

# Pre and post treatment objective evaluation of remission in oral lichen planus using fractal analysis and comparison with visual analog (vas) and thongprasom scale- a cohort study

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## Abstract

Oral lichen planus (30) treated with topical steroid therapy were included for the subjective and objective assessment of lesion remission. Pre-treatment and Post treatment values were recorded using Visual Analogue Scale, Thongprasom score and Fractal analysis scores. All the scores were compared and co-related. There was significant statistical difference in the fractal dimensions, Thongprasom score and VAS score of OLP patients before and after treatment. Fractal analysis and Thongprasom score could be used as an objective evaluatory method to assess the remission of lichen planus lesion.

**Keywords:** Oral lichen planus, Fractal Analysis, Visual analogue scale, Thongprasom score

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## 1. Introduction

Oral lichen planus (OLP) is a chronic inflammatory disease that affects the mucus membrane of the oral cavity. It is an autoimmune condition mediated by T cells in which cytotoxic CD8+ T cells cause the basal cells of the oral epithelium to undergo apoptosis. Lichen planus is common in the general population, with prevalence rates of up to 5% and 0.5-2.2% for its oral form, respectively, with a female to male incidence ratio of 2:1 [1]. In as many as 60% of patients, oral symptoms appear after the disease has first damaged their skin. Yet, only 15% of people with oral disease experience symptoms that affect their skin or reproductive system [2]. OLP is particularly challenging to fully treat, and numerous treatment modalities have been tried [3]. High-potency topical steroids such as clobetasol propionate, fluocinolone acetonide, and fluocinonide are the first line of treatment for OLP [4,5]. In addition, the systemic corticosteroids cyclosporine and tacrolimus can be used in unresponsive patients with OLP in place of topical steroids [6]. Despite the potential for these drugs to control pain and the clinical appearance of OLP, they are associated with side effects including secondary candidiasis, mucosal atrophy and dryness, bad taste and delayed healing, due to the chronic nature of OLP and the long-term use of these

drugs. Most importantly, some patients may experience a refractory response [7]. The assessment of the remission of oral lichen planus is done based on subjective reduction in symptoms and clinically through naked eye [8]. Lichen planus tends to follow an evolution that comprises periods of remission and exacerbation on a chronic course and may lead to malignant transformation making it crucial to monitor the lesion remission [9]. Mandelbrot in his work aimed to provide mathematical interpretations of real phenomena dominated by randomness and chaos and to devise means of describing shapes endowed of complexity and self-similarity, by developing the concept of fractals [10]. Fractal analysis is, a non-invasive method, used to determine the intricate characteristics of the matter. Fractal dimensions are measured as numerical value. It decreases or increases as the complexity changes [11]. Thongprasom score is frequently used an objective scoring system based on the presence and extent of white striae, erythema and atrophy of the lesion [12]. Visual Analogue Scale is a tool used to measure pain subjectively [13].

Assessment of oral lesions using fractal dimension has been done in various conditions like leukoplakia, oral cancer with paucity of research which evaluates the objective outcome of treatment remission in oral lichen planus using

fractal analysis. To our knowledge there is no research comparing other objective evaluating tools using fractal dimension. Hence, the study was pursued to assess the oral lichen planus lesions for both subjective and objective evaluation.

## 2. Materials and methods

### 2.1. Study design and Ethical Consideration

A prospective cohort study was designed to evaluate the objective tools of assessing remission in oral lichen planus using Visual Analog, Thongprasom Scale and Fractal Analysis. The study design was approved by the Institutional Review Board (SRMU/M&HS/SRMDC/2022/PG/015). Prior informed consent was obtained from all the participants and those who were not willing to participate were allowed to refrain from the study at any point of time.

### 2.2. Study participants

Patients attending the Outpatient Department of Oral Medicine and Radiology SRM Dental College Ramapuram were screened for the presence of oral lichen planus with symptoms and satisfying the inclusion criteria were recruited in the study. The sample size was calculated in G\* Power version 3.1.9.4 with a power of 90% and confidence interval 95% as 30.

### 2.3. Criteria of patient selection

The inclusion criteria included patients with symptomatic oral lichen planus of 30-60 years and both male and female genders. The exclusion criteria included patients with asymptomatic oral lichen planus, oral lichen planus being treated using any other modality, patients using steroids and immunomodulatory drugs for any other condition.

### 2.4. Assignment of treatment protocol

The patients satisfying the inclusion criteria were treated using topical 0.1% triamcinolone acetonide thrice daily on affected sites using one finger-tip unit of 0.1% triamcinolone acetonide for 30 days. During the course of treatment, to ensure for patient compliance, they were recalled once in every week for direct observation, reassurance and were encouraged to maintain diaries of their use of medication.

### 2.5. Pre and Post treatment Subjective evaluation of study participants using Visual Analog Scale

The assessment of burning sensation using Visual Analogue Scale scores were recorded from the first day of patient reporting to the Dental OPD till the last day of treatment. The VAS scale ranges from 0 to 10 where 0 stands for no burning sensation and 10 stands for extremely severe burning sensation.

### 2.6. Pre and Post treatment Clinical evaluation of the lesions using Thongprasom Score

Thongprasom score was also recorded from the first day of patient reporting to the Dental OPD till the last day of treatment. The size of the lesion was evaluated using divider and scale and scored accordingly both before and after treatment.

### 2.7. Standardization of photographs

All the photographs were standardized using the digital camera with 12 Megapixel f/2.4 with Quad LED flash for fractal analysis.

### 2.8. Assessment using Fractal Analysis

Clinical photographs were taken before the treatment and after the treatment to perform fractal analysis (Figure 2) All the clinical photographs were uploaded in the Image J software. The images was converted to 8-bit type and blurred by Gaussian filters with a diameter of 35 Pixels. The resulting image was subtracted from the original image location. A value of 128 was added to the image at pixel. The image was transformed to binary and the resultant image was eroded to reduce noise. The image was dilated and skeletonized. The fractal dimension (FD) of all the skeletonised images was calculated using a fractal box count method which included box values (C2, C3, C4, C6, C8, C12, C16, C32 and C64). A graph was obtained between box count and box size in log values which showed the fractal dimension value. The pre and the post treatment values were obtained and compared (Figure 3A and 3B).

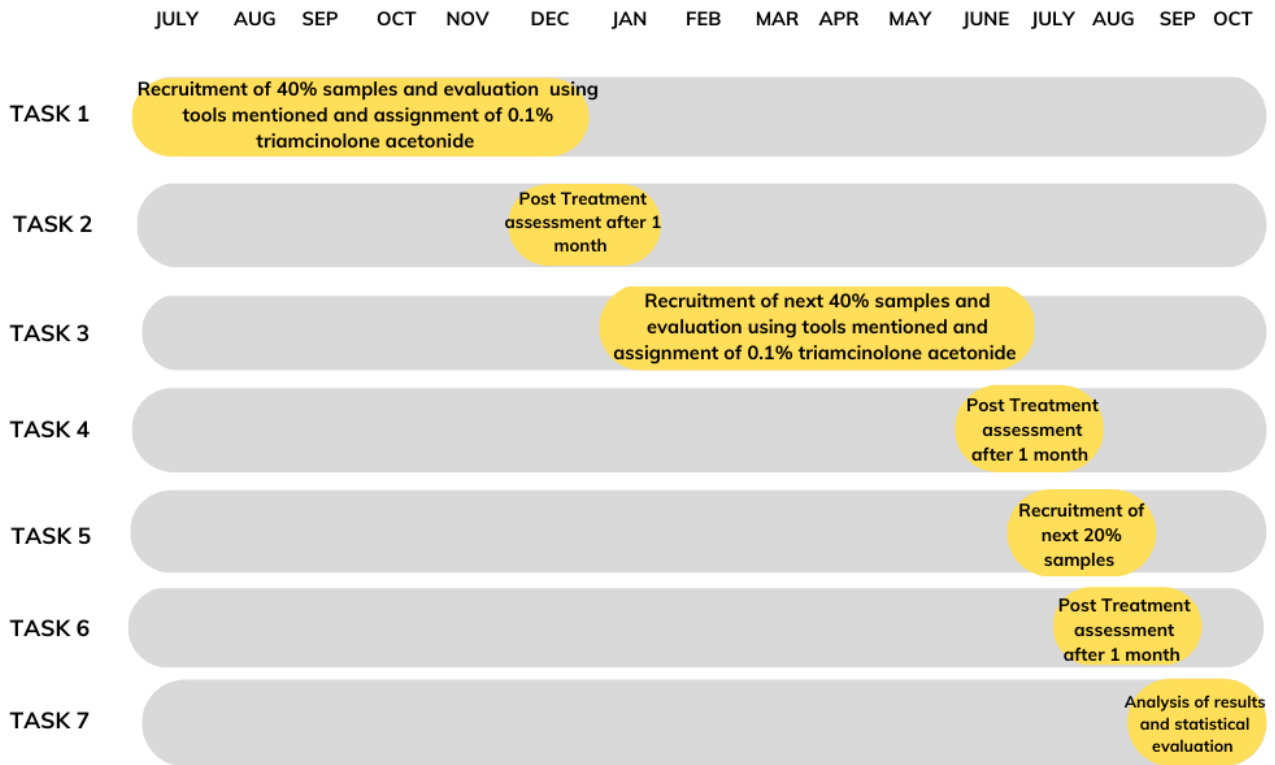
### 2.9. Statistical analysis

Statistical Analysis was done using SPSS software Version 26.0. Descriptive statistics was done to assess among the study variables. Inferential statistics was done by using Paired/Dependent sample T test to compare the mean values between the group. P value <0.05 was considered to be statistically significant. One way ANOVA followed by post hoc test was used to compare the mean values between the fractal analysis, VAS and Thongprasom score.

## 3. Results and Discussions

The mean difference of Visual Analogue Score, Thongprasom score and fractal analysis were obtained separately both pre and post treatment and were found to be statistically significant. Pairwise comparison of pre values of fractal analysis, Thongprasom and VAS had statistically significant results with a p value of 0.001 (Table 1 and Graph 1). Comparison of post-values of fractal analysis, Thongprasom and VAS also had statistically significant results with a p value of 0.001 (Table 2 and Graph 2). Oral lichen planus is a chronic immune mediated mucocutaneous disorder with a worldwide prevalence of 1.01%. The probable mechanism of action is by mast cell degranulation mediated by an antigen-specific mechanism that activates T-cells [14]. These lesions may appear as white linear or lacy pattern sometimes associated with ulcerations and desquamation of gingiva.

## GANTT CHART



**Figure 1:** Timeline of the prospective study



**Figure 2:** (Left)- Pre treatment picture (Right)- Post treatment using topical triamcinolone acetonide

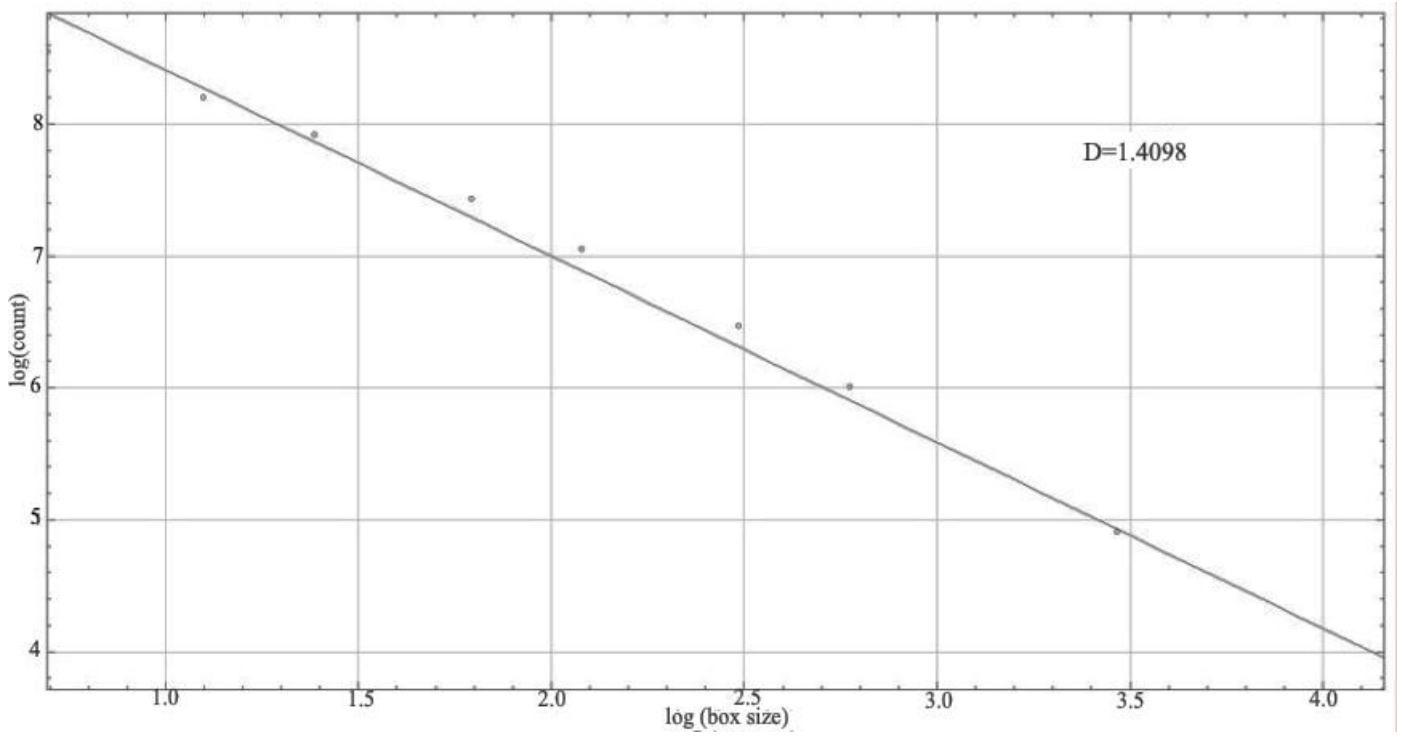


Figure 3A

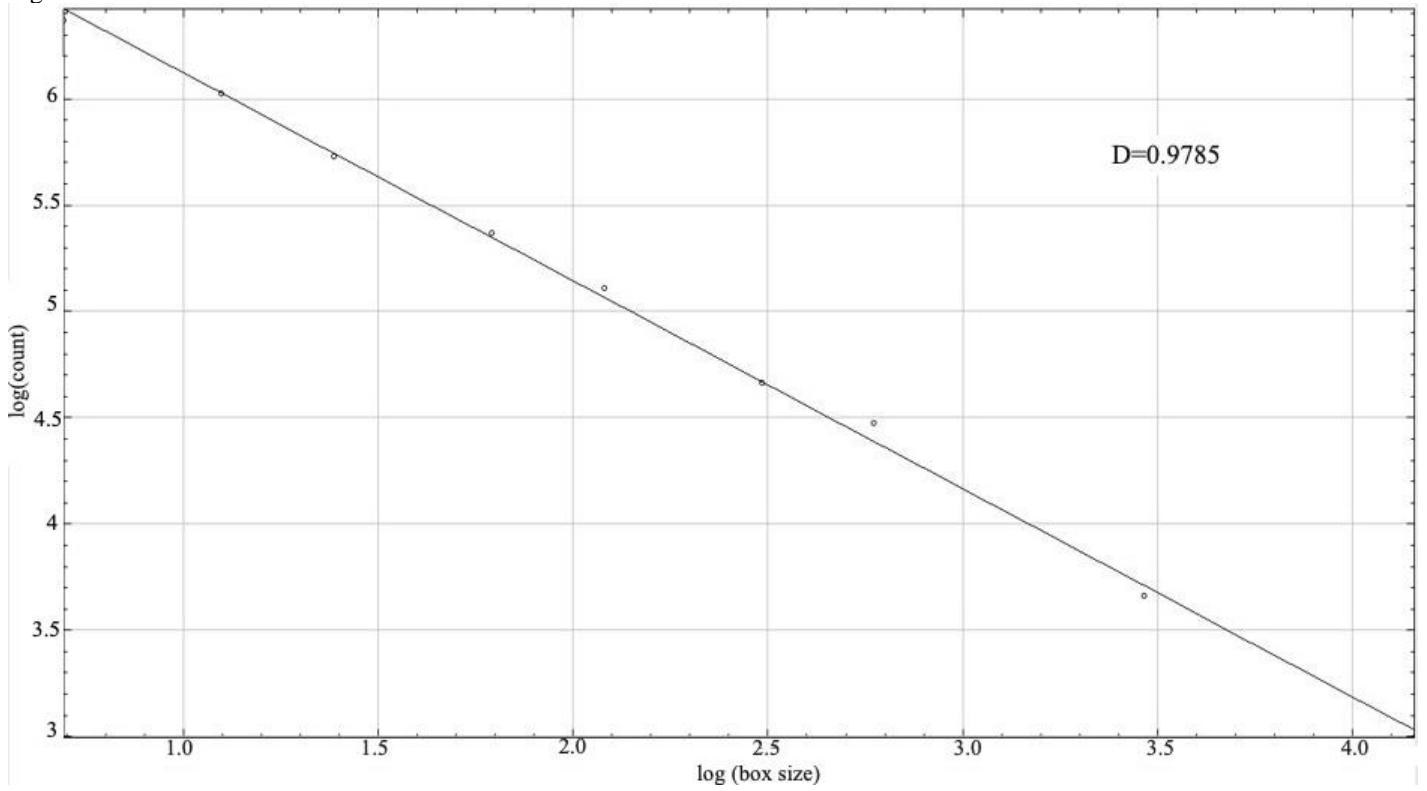


Figure 3B

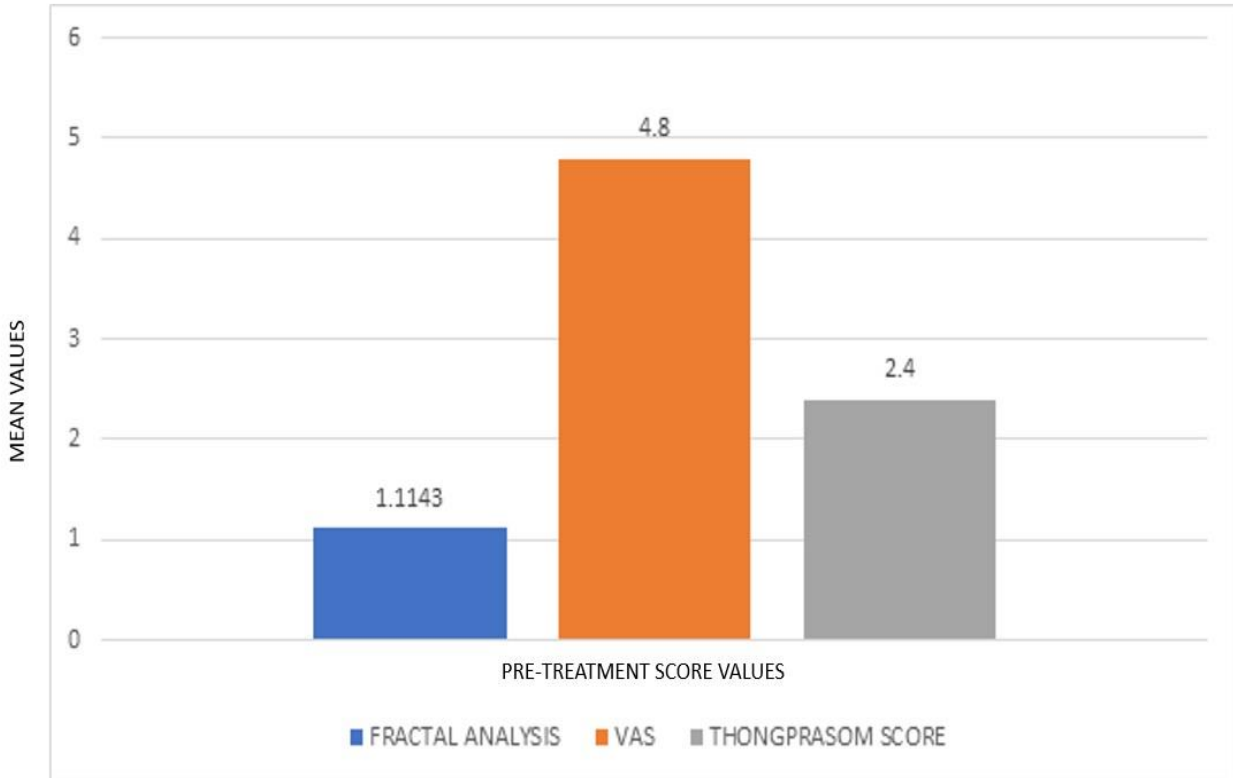
**Figure 3A and 3B:** Fractal dimension pretreatment and post treatment values in graph using box count method.

**Table 1:** Pairwise Comparison of Pre-values Of Fractal Analysis, VAS And Thongprasom Score

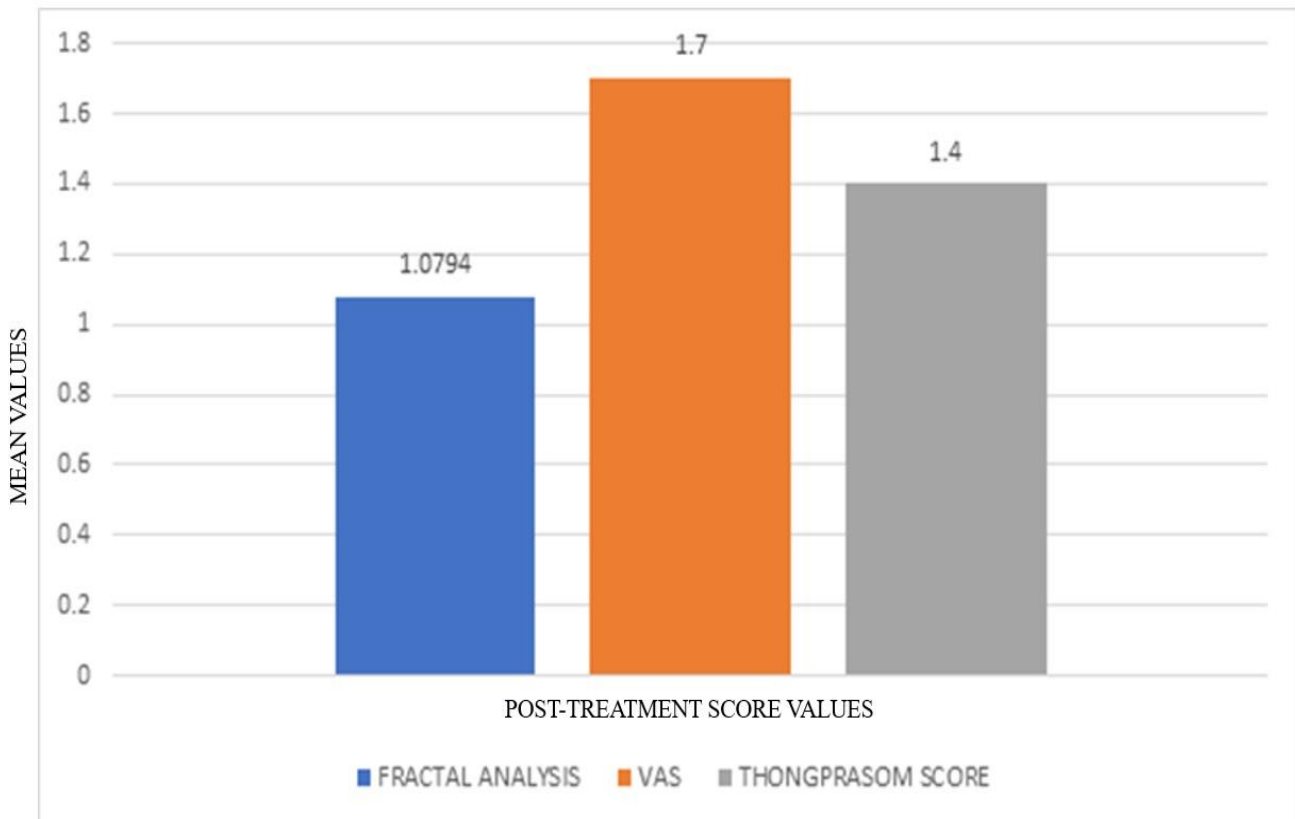
GROUPS	Mean Difference (I-J)	Std. Error	P-value	95% Confidence Interval	
				Lower Bound	Upper Bound
<b>FRACTAL ANALYSIS- VAS</b>	-3.68567*	.25397	0.001*	-4.2912	-3.0801
<b>FRACTAL ANALYSIS- THONGPRASOM SCORE</b>	-1.28567*	.25397	0.001*	-1.8912	-.6801
<b>VAS- THONGPRASOM SCORE</b>	-2.40000*	.25397	0.001*	-3.0056	-1.7944

**Table 2:** Pairwise Comparison Of Post-values Of Fractal Analysis, VAS And Thongprasom Score

GROUPS	Mean Difference (I-J)	Std. Error	P-value	95% Confidence Interval	
				Lower Bound	Upper Bound
<b>FRACTAL ANALYSIS- VAS</b>	-.62056*	.14017	0.001*	-.9548	-.2863
<b>FRACTAL ANALYSIS- THONGPRASOM SCORE</b>	-.32056	.14017	.063 <sup>NS</sup>	-.6548	.0137
<b>VAS- THONGPRASOM SCORE</b>	-.30000	.14017	.088 <sup>NS</sup>	-.6342	.0342



**Graph 1:** A comparison of Pre-values of Fractal Analysis, VAS And Thongprasom Score



**Graph 2:** A comparison of Post-values of Fractal Analysis, VAS And Thongprasom Score

These lesions tend to migrate over time with a constant presence. They have periods of remission and exacerbations which is dependent on many factors [15,16]. It is more common in females over the age of 40. At times of exacerbations, it adversely affects the quality of life because of functional disability associated with constant pain and burning sensation [17].

Steroids have been found to be effective in treating symptomatic oral lichen planus (OLP) by reducing pain and inflammation. Topical corticosteroids are the most reliable and proven agents for the treatment of OLP and is generally preferred as it has fewer adverse effects [18].

Visual analogue scales (VAS) are psychometric measuring instruments designed to document the characteristics of disease-related symptom severity in individual patients. It achieves rapid (statistically measurable and reproducible) evaluation of symptom severity and disease control. VAS is a subjective tool for evaluation of pain and would require an objective assessment of treatment response in certain cases. Despite its disadvantages, VAS tends to be least expensive to administer due to their relative simplicity and ease of completeness. There is also a significant amount of empirical evidence to demonstrate the reliability of VAS methods in terms of inter-rater reliability and test-retest reliability [19]. Assessment of VAS score is done for all oral lichen planus lesions as a routine evaluation protocol for clinical symptoms, starting from the day of lesion presentation and every successive follow up till lesion remission during treatment.

Literature reveals various scoring systems for oral lichen planus. Among these, the one suggested by Thongprasom et al was found to be the most used in clinical trials [12]. Scrutinizing the various specific scoring systems, it could be concluded that the score by Thongprasom, although laborious in multiple aspects, is typically preferred by investigators because of its ease of application at the chairside and the fact that it does not require any sophisticated instrumentation [20]. This feature has been the focus of the authors while formulating the new scoring system. The drawbacks might include that it is a time-consuming process and could result in observer bias.

Fractal dimension analysis is a non-invasive procedure which can be easily carried out on high-quality images of oral lichen planus as it has branching pattern with fractal properties. In addition, FD analysis is easy to perform and can be carried out by medical and paramedical staff [21]. Fractal dimensions are assessed using the complexity of the binary image. The treatment prognosis is determined by reduced complexity of the image. It is easier, less time consuming, effective and an objective tool of treatment remission [22]. Thus, this analysis can be suitably used at primary level of health care to distinguish the remission level of the lesion. There are various counting algorithms for fractal analysis. Among these, box-counting method was utilised for the analysis of lesion pattern. Therefore, we planned this study to evaluate the reliability of fractal analysis in the remission of oral lichen planus lesion.

Alberta Lucchese et al assessed the local vasculature architecture in atrophic-erosive oral lichen planus lesions using fractal analysis and found that they had a close relationship. Fractal analysis provided a quantitative descriptor of the complexity of the vascular patterns, which increases in the OLP samples [23]. In the present study we

have used fractal analysis to evaluate the remission extent in OLP patients.

S M Waring et al identified the correlation between tumour depth and epithelial connective tissue interface using fractal dimension and found that it had a positive correlation. Fractal analysis of the Extracapsular Tumour Invasion (ECTI) provided an unbiased descriptor of neoplasm dissociation and invasion pattern modality with potentially useful prognostic value [24]. Mateusz et al evaluated the efficacy of 980nm laser in the treatment of venous lake of oral mucosa and assessed the results using fractal analysis and texture analysis concluded that fractal analysis can be used to assess the treatment effects. Fractal dimension analysis and Texture Analysis are useful and objective methods of assessing treatment effects for venous lakes [25].

Nagarajan et al assessed the effect of omeprazole on oral leukoplakia and compared it with topical vitamin A application using Fractal Dimension and found that there was statistically significant difference [26]. Our study also showed that, fractal dimensions are effective treatment remission assessment tools comparable to other tools. The major limitation of our study was that it was a pilot testing of 30 samples, prospective studies with larger sample size comparing different treatment outcomes could provide more insight.

#### 4. Conclusions

Visual Analog scale is an effective subjective treatment remission assessment tool and Thongprasom scale is an arduous objective assessment tool, and this study has inferred that Fractal analysis is a promising, cost effective less complex, objective evaluation tool of recording remission in Oral Lichen Planus.

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