

Demographic Assessment of Laser Therapies in 0–18-year-olds: A Retrospective Study

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ABSTRACT

Background: LASER is an acronym for “light amplification by stimulated emission of radiation.” It is one of the most innovative tools, widely being used nowadays in every aspect of dentistry, which increases the efficiency and specificity of dental treatment.

Aim: Retrospective analysis of the demographic data for laser therapies in 0–18-year-olds for 5 years.

Materials and methods: The 5-year data on the number of laser therapies done using a diode laser in 0–18-year-olds from April 2017 to April 2021 was collected using practicing software of the institution “Orion.” The collected data included—age, gender, and treatment performed with laser or used as an adjunct to other procedures and its frequency with respect to age and gender. The Chi-squared test was used for intergroup comparison of the frequency of various laser procedures. For all the statistical tests, $p < 0.05$ was considered to be statistically significant, keeping a error at 5% and β -error at 20%, thus giving power to the study as 80%.

Results: A total of 1,427 laser therapies were conducted in a period of 5 years (April 2017–April 2021) in the Department of Pediatric and Preventive Dentistry. The frequency of laser therapies done, based on gender, was more in males, 819 (57.4%), when compared to females, 608 (42.6%). The most common procedure performed with laser was fluoride activation, followed by cavity disinfection, wound healing, etc.

Conclusion: A laser is an innovative tool, and it can be applied widely in the field of pediatric dentistry to perform various procedures with minimal discomfort.

Keywords: Diode laser, Pediatric dentistry, Retrospective study.

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INTRODUCTION

Laser is an advanced technology introduced by Theodore Mainman in 1960, and since then, laser technology has been making inroads into a lot of areas of dentistry due to its unique properties, such as a bloodless field of surgery, less operating time, and less patient discomfort.¹

Laser is a type of electromagnetic energy that is directional, collimated, monochromatic, and coherent (in time and space). Depending on the laser wavelength and optical tissue properties, the laser works accordingly on various types of tissues; diode laser is being popularly used in the field of dentistry with wavelengths of 810–980 nm in the range of visible and invisible near-infrared light.^{1,2}

Laser has gained importance in medical and dental fields due to its unique properties, such as it provides a bloodless field of surgery, thus providing a clear field of surgery. Apart from this, it promotes fast wound healing with minimal chances of infection; the patient does not feel any vibration and discomfort and requires less operating time, which in turn increases the ease and comfort of the patient.

Over the years, the application of laser has been explored in various treatment modalities in the field of dentistry like caries detection, cavity preparation, fluoride activation, pit and fissure application, wound healing, root canal disinfection, crown exposure, desensitization, ulcer healing, crown lengthening, bleaching of teeth, gingivectomy, frenectomy, pulpotomy, direct pulp capping, indirect pulp capping, etc.³

The objective of this study was to assess the total number of procedures performed with diode lasers and their wide range of

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applications in performing various dental procedures in the field of pediatric dentistry.

MATERIALS AND METHODS

The study was conducted in the Department of Pediatric and Preventive Dentistry. Ethical clearance was taken from Institutional Ethical Committee, under protocol no. ITSCDSR/IEEC/RP/2021/017.

Study Design

A retrospective observational study was designed, and data was collected from practicing Software Orion, being used in the institution, pertaining to laser therapies conducted in the Department of Pediatric and Preventive Dentistry in 0–18-year-old from April 2017 to April 2021.

The individuals were categorized into four groups—group I—0–5 years, group II—6–10 years, group III—11–15 years, and group IV—16–18 years.

The total number of procedures performed with laser was collected. From the gathered data, the procedures performed, such as cavity disinfection, crown exposure, crown lengthening, desensitization of teeth, fluoride application, frenectomy, gingival depigmentation, gingivectomy, mucocoele removal, operculectomy, root canal disinfection, ulcer healing, and wound healing in accordance to gender and age were assessed.

All the procedures were conducted with the help of a diode laser (i-lase, Biolase Technology Inc, California, United States of America), which is a semiconductor laser that works at the wavelength of 910 ± 15 nm.

Statistical Analysis

Data collected were tabulated using Microsoft Excel. Data were analyzed using the Statistical Package for the Social Sciences Software (SPSS) (SPSS v 26.0, IBM). Descriptive statistics like frequencies and percentages for categorical data were used. Comparison of frequencies of categories of variables with groups was done using the Chi-squared test. For all statistical tests, $p < 0.05$ was considered to be statistically significant, keeping α -error at 5% and β -error at 20%, thus giving power to the study as 80%.

RESULTS

On the basis of data obtained from college software Orion, from April 2017 to April 2021, a total of 1,427 laser therapies were conducted in the Department of Pediatric and Preventive Dentistry.

Out of 1,427, the total number of procedures done in males and females were respectively 819 and 608, as depicted in Table 1.

The distribution of laser procedures according to the age-group is shown in Figure 1, in which the maximum number of procedures done with the help of a diode laser was in group II (517), followed by group III (438), group IV (292), and least in group I (180) signifying the importance of diode laser in various age groups.

Different procedures carried out with the help of a diode laser are shown in Figure 2. The maximum number of procedures done with laser was fluoride application (550) followed by cavity disinfection (217), wound healing (170), root canal disinfection (149), crown lengthening (112), gingivectomy (41), crown exposure (40), frenectomy (33), gingival depigmentation and operculectomy (15), desensitization of teeth (10), and the least was mucocoele removal (three).

A comparison of various laser procedures according to the age group is depicted in Table 2. A statistically highly significant difference was seen for the frequency of procedures between the groups ($p < 0.01$), with a higher frequency for fluoride application in group II and cavity disinfection in group IV.

Various laser procedures based on gender were more in male, 819 (57.4%), when compared to female, 608 (42.6%), as shown in Table 3.

There was a statistically non-significant difference seen for the frequency between the groups ($p < 0.01$) with a higher frequency of

fluoride application and cavity disinfection in males and in females, crown exposure, and wound healing.

DISCUSSION

Laser has gained popularity in the field of dentistry since 1989 and is being used to carry out various dental procedures based on its hard tissue and soft tissue applications.⁴

Despite considerable improvements in oral health, dental caries continue to be a public health issue. But nowadays, “maximum preservation with minimal intervention” is being practiced, and laser truly fulfills the concept of Minimally Invasive Dentistry.

In the field of pediatric dentistry, a laser can be used as an essential tool to perform various procedures as it is less invasive and provides a bloodless field of surgery, which in turn, reduces the dental anxiety and pain perception of an individual.

A diode laser is a semiconductor laser with a solid material active media, which is available in various combinations, such as gallium aluminum arsenide and indium gallium arsenide phosphide. They range from 810 to 980 nm, which is under the infrared spectrum of light.⁵

Various dental procedures can be done using diode laser through photodynamics or low-level laser therapy (LLLT).⁶

Based on its clinical implications on tissue, a laser can broadly be classified as—soft tissue laser and hard tissue laser.^{7,8}

Soft tissue application of laser can be used for gingivectomy, gingivoplasty, gingival hyperplasia, operculectomy with minimal bleeding, enhancement of tooth eruption, aphthous lesions, herpes labialis, mucocoele, frenectomy, ankyloglossia, pulp therapy, etc.⁹

Hard tissue application includes caries detection, caries prevention by activation of topical fluoride, cavity disinfection, desensitization, bleaching, etc.

This retrospective study depicts the total number of laser procedures carried out in the period of 5 years from April

Table 1: Number of males and females

	Frequency	Percentage
F	608	42.6
M	819	57.4
Total	1,427	100.0

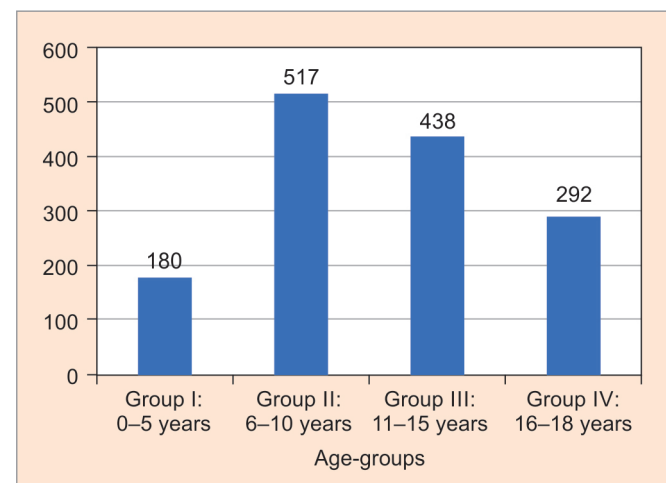


Fig. 1: Age-wise distribution of sample

Chi-square tests

	Value	Degree of freedom	p-value
Chi-square	14.433	12	0.274

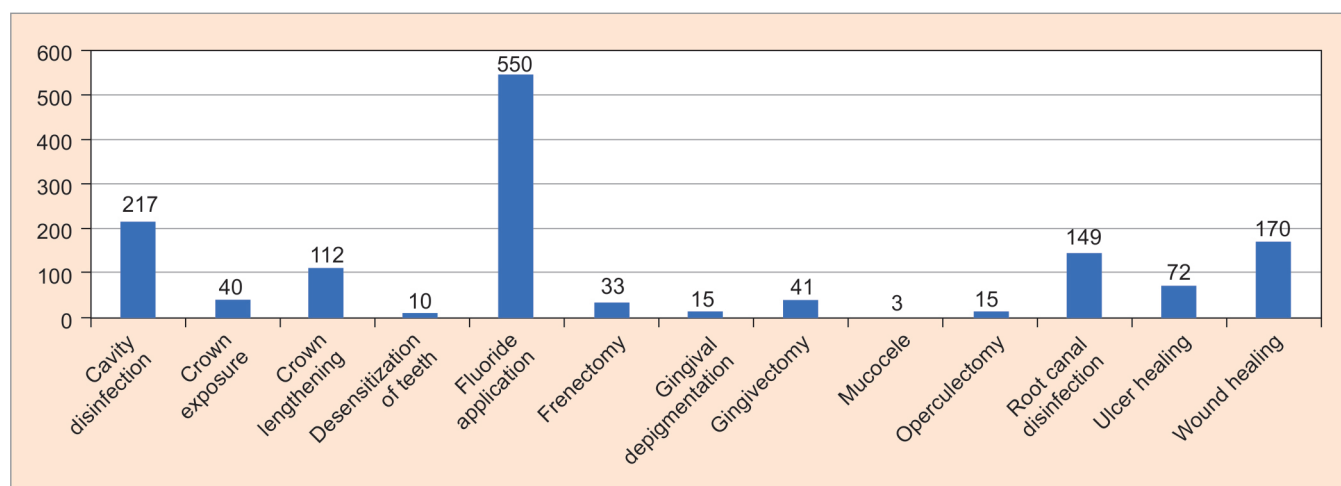


Fig. 2: Procedure-wise distribution of samples

Table 2: Comparison of laser procedure according to age-group

	Age group				Total
	Group I—0–5 years	Group II—6–10 years	Group III—11–15 years	Group IV—16–18 years	
Procedure done cavity disinfection	19	52	70	76	217
Crown exposure	0	40	0	0	40
Crown lengthening	0	19	23	70	112
Desensitization of teeth	0	0	0	10	10
Fluoride application	108	232	210	0	550
Frenectomy	20	13	0	0	33
Gingival depigmentation	0	0	0	15	15
Gingivectomy	0	19	16	6	41
Mucocele	0	1	2	0	3
Operculectomy	0	0	0	15	15
Root canal disinfection	29	27	30	63	149
Ulcer healing	4	9	34	25	72
Wound healing	0	105	53	12	170
Total	180	517	438	292	1,427

Table 3: Gender-wise distribution of various laser procedures

Procedures done	Sex		Total
	Female	Male	
Cavity disinfection	95	122	217
Crown exposure	23	17	40
Crown lengthening	49	63	112
Desensitization of teeth	4	6	10
Fluoride application	213	337	550
Frenectomy	9	24	33
Gingival depigmentation	7	8	15
Gingivectomy	19	22	41
Mucocele	2	1	3
Operculectomy	8	7	15
Root canal disinfection	70	79	149
Ulcer healing	35	37	72
Wound healing	74	96	170
Total	608	819	1,427

2017 to April 2021, which included both surgical and nonsurgical procedures, such as cavity disinfection, root canal disinfection, pocket disinfection, desensitization of teeth, operculectomy, crown exposure, fluoride activation, etc. A total of 1,427 laser procedures were carried out with the help of diode lasers in various age groups—0–18 years.

Topical fluoride application in combination with laser shows a synergistic effect as it changes the polarization of the enamel component, which potentiates the retention and diffusion of fluoride to the inner layer of enamel and generates a fluoride reservoir.¹⁰ Hence, in the departmental study, a total of 550 topical fluoride applications with laser activation were performed.

The results of the study are in correspondence with the study conducted by Al-Maliky et al.,¹¹ in which they investigated the caries prevention effect of laser radiation in combination with fluoride. The authors suggested that laser causes photothermal modification of inorganic and organic components of enamel, thus decreasing the permeability and solubility of enamel.¹¹

Cavity disinfection is recommended with a routine caries removal method in order to eliminate the microorganisms and

reduce the potency of secondary caries. Cavity disinfection, when conducted with the help of a laser, decreases bacterial load and increases bond strength.^{12,13} In the present study, 217 cavity disinfection procedures were done, which showed a success rate of 100% with no secondary caries.

A study conducted by Mohan et al.,¹⁴ showed similar results in which cavity disinfection efficacy of acidulated phosphate fluoride gel, propolis, diode laser, and 2% chlorhexidine for *Streptococcus mutans* and *Lactobacilli* were evaluated, and it was concluded that diode laser is most effective against microorganisms because of the greater depth of penetration of laser radiation of about 1 mm into the dentin, surpassing the effective range of chemical disinfectants.¹⁴

Root canal disinfection with the help of laser helps in better elimination of microbes present in the root canal and, thus, increases the success rate of endodontic therapy.¹⁵ In the present study, 129 root canal disinfection procedures were performed with the help of a diode laser.

The results of the current study are in correspondence to the study conducted by Walia et al.,¹⁶ in which they evaluated the effectiveness of diode laser in root canal disinfection and its comparison with 1% sodium hypochlorite, 2% chlorhexidine, and saline. And it was concluded by the authors that a diode laser could be used as a possible supplement to existing protocols for disinfecting the root canal system.¹⁶

Thermal and photodisruptive effects of the laser are principally considered the reasons for eliminating the bacteria. It causes lethal damage by destroying the cell wall integrity and denaturation of protein. This damage to the cell wall results in the cessation of the growth of cells and successively causes their lysis. So, it can be well applied in the field of dentistry for pulp therapies and cavity disinfection, thus minimizing secondary caries, pulp sensitivity, and pulp inflammation before restoring the cavities.^{17,18}

Also, wound healing can be enhanced with the help of LLLT by influencing various tissue responses such as blood flow, inflammation, cellular proliferation, and cellular differentiation. LLLT stimulates lymphocytes and activates mast cells and the proliferation of various cell types, therefore, acting as an anti-inflammatory and also enhancing wound healing.^{19,20} In the present study, 170 wound healing after extraction and 72 ulcer healing was conducted with the help of a diode laser in various pediatric age groups based on the concept of enhanced wound and ulcer healing.

Laser is also a better alternative for gingivectomy, crown lengthening, frenectomy, and frenotomy than conventional methods, which are more cumbersome. Laser not only minimizes intraoperative and postoperative bleeding but also causes less pain compared to conventional procedures.

A total of 315 procedures, including gingivectomy, crown lengthening, frenectomy, mucocele removal, and crown exposure, were carried out with the help of a diode laser in a period of 5 years with minimal relapse, suggesting that the success rate is very high.

Photothermal interaction with tissue is the basic concept of a surgical laser. Radiant light is absorbed by tissue and transformed into heat energy—changing tissue structure, which, when appropriately applied, can cause incision, vaporization, and coagulation at various wavelengths.²¹

The current study suggests that the laser is gaining popularity, and it is preferably accepted by both patients and clinicians because of its ease of application and minimal discomfort.

This study confirms that lasers can be used in various age groups. The lowest age group in which laser procedure was

conducted was 3 years old, and the highest was 18 years old, suggesting its wide application in various age groups.

Laser is an innovation that has gained popularity due to its unique property of providing a bloodless field of surgery and less postoperative pain and hence can be very well utilized in the field of pediatric dentistry, minimizing the fear and anxiety of a child.

CONCLUSION

So, it can be concluded that a diode laser can be used as an effective tool for conducting both non-surgical and surgical dental procedures in the pediatric age group with minimal discomfort due to its ease of application and several advantages in the form of minimal bleeding and pain.

The limitations of the study are:

- A real-time assessment of various laser procedures would have given more reliable results.
- A better understanding of various laser procedures and their success rate in the field of pediatric dentistry would have been best evaluated if a follow-up study had been planned.

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