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Evaluation Of Low Intensity Pulsed Ultrasound Treatment For Improving Postoperative Outcome In Orthognathic Patients: An Observational Study

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Abstract

Purpose: *The aim of the study is to evaluate the efficacy of LIPUS treatment in improving patient's comfort post Orthognathic surgery*

Materials and methods: *This observational study includes patients requiring orthognathic surgery [Sagittal split osteotomy] for either esthetic or functional improvements and corrections. Patients were provided with written informed consent for the participation. Patients were treated with LIPUS stimulator with 1.5MHz, 30Mw/cm² for 20 minutes postoperatively. The outcome parameters assessed were postoperative wound healing on days 3,5,10,15 and radiographic changes on weeks 4,6,8.*

Results: *The study variables were analysed using mann whitney test.*

Conclusions: *LIPUS therapy helps to reduce postoperative side effects. It speeds up fracture repair, enhances wound healing, and lessens postoperative pain and accelerates overall quality of life and comfort of patients in the post operative period.*

Key words: *LIPUS; Ultrasound; Wound healing; BSSO; Orthognathic surgery;*

INTRODUCTION

Orthognathic surgery entails surgically realigning the facial skeleton to restore the optimal anatomical and functional relationship. Researchers are now much more interested in finding an efficient method to promote healing and hasten recovery as a result of recent advancements in stimulation technology for bone fracture repair. Among these, ultrasonic stimulation has been discovered to be a secure method for accelerating the healing of bone fractures. To provide insight on the possible application of mechanical bioeffects to the therapeutic uses of ultrasound in medicine, an outline of the basic principles behind the main processes by which ultrasonic interacts with biological tissues has been covered in this study. The role of LIPUS in improving the quality of life in the post operative period has not been studied. The purpose of the study is to assess the same for patients undergoing orthognathic surgery by using clinical and radiological parameters. The Null hypothesis of this investigation states that there is no impact of LIPUS on clinical and radiographic outcome post orthognathic surgeries.

The study excluded patients with acute inflammation or infection at the time of surgery, systemic diseases and medically compromised patients, cleft cases, and syndromic cases. In contrast, patients with dentofacial deformity, skeletal class II and skeletal class III, anterior open bite, bimaxillary protrusion, and facial asymmetry were included.

MATERIALS AND METHODS

Study design:

This is an observational and comparative study including patients requiring orthognathic surgery [Sagittal split osteotomy] for either esthetic or functional improvements and corrections.

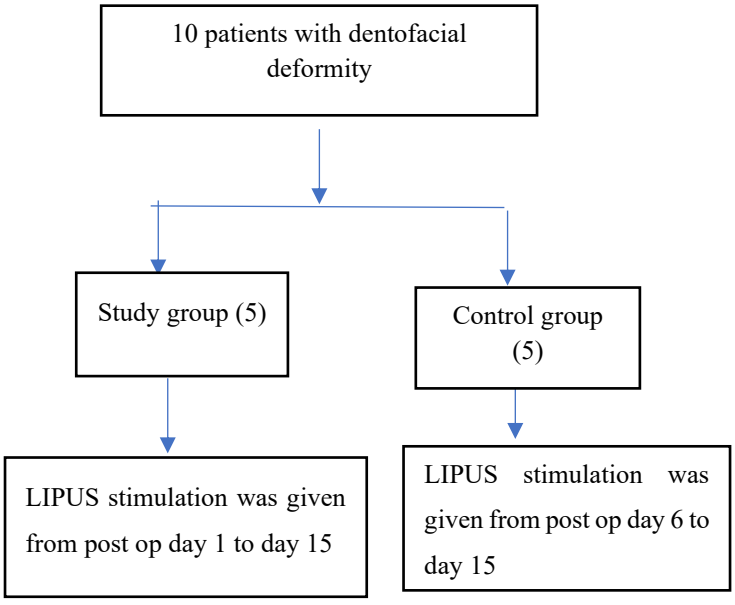
Patient selection:

Patients reporting to Department of Oral and Maxillofacial surgery, SRM Dental college, Ramapuram, Chennai, during the period of April 2022 to March 2025, aged between 18-40 years, diagnosed with Dentofacial deformities and undergoing Orthognathic surgery, willing to take part in the study were

included. Patients were selected following specific inclusion and exclusion criteria mentioned above. Informed consent has been obtained from all the patients. All of them were clearly explained about the procedure and the study methodology. The research was executed with approval from the Institutional Review Board of SRM Dental College, Chennai under reference number (SRMDC/IRB/2022/MDS/NO.401) and with informed permission from the participating patients.
Ten patients reported to the department of oral and maxillofacial surgery with the above-mentioned criteria were selected and they were provided with written informed consent for the participation. All surgical protocols and surgical standardization were done and patients were treated with LIPUS stimulator with 1.5MHz, 30Mw/cm² for 20 minutes [figure 1]. For Study group, post operatively, LIPUS stimulation was given from day 1 to day 15 on both the sides of mandibular jaw and for control group, post operatively, LIPUS stimulation was given from day 6 to day 15 on both the sides of mandibular jaw [flowchart 1, figure 2]. The parameters assessed for both control and study group were radiographic changes on week 4,6,8 and wound healing at the surgical site on day 3,5,10,15.

Fig 1: LIPUS unit

Fig 2: LIPUS therapy being given



Flowchart 1: Patient recruitment

RESULTS

According to the previously mentioned criteria, ten patients reported for surgery throughout the two-year study period were included in the research. With a mean of 23.5 years, the patient s' age ranged from 19 to 29 years. The following are the objectives assessed after orthognathic surgeries- radiographic changes on 4,6,8 weeks [table 1] and wound healing on post operative days 3,5,10,15[table 2]. U statistic and p value obtained from **Mann Whitney's U test**. P value ≤ 0.05 is significant.

Table 1: Comparison of radiographic changes between each group

Parameter	Time	Group	Mean Rank	Sum of Ranks	U statistic	p value
Radiographic changes	4th week	Study	5.50	27.50	12.500	1.00
		Control	5.50	27.50		
	6th week	Study	5.50	27.50	12.500	1.00
		Control	5.50	27.50		
	8th week	Study	6.50	32.50	7.500	0.134
		Control	4.50	22.50		

Table 2: Comparison of wound healing index between each group

Parameter	Time	Group	Mean Rank	Sum of Ranks	U statistic	p value
Wound healing	3rd day	Study	5.50	27.50	12.500	1.00
		Control	5.50	27.50		
	5th day	Study	5.00	25.00	10.000	0.317
		Control	6.00	30.00		
	10th day	Study	5.60	28.00	12.000	0.881
		Control	5.40	27.00		
	15th day	Study	5.00	25.00	10.000	0.317
		Control	6.00	30.00		

DISCUSSION

Ultrasound has several applications in medicine and is still growing in both diagnosing and therapeutic field. In fracture healing, LIPUS therapy increases the cell activity and changes in cell membrane permeability may raise micromechanical blood pressure and hasten fracture healing(1). Ultrasound appears to have an impact on the reparative phase in addition to the inflammatory phase. Chondrogenesis and osteogenesis work together to generate this primary callus in the reparative stage. Ultrasound has been shown to directly boost both the processes. Applying LIPUS causes chondrocytes to produce more proteoglycan and aggrecan messenger RNA, osteoblasts to produce more prostaglandin E2, and platelets to produce more growth factors. In addition to changing ionic permeability and second messenger activity, ultrasound signals cause conformational changes in the cell membrane (2). Additionally, the increased molecular expressions of BMP-2 and Col-1 3, are also associated with bone formation during fracture repair (3). Tehranchi et al (4) demonstrated that there was increased bone density both at medullary bone and mandibular border using Digiora software. According to a study by Claes L et al (5) in the LIPUS group, union of the fractured gap occurred earlier at weeks 5–6, as opposed to the control group's later at 7–8 weeks where measurements of callus breadth and area revealed that the LIPUS group had more callus formation at an earlier stage of fracture repair, along with up regulated gene expression

in Col-1 and BMP-2. To the contrary, in our study, we couldn't appreciate healing radiographically except for two patients, who showed stage 2 healing based on Moed radiographic score [figure 3]. We feel that callus formation will be evident on an orthopantomogram only after 12 to 16 weeks postoperatively in most of the cases and at least a follow-up period of 4 to 5 months is required. Also, there was no statistical difference noted in terms of wound healing for both study and control group [figure 4]. However, in our study, wound dehiscence was seen in one patient from study group which got healed by secondary intention. This outcome is similar to the outcomes achieved by Gopalan et al (6) where they have mentioned satisfactory healing was seen clinically but statistical differences couldn't be achieved.

Figure 3: OPG demonstrating healing at the surgical site

Figure 4: Surgical site showing wound healing

Advantages of LIPUS therapy

- Cost effective.
- There is no or little concern about patient compliance.
- Shorter duration.
- Can be used in compromised wound healing patients.

CONCLUSIONS:

LIPUS through the above-mentioned effects helps to speeds up fracture repair, enhances wound healing, and accelerates overall quality of life and comfort of patients in the post operative period.

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