

# Laser Surgery for Treating Retarded Teeth Eruption in Children

**Dan Xu**

Third Affiliated Hospital of Soochow University: Changzhou First People's Hospital

**Peipei Wang**

Third Affiliated Hospital of Soochow University: Changzhou First People's Hospital

**Hualian Liu**

Third Affiliated Hospital of Soochow University: Changzhou First People's Hospital

**Min Gu** (✉ [gumin106@163.com](mailto:gumin106@163.com))

Third Affiliated Hospital of Soochow University: Changzhou First People's Hospital

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## Research Article

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# Abstract

**Objective:** To analyze the efficacy of laser surgery in treating retarded eruption in children.

**Method:** Sixty-three children (age 7-13 30 boys and 33 girls) were selected and according to the random number table divided into three groups: Laser surgery group (group A), electrosurgery group (group B), and routine surgery group (group C). The total operative time, the duration of pain after gingival excision, and VAS pain intensity scores, gingival healing time, and intraoperative coordination were all recorded. Pain intensity was assessed using a Visual Analogue Scale (VAS) score (0 to 100mm). At six months during the follow-up, this physician checked and recorded the periodontal indicators of permanent teeth, including gum index (GI), plaque index (PLI), and probing depth (PD).

**Results:** All teeth erupted normally in three groups after treatment, showing normal pulp and periodontal tissue. There was no significant difference in operative time, pain duration, pain intensity, healing time between group A and group B. There was a significant difference in total operative time, pain duration, pain intensity, and healing time between electrosurgery group (group B) and routine surgery group (group C) ( $P < 0.05$ ). There was a significant difference in total operative time, pain duration, pain intensity, and healing time between laser surgery group (group A) and routine surgery group (group C) ( $P < 0.05$ ). Periodontal indexes, including gingival indexes, plaque indexes, were examined in three groups at six months after treatment by the same periodontist. Then, the efficacy of the three methods was compared.

**Conclusion:** Laser surgery and high-frequency electrosurgery has favorable efficacy, less pain, and higher operability. However, in the use of the electric knife, the paste flavor may discomfort the children, make them less cooperative, and prolong the procedures.

## Introduction

During the transitional period, retarded growth of permanent teeth causes malocclusion, even cystic lesions in the bone surrounding the teeth, with serious adverse effects on the function, appearance, and psychology of children. Therefore, laser surgery is being used to promote tooth eruption<sup>[1-3]</sup>. But its efficacy should be evaluated through comparison with others.

Electrosurgical and routine surgeries are commonly used to help the eruption of permanent teeth. However, in the use of the electric knife, the paste flavor may discomfort the children, make them less cooperative, and prolong the procedures. Traditional surgery often causes more bleeding. New and minimally invasive, laser surgery has a wide range of applications in clinical oral treatment<sup>[4]</sup>, with a good hemostatic effect and a short healing time<sup>[5, 6]</sup>. This study discussed the application of laser surgery in assisting eruption of permanent teeth in children.

## 1. Material And Methods

## 1.1 Participants

A total of 63 patients (age: 7-13, 30 boys and 33 girls), who received orthodontic treatment at the Affiliated Third Hospital of Soochow University, Department of Stomatology of Changzhou First People Hospital, were recruited from February 2015 to June 2017. The patients were divided into three groups according to the random number table: experimental group (group A): Nd:YAG laser (Equipment: LightWalker, Brand: Fotona, Model: M021-5AF/1) removal of gingiva; experimental group (group B): electrosurgical removal of the gingiva; control group (group C): traditional surgical removal of the gingiva.

The following selection criteria were applied: (1) no systemic blood diseases; (2) blood clotting time and other blood profiles were normal before treatment; (3) the delayed growth of permanent teeth was caused by hypertrophy of the gums; (4) the gap left by the missing teeth was sufficient for the eruption of a permanent tooth. The position and growth direction of the permanent tooth were confirmed by X-ray. If necessary, the oral cone beam CBCT was used to diagnose the direction of the tooth axis. Cases showing other causes that impeded the eruption of the teeth, such as multiple teeth, root development, or cysts, were excluded. This study involving human participants were reviewed and approved by The First People's Hospital of Changzhou, the third Affiliated Hospital of Soochow University (202059), written informed consent to participants in this study was provided by the participants' legal guardian next of kin.

## 1.2 Surgeries

The basic data of each child were collected, concerning name, gender, age, ethnicity, physical condition, history of systemic diseases, oral health, and health habits.

The children were randomly divided into three groups. All operations were performed by the same maxillofacial surgeon. The operation was performed after local infiltration anesthesia through lidocaine injection. Group A received a laser ablation of hypertrophic gingiva (Nd: pulse width: SP; pulse frequency: 50Hz; average output power: 4.5W) to expose the crown for the normal eruption of permanent teeth. Laser hemostasis (Nd: pulse width: VLP; pulse frequency: 20Hz; average output power: 4.00W) was used to control bleeding. Group B received electric knife-assisted removal of gingiva. Group C received the traditional surgical removal of gingiva with 11 blade. No suture was needed. Good oral hygiene was maintained. The total operative time, the duration of pain after gingival excision, and VAS pain intensity scores, gingival healing time, and intraoperative coordination were all recorded by one trained physician. Pain intensity was assessed using a Visual Analogue Scale (VAS) score (0 to 100mm), with a VAS marker of 1-25mm for mild pain; 26-50mm for moderate pain; 51-75mm for severe pain; 76-100mm for unbearable pain.<sup>[3, 7, 8]</sup> Two days after the operation, the patient was followed up by telephone to determine the pain persistence. One week after the operation, the patient was revisited to observe the healing of the gingiva. At six months during the follow-up, this physician checked and recorded the

periodontal indicators of permanent teeth, including gum index (GI), plaque index (PLI), and probing depth (PD).

## 1.2.1 Detection sites

The mesial, distal, and middle of the labial surface of the permanent tooth after the orthodontic forced eruption.

## 1.2.2 Periodontal indexes

The GI was scored as follows: 0=normal gingiva, 1=mild edema, no bleeding on probing (BOP), 2=hyperemia and edema, bleeding on probing (BOP), 3=obvious redness and swelling, automatic bleeding tendency. PLI was scored as follows: 0=no plaque on gingival margin, 1=invisible plaque at the gingival margin but the probe could scrape, 2=a moderate amount of plaque at the gingival margin or adjacent surface, 3=a large amount of food debris at gingival crevice or gingival margin and adjacent surface. Probing depth referred to the distance from the gingival margin to the bottom of the periodontal pocket or the bottom of the gingival crevice.

## 1.2.3 Detection methods and data processing

In the case of unknown patients grouping, according to the numerical random table order, the periodontal indexes were elicited by the same periodontologist. Each site was measured three times and the results of each index were averaged as the final periodontal index of this patient.

## 1.3 Statistical methods

Statistical analysis was performed using SPSS 20.0 statistical software. One-way ANOVA was used for data comparison between groups.  $P < 0.05$  was considered statistically significant.

## 2. Results

Table 1 shows that laser and electrosurgical treatment facilitated the growth of permanent teeth in children with deciduous teeth. There was no significant difference in total operative time, pain duration, pain intensity, and healing time ( $P > 0.05$ ) between laser surgery group (group A) and electrosurgery group (group B). There was a significant difference in total operative time, pain duration, pain intensity, and healing time between electrosurgery group (group B) and routine surgery group (group C) ( $P < 0.05$ ). There was a significant difference in total operative time, pain duration, pain intensity, and healing time between laser surgery group (group A) and routine surgery group (group C) ( $P < 0.05$ ).

Table 1

Operative time, pain duration, pain intensity, healing time of among laser surgery group (group A), electrosurgery group (group B), and routine surgery group (group C)

	<b>Surgery time (min)</b>	<b>Pain duration (d)</b>	<b>Pain intensity assessment (VAS value)</b>	<b>Healing time (d)</b>
Experimental group (group A)	15.7±2.4*	1.5±0.51*	2.07±0.58*	8.2±1.4*
Experimental group (group B)	16.8±2.1*	1.59±0.6*	2.19±0.69*	9.7±0.4*
Control group (group C)	32.5±3.2	4.4±0.3	5.80±0.57	7.0±0.4
Note: Compare group A with group B, $P>0.05$				
*Compared with the control group, $P<0.05$				

Table 2 shows significant differences between the experimental group and the control group in GI, PLI, PD of eruptive permanent teeth after six months of treatment ( $P<0.05$ ).

Table 2

Periodontal indexes of erupted permanent teeth at six months after treatment

	<b>GI</b>	<b>PLI</b>	<b>PD</b>
Experimental group (group A)	0.98±0.35*	1.02±0.52*	2.45±0.58*
Experimental group (group B)	0.97±0.25*	1.10±0.55*	2.44±0.62*
Control group (group C)	0.96±0.65	1.08±0.45	2.46±0.32
Note: *Compared with the control group, $P<0.05$			

### 3. Discussion

The eruption of permanent teeth is often delayed when gingival tissue thickens due to premature deciduous teeth and trauma. With effective correction, the teeth can erupt at the normal position, thus reducing the occurrence of malocclusion [7-10]. This study verified the clinical superiority of laser surgery in promoting delayed tooth eruption.

Lasers are being widely used in oral surgery. Goldman et al. reported the first laser-assisted oral surgery in 1964 [11]. Treated with low-level laser therapy (LLLT) [12], children feel less pain, bleeding, and fear, and are more cooperative. The Nd:YAG laser used in this study emits a laser of 1064 nm to penetrate into the gingiva by a moderate depth, bring much less thermal damage and anxiety to the children [10, 13-16]. Mingwei Li [17] also found that low-level laser can effectively reduce the pain associated with surgical

treatment. The results of this experiment are also consistent with this study. This study found a significant difference in total operative time, pain duration, pain intensity, and healing time between laser surgery group (group A) and routine surgery group (group C) ( $P < 0.05$ ). Laser surgery can shorten operative duration, simplify surgical procedures, and reduce postoperative pain and operation-induced fear, all making it highly applicable to children patients [18].

In this study, we found significant differences in periodontal indexes between three groups when the permanent teeth emerged at 6 months after the operation. Periodontal PD values were within the normal range ( $PD < 3$  mm), but laser surgery and electrocautery surgery brought lower periodontal probe depth than traditional surgery ( $P < 0.05$ ), indicating that laser and electrocautery surgeries are more beneficial for gingival recovery. We also found that GI and PLI of laser surgery group and electrocautery group were more favorable than those in traditional surgery group, also verifying the better restoration of gingival shape.

It is of great advantage to remove periodontal bacteria during the treatment of children with oral hygiene, to prevent gingivitis during orthodontic surgery, and to maintain the periodontal health of patients [19]. There was no significant difference in total operation time, pain duration, pain intensity, healing time, and GI, PLI, PD of eruptive permanent teeth after six months of treatment between the Nd:YAG laser surgery and the high-frequency electrosurgery. However, in the use of the electric knife, the paste flavor may discomfort the children, make them less cooperative, and prolong the procedures.

In conclusion, this study suggests that Nd:YAG laser surgery, with good clinical outcomes, can be used to promote the eruption of permanent teeth in children. But whether the laser can completely replace the electrosurgical knife or traditional blade requires further research.

## Declarations

### ***Ethics approval and consent to participate:***

This study involving human participants were reviewed and approved by the Third Affiliated Hospital of Soochow University, the First People's Hospital of Changzhou (202059). Writted informed consent to participate in this study were provided by the participants' legal guardian next of kin.

### ***Consent for publication:***

Not applicable.

### ***Availability of data and materials:***

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### ***Competing interests:***

The authors have no relevant financial or non-financial interests to disclose.

The authors have no conflicts of interest to declare that are relevant to the content of this article.

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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### ***Author Contributions***

Concept and design of the work were performed by Dan Xu and Min Gu

Acquisition and analysis the data were performed by Min Gu and Hualian Liu.

Interpretation of data and drafted the article and revised it critically for important intellectual content were performed by Dan Xu and Peipei Wang.

Approved the version to be published were performed by Min Gu.

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Not applicable.

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