Dentistry Section

Evaluation of Dental and Periodontal Health Status in Leprosy Patients during Three Different Stages of Drug Regimen: A Cross-sectional Study

MADHUMITA CHOUDHARI[1], PAVAN BAJAJ[2]

ABSTRACT

Introduction: The prevalence of oral lesions in leprosy patients and the risk of developing them with the disease are considerably high. Multidrug Therapy (MDT) can effectively treat leprosy, but its effectiveness is heavily dependent on early detection, when chronic disability might be avoided. Poor oral hygiene combined with weakened immunity increases the risk of developing oral lesions in leprosy patients and impacts their overall health.

Aim: To evaluate the oral, dental and periodontal findings in patients during three different stages of drug regimen.

Materials and Methods: A cross-sectional study was conducted on 150 known leprosy patients from four leprosy facilities in the Vidarbha area, Maharashtra, India. Comprehensive oral examination was performed from July 2022 to September 2022, including the Decayed, Missing, Filled Teeth (DMFT) index, assessment of Non-Carious Cervical Lesions (NCCLs), Plaque Index (PI), Papillary bleeding Index (PBI) and complete periodontal examination by measuring Probing Pocket Depth (PPD) and Clinical Attachment Loss (CAL). Descriptive statistics

were done utilising SPSS version 23. The Analysis of Variance (ANOVA) test was used to check the mean difference between the three groups. The statistical significance established was $p < 0.05$.

Results: The evaluation revealed the prevalence of decayed teeth as 103 out of 150 (68%), that of a missing tooth was 93 out of 150 (62%). NCCLs were found in 80 out of 150 with the prevalence of abrasion as seen in 51 (63.7%) patients and 38 patients (47.5%) for abfraction, and 18 out of 80 patients (22.5%) for erosion. Comparing the PI and PBI between the groups, significantly higher scores were observed in patients who had not undergone treatment (p-value <0.01). CAL was found to be statistically significant with higher scores in patients who had completed their treatment (p-value <0.001).

Conclusion: The findings of the present study indicate that the NCCLS and the DMFT scores were higher in the untreated group. However, there was increased attachment loss in treated patients, which can be supplemented to the drug therapy prescribed for leprosy.

Keywords: Chronic periodontitis, Combination drug therapies, Disease eradication, Hansens disease, Oral health

INTRODUCTION

Leprosy, commonly known as Hansen's disease, is a chronic infectious disease caused by the bacteria *Mycobacterium leprae*. Leprosy is a chronic granulomatous infectious illness that manifests slowly over time with a preference for mucous membranes of the respiratory system, skin, and peripheral nerves [1]. It is a significant public health concern accounting for the high case burden, morbidity, and associated stigma [2]. National Leprosy Eradication Programme (NLEP) reported a total of 65,147 new cases of leprosy in 2020-21, with annual new case detection of 4.56 per 1,00,000 as against 1,14,451 cases in 2019-20. Maharashtra was a significant contributor of over 76 per cent of the cases [3]. In the Vidarbha region, the prevalence is clustered in Amravati, Buldhana, Chandrapur, Gadchiroli, Gondia, and Wardha than in other districts [4]. Children contracting leprosy from adults is primarily transferred through the oral mucosa, which is accounted for second most common site of *M. leprae* infection and transmission [5]. A nasal lesion that obstructs airflow manifests mouth breathing, which causes low intra-oral temperature, allowing the bacillus to thrive [6,7]. There are two clinical types of the illness recognised: tuberculoid leprosy and lepromatous leprosy.

Various studies [8,9] mentioned in literature for oral findings in leprosy comprise periodontal diseases, gingival bleeding, papillary hypertrophy, and tooth loss. With the advancement of leprosy, deformities such as claw hands, arthralgia, thumb paralysis, contractures and wounds delimit the patients to maintain oral

hygiene [6]. The clinical kinds of leprosy are categorised using the actions of *M. leprae* with the human immune system [7].

MDT is utilised as a treatment model effectively curbing the disease but is associated with various side effects throughout the patient's life. Many factors, including diet, psychological health, and oral and systemic health, are affected. Literature reveal plethora of oral abnormalities comprised of salivary gland hypofunction, altered saliva composition and flow, increased predisposition of caries susceptibility, periodontal diseases, mucositis, angular cheilitis [10].

Despite the literature establishing the oral health profile of patients with leprosy, there is a significant knowledge gap addressing the oral profile pre to, during, and following the MDT. In order to compare the outcomes across different treatment stages, there is a need to look into the state of comprehensive oral and periodontal integrity within the staged-therapy model.

Hence, the aim of this study was to evaluate the oral, dental and periodontal findings in patients of different stages of leprosy so as to create a guide for clinicians to formulate appropriate oral health conservation and rehabilitative outcomes for such patients during the course of their life. This study makes an effort to examine soft and hard tissue and periodontal health in the oral findings, and correlates them with different stages of leprosy.

MATERIALS AND METHODS

A cross-sectional study with 150 patients of leprosy was selected from Anandvan, Amravati, Ashokwan and Dattapur, Maharashtra,

India, in the months of July, August and September 2022. The authorised personnel of the leprosy centres were requested to provide written consent. The study was performed under the ethical standards and institutional ethical guidelines prescribed by the university's Institutional Ethics Committee (Reference no.: DMIMS (DU)/IEC/2022/1190.)

Inclusion criteria: Those dentulous leprosy patients who were having more than 15 teeth, either already under treatment or not yet started with treatment, and consented for study participation were included in the study.

Exclusion criteria: Edentulous or partially edentulous patients having less than 15 teeth, who do not have any medical records , have not been examined by a medical professional and not giving any consent for participation in the study were excluded.

Sample size estimation: Minimum sample size required

Formula: $N = \dfrac{Z^2_{1-\alpha/2} * p * (1-p)}{D^2}$

$Z_{1-\alpha/2} = 1.96$, at 5% level of significance

Percentage of deformities in leprosy patient with deep pockets (highest severity)=6.8%

P=6.8% [11].

D=estimated error (5%)=0.05

$=(1.96)^2 * 0.068 * (1-0.068)/(0.05)^2 = 98$

Minimum sample size required was 98.

Clinical measurements:

The groups were then examined clinically:

- **Dental examination:**

  Intraoral hard tissue examination included the examination of:

  1. Caries prevalence was noted using the DMFT index as decayed (D), missing (M) and filled (F) teeth [12].

  2. NCCLs primarily attrition, abrasion and abfraction on the buccal/labial, lingual, occlusal, mesial, and distal aspects of the teeth.

- **Oral hygiene status:**

  1. PI (Sillnes and Loe, 1964) [13] was employed to record plaque on the labial/buccal and lingual surfaces and scored on a 0-3 scale.

  2. Papillary Bleeding Index (PBI): A periodontal probe (William's Calibrated Probe) was carefully inserted into the gingival sulcus at the base of the papilla on the mesial aspect and then moved coronally to the papilla tip, repeating it on the distal aspect of the same papilla. The intensity of bleeding thus provoked was recorded on a 0-4 scale using the PBI (Muhlemann HR, 1977) [14].

     The PBI score per person was obtained by totalling all the papillary bleeding scores, divided by the number of surfaces examined.

- **Periodontal examination:**

  1. The PPD was recorded with A UNC-15 probe from the free gingival margin to the base of the sulcus [15]. CAL was also measured from the gingival margin to the Cement-Enamel Junction (CEJ) [16].

STATISTICAL ANALYSIS

All information was recorded and organised in an MS excel sheet. Descriptive statistics were done utilising SPSS version 23. As the information followed typical distribution, parametric tests were employed to investigate the information. The ANOVA test was used to check the mean difference between the three groups. The post-hoc Tukey HSD test was utilised to check the proportion differences. The statistical significance established was p<0.05.

RESULTS

Among the 150 patients, 54 were men and 96 women. Each group consisted of 50 patients.

A total of 103 out of 150 patients presented with decayed teeth (68.66%). A total of 93 out of 150 patients presented with at least one lost tooth (62.00%), and 64 out of 150 had their teeth filled (42.66%), as displayed in [Table/Fig-1]. NCCL were observed in 80 out of 150 patients. A total of 49 out of 96 females (51%) and 31 out of 54 males (57%) that presented with NCCL. A total of 51 out of 80 patients (63.75%) displayed abrasion, 38 out of 80 patients (47.5%) demonstrated the presence of abfraction, and 18 out of 80 patients (22.5%) presented with erosion [Table/Fig-2-5]. Mean DMFT score was highest in Group-3 followed by Group-2. Significant difference in DMFT scores was found between Group-1 and 3 and Group-2 and 3 (p=0.001) [Table/Fig-6].

[Table/Fig-7] shows the descriptive statistics and the output of the ANOVA analysis of the oral hygiene status using PBI and PI. Highest PBI score was found in Group-3 (3.44±0.67) and the difference was significant between all the three groups (p<0.01). PI score was lowest in Group-1, followed by Group-2.
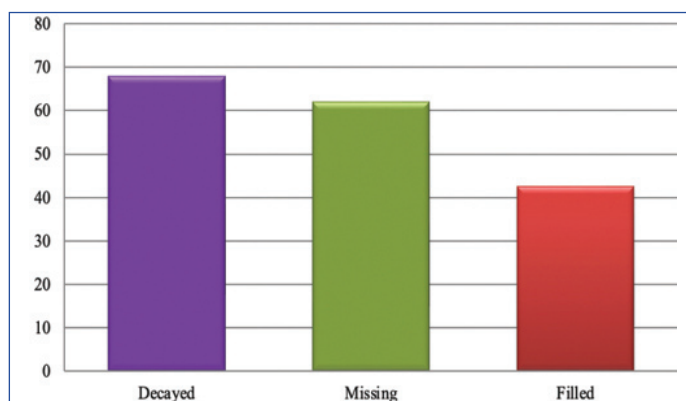
[Table/Fig-1]: Distribution of DMFT in all the groups (%).

[Table/Fig-2]: Abrasion of mandibular incisors.

[Table/Fig-3]: Abfraction of maxillary canine and premolars.

[Table/Fig-4]: Abfraction of mandibular anterior teeth.

[Table/Fig-5]: Erosion of mandibular posteriors.

	NCCL	Mean	Std. Deviation	Std. Error mean	p-value (Post hoc tukey)
Group-1 and 2	Group-1	1.22	0.99	0.178	0.81
	Group-2	1.09	0.83	0.149	
Group-1 and 3	Group-1	1.22	0.99	0.178	0.0001
	Group-3	2.03	0.84	0.150	
Group-2 and 3	Group-2	1.09	0.83	0.152	0.0001
	Group-3	2.03	0.84	0.150	
	DMFT	Mean	Std. Deviation	Std. Error mean	p-value
Group-1 and 2	Group-1	0.92	0.79	0.130	0.89
	Group-2	0.97	0.68	0.112	
Group-1 and 3	Group-1	0.92	0.79	0.130	0.001
	Group-3	1.92	0.72	0.510	
Group-2 and 3	Group-2	0.97	0.68	0.113	0.001
	Group-3	1.92	0.72	0.510	

[Table/Fig-6]: Group wise analysis for dental findings using NCCLS and DMFT Index using one0way ANOVA.

The PPD of patients undergoing treatment was 2.28±0.96, while for patients with completed treatment was 2.54±1.11, the difference between the two groups was 0.2±0.7 which was not statistically significant p-value (0.39) [Table/Fig-8-11].

The CAL of patients undergoing treatment was 5.06±1.26, while for the patients with completed treatment was 6.64±1.13 and the difference between the two groups was statistically significant p-value=0.001. The CAL of the patients who were not undergoing treatment was 4.02±1.09, while that for patients undergoing treatment was 5.06±1.26, and the difference between the two groups was 1.04±1.77 which was statistically significant p-value=0.001 [Table/Fig-12-16].

	PBI	Mean	Std. Deviation	Std. Error mean	p-value (Post-hoc tukey)
Group-1 and 2	Group-1	1.0200	0.76904	0.10876	<0.01
	Group-2	2.0400	0.90260	0.12765	
Group-1 and 3	Group-1	1.0200	0.76904	0.10876	<0.01
	Group-3	3.4400	0.67491	0.09545	
Group-2 and 3	Group-2	2.0400	0.90260	0.12765	<0.01
	Group-3	3.4400	0.67491	0.09545	
	PI	Mean	Std. Deviation	Std. Error mean	p-value
Group-1 and 2	Group-1	1.2400	0.89351	0.12636	0.19
	Group-2	1.6400	0.77618	0.10977	
Group-1 and 3	Group-1	1.2400	0.89351	0.12636	<0.01
	Group-3	2.7600	0.47638	0.06737	
Group-2 and 3	Group-2	1.6400	0.77618	0.10977	<0.01
	Group-3	2.7600	0.47638	0.06737	

[Table/Fig-7]: Group wise analysis of oral hygiene status using Papillary Bleeding Index (PBI) and Plaque Index (PI) using one-way ANOVA.

Group	Mean	Standard deviation	Min	Max	p-value
Group-1	2.54	1.11	1	4	0.06
Group-2	2.28	0.97	1	5	
Group-3	2.08	0.87	1	5	

[Table/Fig-8]: Comparison for periodontal examination using Probing Pocket Depth (PPD) in all groups using one-way ANOVA.

Group-1- Group-2	I	II	Difference	p-value
FR (Mean±SD)	2.54±1.11	2.28±0.97	0.2±0.7	0.39
Group-1- Group-3	I	I	Difference	p-value
FR (Mean±SD)	2.54±1.11	2.08±0.87	0.2±0.7	0.06
Group-3- Group-2	III	II	Difference	p-value
FR (Mean±SD)	2.08±0.87	2.28±0.97	0.2±0.7	0.56

[Table/Fig-9]: Group-wise comparison of Probing Pocket Depth (PPD) in all groups with post-hoc Tukey HSD Test.

[Table/Fig-10]: Periodontal pocket in left mandibular canine.

[Table/Fig-11]: Periodontal pocket in right mandibular canine.

Group	Mean	Standard Deviation	Min	Max	p-value
Group-1	6.64	1.13	5	8	
Group-2	5.06	1.26	3	8	<0.001
Group-3	4.02	1.09	2	7	

[Table/Fig-12]: Comparison of Clinical Attachment Loss (CAL) in all groups using one-way ANOVA.

Group-1- Group-2	I	II	Difference	p-value
FR (Mean±SD)	6.64±1.13	5.06±1.26	1.58±1.77	**0.001**
Group-1- Group-3	**I**	**III**	**Difference**	**p-value**
FR (Mean±SD)	6.64±1.13	4.02±1.09	2.62±1.45	**0.001**
Group-2- Group-3	**II**	**III**	**Difference**	**p-value**
FR (Mean±SD)	5.06±1.26	4.02±1.09	1.04±1.77	**0.001**

[Table/Fig-13]: Comparison of Clinical Attachment Loss (CAL) in all groups with post-hoc Tukey HSD Test.one-way ANOVA.

[Table/Fig-14]: Marginal tissue recession mandibular incisor.

[Table/Fig-15]: Marginal tissue recession in mandibular canine and premolar.
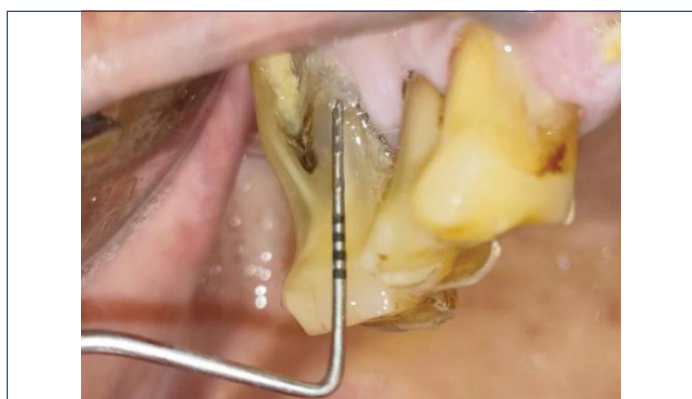
[Table/Fig-16]: Marginal tissue recession maxillary molar with exposed furcation area.

DISCUSSION

Leprosy is one of the world's oldest diseases [17]. Despite advances in all medical science, leprosy remains a public health concern in countries such as India. The principal weapon against leprosy is MDT, which has drastically reduced the incidence of leprosy in India [18]. The therapy's efficacy largely depends on early diagnosis and prompt intervention.

In the present study, oral and comprehensive periodontal examinations were done on patients in different stages of treatment. The dental examination included scrutiny by DMFT index and NCCLs. The prevalence of decayed teeth was 68%, that of missing teeth was 62%, and of the patients who did not have their teeth filled was 42.6%. The findings were in accordance with the study by Souza VA et al., who reported a prevalence of decayed teeth in 73%, 71.4% of missing teeth and 60.3% of the patients did not have their teeth filled [19]. The prevalence of abrasion was 71%, abfraction was 47.5% and 22.5% for erosion, which was similar to the findings by Gadge RS and Bajaj PS in a study that examined 200 patients for NCCLs with the prevalence of abrasion being 77%, 44% for abfraction and 29% for erosion [20]. Additionally, it has been discovered that the quantity and quality of saliva play a part in the emergence of these lesions. This could be explained by xerostomia brought on by the medications used to treat the illness, which directly impacts these conditions [21].

Recurrent gingival bleeding, papillary expansion of the gums, tooth loss, and hypoesthesia patch along the boundary of the alveolar mucosa define the lepromatous form of leprosy, which is extremely common. Claw hands, numbness, stiff joints, paralysed thumbs, widespread absorption, contractures, fissures, and ulcers are common in leprosy patients, making it difficult to maintain oral hygiene, which worsens oral health. On periodontal examination, a comparison of the difference between the PPD of the patients in all groups was not statistically significant; however, CAL was found to be statistically significant with higher scores in patients who had completed their treatment (p-value=0.001). The outcomes support those of Matos FZ et al., where the periodontal condition was exhibited in all individuals of groups with gingivitis (63.1%) and periodontitis (25%) [1]. Periodontitis was most prevalent (25%) in Group-1 (individuals who had already completed the leprosy treatment).

Souza VA et al., examined leprosy individuals to diagnose roughly 80 to 88% of patients with periodontal disease and gingival bleeding in 92% of the patients, per the present study's findings [19]. Jacob Raja SA et al., evaluated leprosy patients' oral and periodontal health [6]. The study included 62 patients treated in a leprosy centre in the Dindigul district. The most common observation was gingival recession (54.8%), followed by tooth loss (69.5%), mobility (60.86%), attrition (56%), chronic pulpitis (34.7%), and dental caries (26%). A study by Rawlani SM et al., revealed that the prevalence of periodontal disease was 78.75% [22]. Radiographic findings showed mean alveolar bone loss of approximately 5.6 mm in the maxilla and mandible, corroborating the above mentioned findings.

The majority of the patients had advanced periodontitis. Previous research by Marks Jr in 1978 demonstrated that resorption of alveolar bone in the anterior maxilla is a typical skeletal deformity of leprosy and likely causes local osteoclast activity [23]. Findins of similar studies from the literature has been tabulated in [Table/Fig-17] [1,6,19,20,22].

All the compiled data point towards declining periodontal health with the disease advancement and the MDT treatment model. Dapsone, clofazimine, rifampicin, ofloxacin, and minocycline were frequently prescribed to these patients as part of the MDT suggested for treating leprosy. The patient also took steroids and anti-inflammatory medications in addition to these antibiotics for a long time. Dapsone therapy has been shown to be capable of causing patients' hematopoietic changes [24]. Thus, the presence of dental findings, including NCCLs, along with an increase in CAL, can be attributed to the adverse effects of the drugs. Oral health is said to be a reflection of systemic health. Poor oral hygiene weakened immunity paves the way for deviation in oral health

Authors year and place of study	Number of subjects	Objective	Results	Conclusion
Souza VA et al., [19] 2009 in Serra, Brazil	99	To describe dental and periodontal diseases and oral lesions in newly diagnosed leprosy patients.	Average number of lost teeth was 8.8, with 73% decaying teeth and 71.4% with at least one tooth loss. DMFT index was 14.4. 82% of the patients had periodontal disease, and 92% had gingivitis.	They concluded that the data showed a lack of oral health prevention and treatment, as well as restricted access to cases of leprosy that had not yet been recognised.
Rawlani SM et al., [22] 2011 in Wardha, Maharashtra	160	To evaluate alveolar bone loss in treated leprosy patients of central India.	Widespread alveolar bone loss, which may have been brought on by the disease's advanced stages or delayed admission to a rehabilitation facility.	They concluded that the leprosy patients' general dental health was poor due disease's advanced stages or delayed admission to a rehabilitation facility and required greater dental care.
Raja SA et al., [6] 2016 in Dindigul, Tamil Nadu	62	To assess the oral and periodontal status of the leprosy patients in Dindigul district.	Tooth loss (69.5%), mobility (60.86%), attrition (56%), and chronic pulpitis (34.7%), and dental caries (26%), gingival recession (54.8%) was observed.	They came to the conclusion that a course of antibiotics given to Leprosy patients as part of MDT is effective against Gram-positive bacteria that cause dental caries and other concerns in the oral cavity.
Matos FZ et al., [1] 2017 in Cuiabá-Mato Grosso, Brazil	160	To evaluate the oral health status, salivary flow and halitosis among individuals diagnosed with leprosy as compared with healthy subjects.	Mean DMFT was greater than 6.6. 10% and 13.7% who had low and extremely low flow, respectively. Gingivitis (63.1%) and periodontitis (25%) were seen.	The authors came to the conclusion that those who had experienced leprosy had poor dental health.
Gadge RS and Bajaj PS [20] 2020 in Wardha, Maharashtra	110	To check the occurrence of NCCLs in Tuberculoid and Lepromatous leprosy.	Erosion and abrasion were reported in 10 of the 110 patients (10%). 21 of the 110 patients (19%) had both abrasion and abfraction, which was statistically significant.	They determined that the presence of NCCLs can be attributed to MDT health risks.
Present study	150	To evaluate the oral, dental and periodontal findings in patients during three different stages of drug regimen.	68% had decayed teeth, 62% had a missing tooth, 42.6% had their teeth filled. NCCLs were found in 80 out of 150 with abrasion seen in 51 out of 80 patients (71%), 38 out of 80 patients (47.5%) for abfraction, and 18 out of 80 patients (22.5%) for erosion. CAL was found to be statistically significant with higher scores in patients who had completed their treatment.	The findings of our study re-emphasise the presence of oral and periodontal findings in various stages of leprosy including caries, NCCLs and increased CAL. The increased attachment loss in treated patients can be supplemented to the drug therapy prescribed for leprosy.

[Table/Fig-17]: Findings and comparison of similar studies [1,6,19,20,22].

and impacts an individual's overall health. To prevent additional morbidity, leprosy patients should be educated about oral health issues and encouraged to practice good dental hygiene and also to improve the quality of life for those undergoing treatment.

Limitation(s)

It is important to note that the samples used in the current study were convenience samples gathered in context of specific centres in Vidarbha, Maharashtra. Hence, they may not be representative of the communities at large being researched. Furthermore, the current data's non-random and cross-sectional qualities imply that the interpretation of the results should be limited to the groups examined at the time of this research. Given the size of the disease in relation to public health and the high incidence of the disease in India, the upper airways are the most important entryway for the bacillus and the oral and para-oral findings of broad disease beginning; leprosy is not mentioned frequently in dental literature on a longitudinal basis. As a result, when considering the current findings and conclusions, readers should approach with caution.

CONCLUSION(S)

This study concludes that there was a correlation between declining oral health with the advancement of disease. The findings of the present study re-emphasise the presence of dental and periodontal findings in various stages of leprosy including caries, NCCLs and increased CAL. The increased attachment loss in treated patients can be supplemented to the drug therapy prescribed for leprosy. The key take home message for clinicians and public health professionals is to be more forthcoming with regard to the disease's progression and the broader implications of disease and treatment approaches including early diagnosis along with the formulation of preventive and therapeutic treatment models, with vigilant screening of relevant findings to lessen the burden of disease.

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PARTICULARS OF CONTRIBUTORS:

1. Intern, Department of Periodontics and Oral Implantology, Sharad Pawar Dental College, Datta Meghe Institute of Higher Education and Research, Sawangi, Wardha, Maharashtra, India.
2. Associate Professor, Department of Periodontics and Oral Implantology, Sharad Pawar Dental College, Datta Meghe Institute of Higher Education and Research, Sawangi, Wardha, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Madhumita Choudhari,
Intern, Department of Periodontics and Oral Implantology, Sharad Pawar Dental College, Datta Meghe Institute of Higher Education and Research, Sawangi, Wardha-442001, Maharashtra, India.
E-mail: madhumita.a.choudhari@gmail.com

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