded that TCR is triggered by the stimulation of V2 but not V3 branch of trigeminal nerve.

**Conflict of interests:** The authors declared none.

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