

Application of Computer Software for Objective Evaluation of Changes in Size and Colour of Gingiva after Scaling and Root Planing

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ABSTRACT

Introduction: Gingival inflammation shows redness and swelling as a sign of inflammation. Reduction of gingival inflammation is an indicator of recovery from gingival disease. This study investigated the quantitative analysis of gingival swelling and colour characteristics by digital images before and after treatment.

Material and Methods: 20 patients with gingival inflammation were recruited for digital photographs and measurements were recorded at the baseline visit. One month following scaling and root planning, another image was taken by the same examiner. Changes in gingiva were detected by assessing redness and tooth surface area visible between the level of the inter-proximal papillae and the gingival margin.

Results: Significant difference was found between the pre-operative and post-operative photographs with respect to gingival redness and swelling.

Conclusion: This method performed analysis of color characteristics and swelling of gingiva. It is simple, non-invasive and innovative procedure of detecting gingival inflammation that maintains digital records too.

Keywords: Gingival inflammation, Photographic interpretation, Adobe Photoshop,

century.¹ Gingival inflammation index was formerly used to compare scores lowered after treatment. Scoring was reversible in gingival index.

In the presence of gingival inflammation, the gingiva is red, oedematous, bleeds on slight provocation or spontaneously, and is swollen or enlarged associated with loss of stippling. Electronic measurement of gingival colour by digital image is a non-invasive reproducible, inexpensive method of assessment and it also reduces subjective variations. Gingival swelling was scored as 0–3 according to Harris and Ewalt² as development by Syemour et al,³ Ellis et al,⁴ projected the photographs of the patient and then gave the scores as given earlier. Since absence of gingival bleeding on probing was considered as the gold standard of gingival health, assessment of gingival health was done using mouth mirror and probe. However, this again is a subjective method of grading the gingival enlargement.

Aim of this study was to evaluate the colour characteristics and gingival swelling by digital images before and after treatment of individual patients using a computer software.

MATERIAL AND METHODS

Study population was obtained from patients visited the department of Periodontology and Implantology, MGVS KBH dental college, Nashik. Patients who had signs of gingival inflammation, age between 18 to 65 years, were explained about the study and included in the study if they were willing to participate. Informed consent was obtained from them. Patients who were medically compromised or who consumed any drug that causes gingival enlargement were excluded from the study. Patient was checked for gingival bleeding presence or absence. Pre-treatment photographs were taken by positioning the patient in the frontal head position and the camera was stabilized on a tripod with fixed distance between the frontal head positioning and patient in all the cases. Fujifilm digital camera s100 fs was used with autofocus settings and 20 x optical zoom at a specified 15cm

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INTRODUCTION

Gingival inflammation is most often caused by the development of plaque, which is a sticky film that continually forms on teeth and at the gingival line. Because plaque contains bacteria that release harmful toxins, it will irritate gingiva if it is not removed. When left untreated, the inflamed gingival tissue may become recessed and pocket formation may develop and continue to trap plaque below the gingival line. This complication further irritates the tissue and continues to destroy bone and other tooth-supporting tissues. According to the American Academy of Periodontology, the main cause of inflammation of the gingiva is plaque, but other factors may contribute to this issue or increase the likelihood of its development. Stress, poor nutrition, tobacco use, obesity and being over the age of 65 increase the risk. The cardinal signs of inflammation include rubor, tumor, calor, dolor and functio laesa. In routine clinical practice presence of gingival inflammation is assessed subjectively using indices. During the 1950s, it was grouped as good, medium or poor. Later, the index methods were further refined, which were widely used in general practice and in epidemiological studies. The World Health Organization (WHO) promoted the development of the Periodontal Index which was widely used up to the later part of the 20th

	Pre-Operative		Post-Operative		Difference	
	Colour Change	Size change	Colour Change	Size change	Colour Change	Size change
Mean	190.46	300.69	190.04	299.02	-0.4215	-1.674
Std deviation	12.639	22.814	12.493	22.472	0.4546	1.632
Std error	2.826	5.101	2.794	5.025	0.1017	0.3649
Lower 95% CI	184.54	290.02	184.19	288.50	-0.6343	-2.438
Upper 95% CI	196.38	311.37	195.89	309.54	-0.2087	-0.9103

Table-1: Post-treatment and Pre-treatment changes in gingival redness and swelling



Figure-1: Cropped photograph for histogram

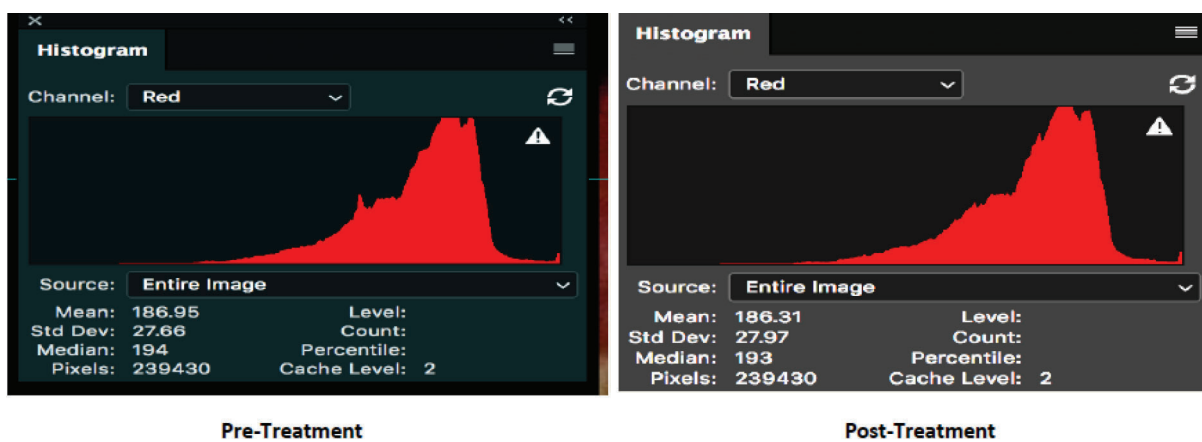


Figure-2: Showing Pre-Treatment and Post-Treatment Histograms

distance. After that scaling and root planning was done, patients were recalled after 1 month, and photographs were taken again maintaining similar standardization measures.

Photograph Interpretation and calibration of photograph for gingival redness and gingival swelling was carried out using Adobe Photoshop cs2 version 9.0. The histogram option in the Adobe Photoshop software was selected, which gave the mean, standard deviation, and pixels of the selected gingival area.

For histogram reading of the inflamed gingiva, area of gingiva was cropped (See fig 1) and the histogram reading (see fig 2) for mean, standard deviation, highest level of pixel count, pixels of red or white, and total pixel counts was obtained and noted. This was process was performed for the post-operative photographs too. In the presence of gingival swelling, part of tooth surface is encroached upon by gingiva that will be uncovered in the absence of gingival inflammation. Therefore visible tooth surface area will be increased in the absence of inflammation. Thus, tooth surface area was assessed by quantifying using the scales.

Statistical analysis

The histogram reading for mean, standard deviation, pixels of red, at highest level of pixel count was obtained for each photograph for both the gingival redness and gingival swelling assessments and taken for statistical evaluation.

Paired t-test was used to evaluate the difference between the pre-operative and post-operative groups for both the gingival redness and gingival swelling assessments.

RESULT

At 95% confidence interval P value was 0.0005 found significant in red pixel counts for gingival redness assessment. Graph was plotted in the histogram for pre-operative and post-operative group. In case of gingival swelling assessment statistical difference was found P value is 0.0002 at 95% confidence interval, considered significant in relation to the parameters measured for pre-operative and post-operative groups. (Table 1)

DISCUSSION

Gingivitis has been defined⁵ and refined⁶ but in many ways our views about gingivitis are still emerging. Gingival diseases are a diverse family of complex and distinct pathological entities found within the gingiva that are the result of a variety of etiologies. There are several clinical characteristics common to all gingival diseases and these features include clinical signs of inflammation.⁷

The method used for this study was selected to keep the best use of current technology and to fulfil the objective results as far as possible in mind.⁸ Some studies show that the results of digital image captured by digital camera are reproducible

and acceptable, reliable by the means of measuring gingival redness.^{9,10} This is the reason that choice of assessing colour and area change considered in this study was reasonable.

While assessing the gingival redness, significant difference was found in red pixel counts that were obtained at particular level of pixels measured in graph, for pre-treatment and post-treatment groups. There was no significant difference found in relation to the gingival mean redness, standard deviation of gingival redness of the cropped area in the highest level of pixels measured in the graph plotted by the histogram for the pre-treatment and post-treatment groups. During the assessment of gingival swelling statistically significant difference was found, also for standard deviation of the pixels in the histogram, total count of pixels obtained at the particular level of the graph plotted by the histogram.

In the present study, noticeable results were seen for some patients, the overall results within the group may be seen affected by some patients showing a less response to treatment. There were restrictions for the image assessment due to the area of interest selected for photographs. Along with that only anterior part of the patient's oral cavity was assessable. The inflammatory response is mainly related to the gingival margin.¹¹ The method used total red pixel values from the cropped gingival area that included marginal and attached gingiva both, and the study included overall changes from other parts of gingiva as well, i.e. attached gingiva. But the method did not mask the changes at the gingival margin. As reported in some studies done earlier in relation to the gingival redness, gingival swelling, plaque, etc.

This objective method of assessing the gingivitis will help in providing pictorial data confirmed with the software data. That matches the clinical changes in colour and size of the gingiva. To record such information generally the standard index method is used. Which may give subjective error due to giving higher or lower score. Hence this new method will be helpful to clinician to evaluate the pre-treatment and post-treatment gingival changes.

LIMITATIONS

Sample size and little illumination difference between the images cannot be eliminated.

CONCLUSION

Analysing the effect of treatment in gingival inflammation patients by the use of this innovative photographic interpretation method will be helpful to clinician. As we can check changes in swelling, colour characteristics of gingiva. This method is accurate, objective, non-indexed, and inexpensive. All of this will reduce subjective variations of evaluation procedure of gingival inflammation.

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