

# Treatment of Interdental Papillary Deficiency Using Different Concentrations of Hyaluronic Acid: A Pilot Study

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## ABSTRACT

**Background:** In the present era, demand of beauty and esthetics has increased rapidly. Interdental papilla (IDP) construction, especially in the esthetic area, is one of the most challenging tasks. Interdental papilla loss might occur due to several reasons as a consequence of periodontal surgery or trauma.

**Aims and objectives:** The present study aimed to prepare economically feasible injectable form of hyaluronic acid gel (HA) in three different concentrations—HA 1%, 2%, and 5% to evaluate its efficacy in the augmentation of IDP.

**Materials and methods:** Total 14 sites were selected with 6 sites (1% HA), 3 sites (2% HA), and 5 sites (5% HA), respectively, for the IDP reconstruction in 18–40 years of age group of both the sexes. Hyaluronic acid was injected at 2 mm apical to tip of papilla for continuous 3 weeks. The IDP augmentation was measured at a time interval of 1, 3, and 6 months using stent with UNC15 probe and photographic analysis was done using ImageJ software.

**Results and conclusion:** From the results of this case series, 5% HA has shown both clinical and photographic improvements, which can be dependable for papillary enhancement.

**Keywords:** Esthetics, Hyaluronic acid, Interdental papilla, Interdental papillary deficiency.

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## INTRODUCTION

In present scenario, the esthetic demand in dentistry has increased rapidly, driven by an enhanced awareness of beauty and esthetics.<sup>1</sup> Interdental “black triangles” were considered as the third most disliked or unattractive esthetic problem after caries and crown margins.<sup>2</sup> The deficiency of interdental papilla (IDP) causes open gingival embrasures, phonetic problems, food impaction, and other esthetic concerns.<sup>3,4</sup>

Several efforts have been undertaken to treat and restore the missing interproximal papilla, which include surgical and nonsurgical approaches.<sup>5</sup> The surgical techniques are invasive, unpredictable, and lead to jeopardization of the blood supply to the recipient site. Thus, considering its traumatic and invasive nature, use of a safer and less invasive technique such as the application of hyaluronic acid gel (HA) can be considered as a suitable alternative for the treatment of deficient IDP and it can replace the conventional invasive methods.<sup>6</sup> Few authors<sup>7–11</sup> have used commercially available HA in treating IDP deficiency which are expensive and not readily available. Therefore, the objective of the current study was to prepare the economically feasible injectable form of HA without crosslinking agent (which is known to cause allergic reaction in commercially available products) in three different concentrations—HA 1%, 2%, and 5% to evaluate its efficacy in the augmentation of IDP.

## MATERIALS AND METHODS

The present study was conducted in total 14 anterior sites of 7 systemically healthy subjects (7 females and 1 males) of 25–40 years of age group. The study protocol was approved by institutional IRB (Ref. No. CODS/1977/2015-2016) fulfilling the criteria of RGUHS, India. Subjects were divided into three groups—group I (6 sites in 3 subjects), group II (3 sites in 1 subject), and group III (5 sites in

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3 subjects) in which 1%, 2% and 5% HA was injected, respectively. The study included the patients with clinically normal periodontium other than deficient papilla with cardaropoli papilla presence index<sup>12</sup> scores 2 and 3, plaque score of <10% (O’Leary et al.).<sup>13</sup> Exclusion criteria involved the subjects with known allergic to HA, on medication known to the increased risk of gingival overgrowth, teeth with hopeless prognosis, parafunctional habits and traumatic occlusion, patient undergone any periodontal plastic surgery in the selected area in the last 1 year, pregnant women, and smokers. After collecting the information about this study such as the objectives, expected outcomes, and the degree of discomfort that might occur, the subjects gave their informed consent.

The procedure of injecting HA was similar in all the concentrations. After phase one therapy, the selected site was first anesthetized using lignocaine 2%, 1:80,000 adrenaline. Less than 0.1–0.2 mL of the HA was injected using insulin syringe. The needle was inserted at a 45° angle in an area of 2–3 mm apical to the IDP tip, ensuring the bevel upward by pointing the slant of the

needle coronally.<sup>10</sup> The area was gently massaged for 1 minute. The patients were discharged and instructed not to use dental floss at the treatment sites and brush their teeth at the day of injection and resume oral hygiene the day after using a soft toothbrush at the anterior teeth and place it coronal to gingival margin.<sup>8</sup> Injection was repeated on 2nd and 3rd weeks. Patients were followed up at 1, 3, and 6 months. Clinical parameters and photographic parameters were recorded at baseline and at every follow-up time period. Clinical measurement was performed using modified stent and straight UNC15 probe from tip of IDPs to the apical extent of the stent for the first time and readings were rounded off to the nearest 0.5 mm<sup>14</sup> (Fig. 1). Modification was done by completely trimming the interdental portion of stent so as to avoid angulation and the probe enters parallel to the tooth to touch the tip of papillae. For photography, utmost effort was made to use the same distance and horizontal and vertical angles during photography. Clinical photographs were used to measure the area of the selected black space using the Image analysis software (NIH ImageJ software)<sup>8</sup> (Fig. 2). The area of interest (each papillary area) was calculated at baseline (prior to the injection) and at 1, 3, and 6 months (Fig. 3). The data were statistically analyzed using repeated measures test and analysis of variance (ANOVA) test.

## RESULTS

A total of 14 sites were included in the study (Table 1). In the present study, the IDP reconstruction using the injectable 1%, 2%, and 5% HA was performed in 6 sites (1% HA), 3 sites (2% HA), and 5 sites (5% HA), respectively. Percentagewise and the mean value with standard deviation change in the papilla reconstruction at different follow-up times are presented in Tables 2 and 3. As a result, 1% HA group showed a maximum improvement of 16.6% with the mean value of  $3.1 \pm 0.7$  till 3 months. Between 3rd-month and 6th-month period, rebound was observed and improvement seen was 10.1%

**Table 1:** Demographic table

	1% hyaluronic acid	2% hyaluronic acid	5% hyaluronic acid
Age (mean)	30	31	31
Male	1	0	1
Female	2	1	2
Sites	6	3	5
Maxillary	1	1	2
Mandibular	5	2	3



**Fig. 1:** Clinical measurement of interdental papillary deficiency using stent and UNC15 probe



**Fig. 2:** Area measurement of interdental black space using ImageJ analysis



**Figs 3A and B:** Clinical and photographic analyses of interdental papillary deficiency: (A) At baseline; (B) At 6 months after the hyaluronic acid injection showing improvement in IDP

**Table 2:** Stent measurement of interdental papilla in 1%, 2%, and 5% hyaluronic acid injection at different time intervals

	Baseline	1 month	3 months	6 months	F value	p value
1% HA (%-wise improvement)	3.7 ± 0.7	3.1 ± 0.9 (16.3%)	3.1 ± 0.7 (16.6%)	3.3 ± 0.7 (10.1%)	5.33	0.02 (S)
2% HA (%-wise improvement)	3.5 ± 0.86	3.3 ± 0.57 (5.8%)	3.2 ± 0.64 (8.6%)	3.8 ± 0.76 (-8.5%)	2.5	0.22 (NS)
5% HA (%-wise improvement)	2.9 ± 0.5	2.5 ± 0.6 (13.8%)	2.4 ± 0.5 (17.3%)	2.5 ± 0.5 (13.8%)	4.39	0.07 (S)
F value	15	1.51	2.3	3.4		
p value	0.26 (NS)	0.26 (NS)	0.1 (NS)	0.06 (NS)		

S, significant; NS, nonsignificant; %, percentage; HA, hyaluronic acid

**Table 3:** Photographic measurement of interdental black space in 1%, 2% and 5% hyaluronic acid injection at different time intervals

	Baseline	1 month	3 months	6 months	F value	p value
1% HA (%-wise improvement)	444.6 ± 164	360.6 ± 165 (19%)	329.8 ± 157 (26%)	351.1 ± 178 (21%)	3.67	0.05 (S)
2% HA (%-wise improvement)	249 ± 38.5	227 ± 24.0 (8.9%)	235 ± 20.0 (5.7%)	249 ± 18.2 (0%)	3.15	0.19 (NS)
5% HA (%-wise improvement)	302.6 ± 259	222.0 ± 285 (26.5%)	210.2 ± 288 (30.5%)	212.6 ± 304 (29.9%)	4.38	0.90 (NS)
F value	1.28	0.76	0.51	0.58		
p value	0.31 (NS)	0.49 (NS)	0.61 (NS)	0.57 (NS)		

S, significant; NS, nonsignificant; %, percentage; HA, hyaluronic acid

(3.3 ± 0.7) at 6 months from baseline. Two percentage HA showed a maximum improvement of 8.6% (3.2 ± 0.64) at 3 months. Rebound was seen at 6th month, which is suggestive of 8.5% apical shift of papilla from the baseline level. The 5% HA group showed a maximum improvement of 17.3% at 3 months, which got reduced to 13.8% at 6 months due to apical shift of treated papilla. The improvement was statistically significant in 1% ( $p = 0.02$ ) and 5% HA ( $p = 0.002$ ) groups.

Pre- and posttreatment area of black triangles was calculated by ImageJ analyzer. Each site was individually evaluated for change between initial and final applications. The method measures dimensional changes in dark spaces from clinical photographs. Photographically at 3 months, 1%, 2%, and 5% HA groups showed a maximum improvement of 26%, 5.7%, and 30.5%, respectively. At 6th month, the apical shift of treated papilla (rebound) resulted in reduction of percentage improvement, i.e., 21% and 29% in 1% and 5% HA, respectively, whereas in 2%, there was 100% rebound suggestive of no improvement. Maximum improvement with less rebound (29.9%) at 6 months was seen in 5% HA group. However, the difference in improvement between different groups was statistically nonsignificant. There were no postinjection adverse reactions seen in any of the patients within 24 hours or 1 week.

## DISCUSSION

To our knowledge, this is the first study in which different concentrations of HA (1%, 2% and 5% HA) was tested for augmenting deficient IDPs. There are various treatment modalities to treat black triangle spaces which can be categorized into noninvasive and invasive techniques. The application of HA can be considered as a suitable alternative and it can replace the conventional invasive methods.<sup>8</sup> Hyaluronic acid was discovered in 1934 by Meyer and John Palmer. Hyaluronic acid is naturally occurring glycosaminoglycans,<sup>15</sup> a carbohydrate, more specifically

a mucopolysaccharide, occurring naturally in all living organisms.<sup>16</sup> Few authors<sup>7-11</sup> have used the commercially available HA in the treatment of IDP deficiency. To date, no comparative study has been conducted on the different concentrations of this material. The clinical measurement using modified stent has been used for the first time in the literature. The authors pertaining to HA and IDP treatment studies have used only photographic analysis.

In the current study, on both clinical and photographic measurements, 5% HA group showed maximum improvement at the end of 6 months. On clinical measurement, 1% and 5% showed a maximum improvement of 10.1%, and 13.8%, respectively, whereas in 2%, there was 8.5% apical shift of papilla from the baseline level. On photographic analysis, 1% and 5% showed 21% and 29.9% improvements, respectively, whereas in 2% HA group, there was 100% rebound at 6 months. This possibly could be due to less number of sites got remained in 2% HA group as patients dropped out. It requires further study to analyze its effects.

The use of a HA to treat IDP loss has been investigated by several authors. Becker et al.<sup>7</sup> reported 100% improvement in 3 sites and 88–97% in 8 sites and 57% in 1 site. Mansouri et al.<sup>8</sup> reported that the average improvement was 29% and 47% at 3 and 6 months, respectively. Awartani and Tatakis<sup>9</sup> showed 62% and 41% reduction in black triangle 4 and 6 months, respectively. Lee et al.<sup>10</sup> observed complete papilla reconstruction in 29 sites and 39% to 96% in 14 sites. Contrary to the above studies, Bertl et al. observed no differences in control group (saline injection) and test group (HA injection) at baseline, 3, and 6 months posttreatment.<sup>11</sup>

The above studies are not comparable to the current study as the concentration of HA and number of injections used in these studies are not similar to our study. The above studies used commercial preparation, whereas in the present study, self-prepared HA was used.

In the current study, relapse was seen between 3 months and 6 months. Similarly, the study done by Awartani showed relapse



between 4 months and 6 months, and Lee reported relapse in 6 out of 14 sites of papilla reconstruction group whereas Mansouri and Becker reported improvement over the time of 6 months and 25 months (for 1 site), respectively, without relapse. Such disparity may be due to the different materials used, apparent papillary deficiency, and other related influencing factors the treated defects.<sup>9</sup> Mild patient discomfort in terms of mild localized pain was reported within 1 day postinjection.

There are various factors, which influence the IDP morphology, position, and its functions. They are availability of underlying osseous support,<sup>17</sup> distance between interproximal contact positions to alveolar bone crest,<sup>18</sup> interproximal contact positions to alveolar bone crest,<sup>19</sup> periodontal biotype,<sup>20</sup> tooth morphology,<sup>21</sup> diverging roots and postorthodontic treatment,<sup>22</sup> and patient age.<sup>23,24</sup> With these considering factors, the IDP deficiency can be planned.

From the results of this case series, the HA formulation is easy and economical as the available commercial preparations are highly expensive. The 1% and 5% HA are recommended; however, 5% HA has shown both clinical and photographic improvements, which can be dependable for papillary enhancement. Further implant papillary deficiency can be treated using HA preparations.

## CONCLUSION

The close association between IDP reconstruction using injectable HA and the number of applications were discovered. Future studies are needed to ascertain long-term outcomes, to determine the appropriate time period for retreatment, to identify pretreatment determinants of positive outcomes and patient satisfaction, and to perform comparisons between different available materials.

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