

# Role of C-reactive Protein, Total Leukocyte count and Erythrocyte Sedimentation Rate as a Diagnostic and Prognostic Indicator in Maxillofacial Infections

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## Abstract

**Purpose:** The aim of this study was to evaluate the role of C-reactive protein (CRP), Total Leukocyte Count (TLC) and Erythrocyte Sedimentation Rate (ESR) levels as diagnostic and prognostic indicators in patients diagnosed with maxillofacial odontogenic infections.

**Materials and Methods:** A prospective study was done among 30 patients with maxillofacial odontogenic infections. Blood samples were collected at 3 intervals to detect the level of the study parameters followed by incision and drainage for all the patients under Local anesthesia.

**Results:** The mean CRP, TLC and ESR levels gradually reduced on 5<sup>th</sup> post-operative day as compared to day 1 and 3 suggestive of resolution of the infectious state.

**Conclusion:** We conclude that CRP is required only in selective cases of maxillofacial infection where monitoring under intensive care will be required, else TLC alone is sufficient to indicate the presence of infection along with adequate medical and surgical care.

**Keywords:** Serum markers, C-reactive protein, maxillofacial infection, odontogenic, TLC

## Introduction

There are several adages in surgery and one among them which has endured successfully along time is “Never let the sun go down on undrained pus”. This is emphasized in every maxillofacial odontogenic space

infection patients. Owing to the complex anatomy of maxillofacial region, it is important to be highly vigilant regarding the clinical status of maxillofacial infection as they are at possible risk of complications like upper airway obstruction, descending mediastinitis, venous septic emboli, rupture of carotid artery, adult respiratory distress syndrome (ARDS), pericarditis, septic shock and disseminated intra-vascular coagulopathy (DIC). The use of anti-biotics in such patients should also be monitored so as to prevent early withdrawal or excessive dosage which can cause unwarranted complications.<sup>1</sup>

It is desirable to have a monitoring system which would accurately indicate the end point of the infective state. The role of inflammatory markers in disease

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arousing interest in identifying substances which could function as prospective monitor of disease progression. Thus various inflammatory markers were identified. CRP is usually present in trace quantity ( $< 10$  mg/dl) in a healthy individual and involved in process of innate immunity with functions of complement activation, antigen clearance and mediation of phagocytosis by activating neutrophils. It is synthesized in the liver and its production is controlled by interleukin – 6 (IL – 6). Qualitative and quantitative analysis of CRP can be performed of which the quantitative analysis estimates the accurate CRP level and useful in maxillofacial infections. Increase in CRP concentration is seen up to 1000-fold within few hours of infections with a short half-life of 5–7 hours makes it a sensitive marker of infection.<sup>1,2</sup>

The aim of the present study was to estimate the role of CRP, TLC and ESR levels as diagnostic and prognostic indicators in the management of patients suffering from maxillofacial infections and decision to prolong or withdraw anti-biotic usage based on the parameters indicating evidence of infection.

### Materials and Methods

A prospective clinical study was undertaken among 30 patients to assess the levels of CRP, TLC and ESR as a diagnostic and prognostic indicator in patients diagnosed with maxillofacial odontogenic infections. The study was performed in compliance with the Declaration of Helsinki on medical protocol and approved by the institutional ethical committee, IRB number: PCDS/ACAD/ 8/2016/59. A detailed clinical history was recorded along with basic radiologic investigation as necessary to rule out non-odontogenic cause, if any. The patients included in the study were informed about the surgical procedure and the sample collection for blood investigation. An informed consent was obtained from all participants and patients who were willing to report for the subsequent follow ups were recruited as the study require sample collection at three different intervals.

Inclusion criteria were patients aged 18 years and above from both the genders diagnosed with infections in the maxillofacial region of odontogenic origin. Patients with known history of any systemic illness, patients on anti-biotic therapy in the previous 3 months, patient who underwent treatment (medical/surgical) for maxillofacial infection were excluded from the study. The samples was obtained on three intervals, Day 1 (Pre-treatment) followed by incision and drainage (I and D) under local anesthesia (LA) and on day 3 and 5 (Post-treatment). Sample was collected on day 10, if clinical symptoms persisted.

On day 1, under aseptic conditions, a single qualified nursing assistant collected 5 ml of blood from the anti-cubital fossa from the study population and 2 ml of blood was transferred to a sterile glass test tube for CRP level detection and 3 ml of blood was transferred to an EDTA containing test tube to determine the TLC, ESR levels and transferred to the lab technician immediately for analysis followed by I and D, extraction of the offending tooth under LA (9 parts, plain LA) (LOX 2%, Neon, Laboratories Ltd.) mixed with Sodium bicarbonate (1 part) (Pharma Cure Laboratories). The patients were followed up on subsequent visits and samples were collected for analysis on day 3 and 5.

### Results

A total of 30 patients (n=30) diagnosed with maxillofacial odontogenic infections were included in this study. Of the 30 patients, the total number of female and male patients among the study population was 11 (36.66%) and 19 (63.33%) respectively.

The mean  $\pm$  Standard deviation (SD) of CRP level on day 1 was  $63.69 \pm 35.32$ . The mean  $\pm$  SD on day 3 and 5 were  $29.916 \pm 20.137$  and  $11.52 \pm 8.297$  respectively. Intra-group comparison was done to compare the levels on day 1 and 3, day 1 and 5. The  $t$  value for intra-group comparison between day 1 and 3 is 4.55 with a significant  $p$  value of 0.000014. Intra-group comparison for day 1 and 5 showed a  $t$  value of 7.875 with a  $p$  value of 0.00001 which was statistically significant. (Table 1)

**Table 1: Intra-group comparison of C – reactive protein (CRP) on day 1,3 and 5**

Variable	Day 1	Day 3	Day 5
Mean	63.69	29.916	11.52
Standard Deviation (SD)	35.3216	20.137	8.297
t Value	Intra-group comparison between Day 1 and 3		Intra-group comparison between day 1 and 5
	4.54967		7.87545
p value	< 0.000014		< 0.00001

The TLC had a mean  $\pm$  SD value of  $13.43 \pm 1.477$  respectively on day 1. The mean  $\pm$ SD value for day 3 and 5 was observed to be  $10.25 \pm 4.779$  and  $8.79 \pm 4.209$  respectively. The intra-group comparison on day 1 and 3 had a  $t$  and  $p$  value of 3.481 and  $< 0.00047$  respectively. Intra-group comparison for day 1 and 5 showed a  $t$  value of 5.697 with a significant  $p$  value of  $< 0.00001$ . (Table 2)

**Table 2: Intra-group comparison of Total Leukocyte Count (TLC) on day 1, 3 and 5.**

Variable	Day 1	Day 3	Day 5
Mean	13.43	10.25	8.79
Standard Deviation (SD)	1.477	4.779	4.209
t Value	Intra-group comparison between Day 1 and 3		Intra-group comparison between day 1 and 5
	3.48194		5.69742
p value	<0.00047		< 0.00001

The mean  $\pm$  SD of ESR on day 1 was found to be  $12.16 \pm 1.599$ . On day 3 and 5, the mean  $\pm$ SD was found to be  $9.66 \pm 4.51$ ,  $9.33 \pm 4.42$  respectively. The  $t$  value for intra-group comparison on day 1 and 3, day 1 and 5 was found to have a  $t$  values of 2.86 and 3.49 respectively with significant  $p$  values of  $< 0.0029$  and  $< 0.00045$  respectively. (Table 3)

**Table 3: Intra-group comparison of Erythrocyte Sedimentation Rate (ESR) on day 1, 3 and 5.**

Variable	Day 1	Day 3	Day 5
Mean	12.16667	9.6667	9.3333
Standard Deviation (SD)	1.59921	4.51307	4.4204
t Value	Intra-group comparison between Day 1 and 3		Intra-group comparison between day 1 and 5
	2.85985		3.49058
p value	< 0.002941		< 0.000451

Samples were collected for  $n = 8$  (26.66%) patients on day 10 to evaluate the above mentioned parameters as the result range was above the normal limits on day 5. The levels were within normal range for all the patients on day 10.

## Discussion

The parameters assessed in the present study were CRP, TLC and ESR levels on three consecutive intervals, i.e., day 1, 3 and 5 in patients diagnosed with maxillofacial infection of odontogenic origin. There was significant reduction in the parameter levels followed by medical and surgical management of the maxillofacial infections was observed on day 3 and 5. If the signs of infections still persisted, then the parameters were evaluated on day 10. In few patients, study parameter levels declined but swelling and pus continued to re-occur indicative of improper I and D. Pus culture and sensitivity exhibited sterile pus in such patients.

There are several studies in literature showing the significance of CRP level being superior as compared to conventional parameters. Sharma A et al. evaluated the efficacy of CRP level as markers in facial space infection patients and to monitor infection severity, hospital stay duration, nutritional status and efficacy of the treatment. He observed a strong co-relation between the CRP levels and clinical parameters to the severity of infection.<sup>3</sup> Similar results were observed by Singh TW et al., Mirochnik R et al. and Stathopoulos P et al. in their clinical studies where CRP was an effective indicator of hospital stay, severity of infection.<sup>4,5,6</sup>

Bali R et al. in their clinical study compared the efficacy of CRP level and TLC as biomarkers to monitor the odontogenic infection course in 50 patients. He observed that CRP was elevated in all patients at the time of admission but only 64% patients had elevated TLC count. This was contrary to the present study where all the patients had elevated levels of CRP as well as TLC but there was variation in ESR in few patients.<sup>7</sup>

Bagul R et al. and Seppänen L et al. in their studies have observed that the levels of CRP and WBC count were increased in the first visit of the patient presenting

with maxillofacial odontogenic infection but it subsequently decreased in the follow-up visits following surgical and medical management. They did not observe any superiority in CRP as compared to WBC count. They concluded that CRP and WBC count are effective markers to determine the infection severity, treatment outcome and helps to avoid excessive anti-biotic usage. The present study is supported by the above mentioned literature evidence as we did not find any superiority of CRP over TLC count to assess the infectious state. Not much evidence in literature to support the role of ESR in such patients but we have observed that though it is a non-specific inflammatory marker, it can be used as an adjunct with WBC count.<sup>8,9</sup>

Igoumenakis D et al. determined the level of WBC count and CRP level in odontogenic infection where the causative tooth was extracted in study group and control group included no extraction and observed that there was a mean decline in their levels in study group as compared to the control group. This was supported by the study conducted by Seppänen L et al. and the present study where the causative tooth was subjected to extraction and local debridement along with incision and drainage.<sup>9,10</sup>

Another potential disadvantage of CRP is the lack in ease of availability in all centers as it is uncommon in primary and secondary health care centers along with increased cost. It can be used when patients require intensive monitoring and the presence of sepsis with other organ involvement who may need extensive care and longer duration of hospital stay. Thus, a clinician should have a sound knowledge on the disease process and the necessary laboratory investigations required for it.

## Conclusion

From this study we conclude that the CRP, TLC and ESR can predict the presence of infection. The levels of all the three parameters were elevated during the onset of infection and there was reduction in their levels on the subsequent days post treatment. However, these laboratory parameters alone cannot be considered as a diagnostic indicator to monitor the presence or absence

of infection as the infection can be masked by the use of anti-biotics but the clinical features can still be persistent.

Compliance with Ethical Standards

**Funding:** Self-funded

**Conflict of Interest:** None

**Ethical approval:** Obtained. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent:** Informed consent was obtained from the patients involved in this study.

**IRB number:** PCDS/ACAD/8/2016/59

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