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ORIGINAL ARTICLE

Comparison of two L shaped Plate on Plate Versus Single Conventional L Miniplate in Fixation of Subcondylar Mandibular Fractures

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Abstract
Aim To compare and evaluate treatment outcome and postoperative complications in subcondylar fractures of mandible–single L shape plate versus two L shape plate–using plate on plate technique.
Materials and Methods The clinical trial had a total of ten patients (ten unilateral subcondylar fracture sites), which were divided randomly into two groups of five each. Group I patients underwent open reduction and internal fixation with single L shaped miniplate and Group II ORIF was done with two L shaped miniplates by plate on plate technique.
Results Both the groups showed comparable results in terms of postoperative complications. Few cases in Group I presented with minor occlusal discrepancy which was easily corrected with transitional inter-maxillary fixation(IMF) for 1 week, and none of the Group II cases required postoperative IMF, but stability in Group II was better than Group I.
Conclusion The results of this trial suggested that the treatment of mandibular condylar fractures with 2 (2-D) plates placed one over the other is better suited than conventionally practiced single-plate fixation. Increased 3-dimensional stability, low morbidity and infection rates are the advantages offered by 2-plate technique of ours.

Keywords Subcondylar fracture · Miniplates · Plate on plate · 3D plates

Introduction

Fractures of the mandibular condyle still account for a significant amount of all mandibular fractures, according to recent clinical reviews (25–45%) [1].

Aim of the treatment should be functional restoration of occlusion, a mouth opening > 40 mm, absence of pain during function [1]. Consequently, the need for accurate surgical anatomic reduction to achieve the desired outcome proves prudent [2].

Conventional wisdom has suggested closed reduction as the treatment of choice for mandibular fractures for decades [2]. In 1924, Perthes [3] carried out the first surgical treatment of a condylar fracture and with the cutting edge research and methodologies the *conventional wisdom* stands outdated. Recently, miniplates and modifications of miniplates based on Champy's principle like titanium 3D plates have been developed to meet the requirements of semirigid fixation with lesser complications. Treatment outcome with conventional miniplates, 3D plates and other modification of miniplates when used for fractures of different regions of mandible have been compared innumerous times, but literature pertaining to comparison of different plates in the mandibular condylar region is scarce.

Most probable reason for scarcity of data according to us is (1) difficult access to the condylar head, (2) difficult fixation techniques, (3) difficulty in reduction of displaced

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fracture segment. We with this communication want to propose a simpler, less technique sensitive but quite stable fixation technique for subcondylar fractures and also compare its outcome with conventional miniplate fixation technique.

Materials and Methods

This clinical trial consisted of a sample of 10 patients (10 fracture sites) divided randomly but equally into two groups. Each group contains 5 patients. Group I was treated with open reduction and internal fixation using 2-dimensional (2-D) miniplates. Group II was treated using 2 [2-dimensional (2-D) 1.5 mm] miniplates.

Otherwise medically fit patients with subcondylar fracture of mandible were included in the study. Care was taken to exclude patients with debilitating medical conditions and having other concomitant fractures of maxillofacial region other than in mandible. This was done to maintain standardization and to prevent development of complications due to improper fixation of other fracture site.

All cases were operated upon by the same team with same protocol to eliminate bias.

Surgical Technique

Through Hind's or retromandibular approach, fracture site was exposed and fractured segment was reduced anatomically. In Group I patients, a single 1.5-mm thickness "L"-shaped plate was adapted parallel to the posterior border of mandible and fixed (Figs. 1 and 2). In Group II, another "L"-shaped plate was placed such that long arm was parallel to the sigmoid notch and the lower limbs of both the "L" plate faced each other. The apex of this triangular arrangement was formed by overlapping proximal1 hole in both the "L"

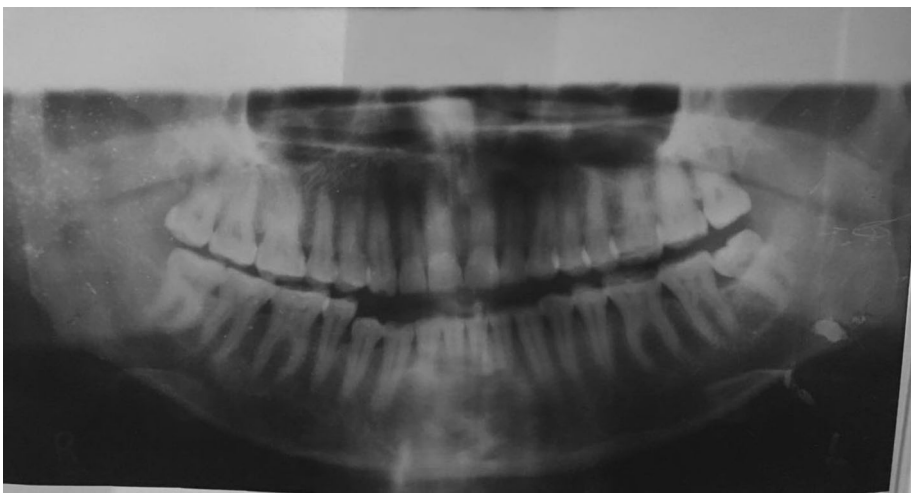

Fig. 1 Preoperative OPG showing left subcondylar fracture

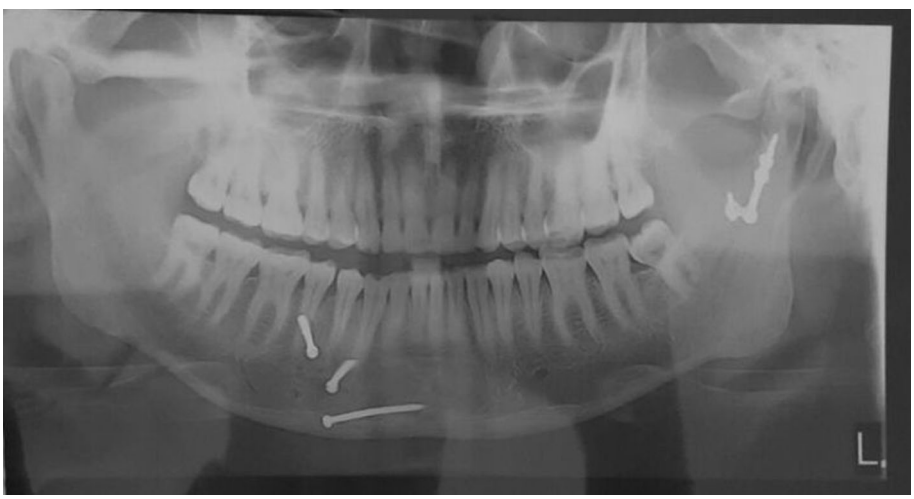

Fig. 2 Postoperative OPG showing single L plate fixation for left subcondylar fracture and lag screw fixation for right parasymphysis fracture

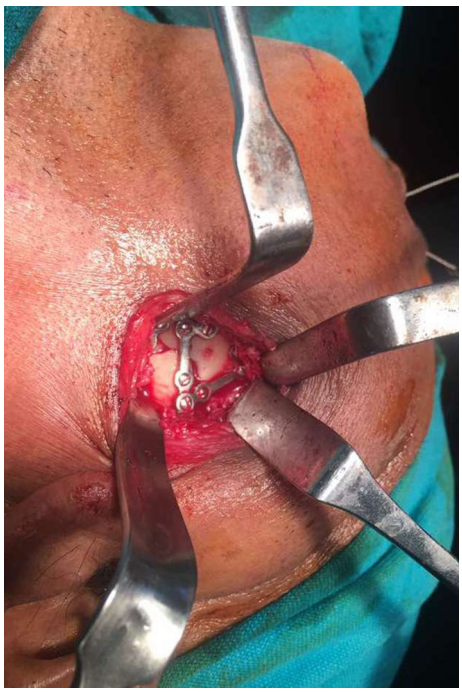

Fig. 3 Intraoperative clinical picture showing the use of plate on plate technique

plates (Fig. 3). The overlapping hole was fixed with a 1.5 × 8 mm screw, rest all holes were fixed with 1.5 × 6 mm screw. Since the screw which was used to anchor both the plates at the proximal end was longer, it could sandwich both the plates between the screw head and the condylar head, without any stability issues.

The patients were followed up for a period of 6 weeks initially for every week and later at a period of 3 months. All the parameters used were assessed at various recall visits and recorded. Pre and Postoperative OPG was taken in all the cases (Figs. 4 and 5). Additional OPG was taken if required. PA view of Skull was also taken to assess three dimensional stability (Figs. 6 and 7). Figure 8 is postoperative OPG of same patient in Figs. 6 and 7. Figures 9 and 10 another patient with plate on plate fixation, pre and postopertive OPG.

Evaluation Criteria

Intraoperative

1. *Adequacy of Fracture Fixation*

Adequacy of fracture fixation was checked immediately after fixation by clinical manipulations in three dimensions. In case of adequate fixation, no further treatment was done.

Postoperative

1. *Radiological Assessment*

Postoperative radiographs—Standard OPG was taken as early as possible after the surgical procedure. And evaluation was done in the following manner.

- Radiological evidence of precise anatomic reduction in the fracture site.
- Reduced fractures that were slightly displaced but had a satisfactory occlusion.
- Poorly reduced fractures that required a second operation to correct poor alignment and unacceptable occlusion.

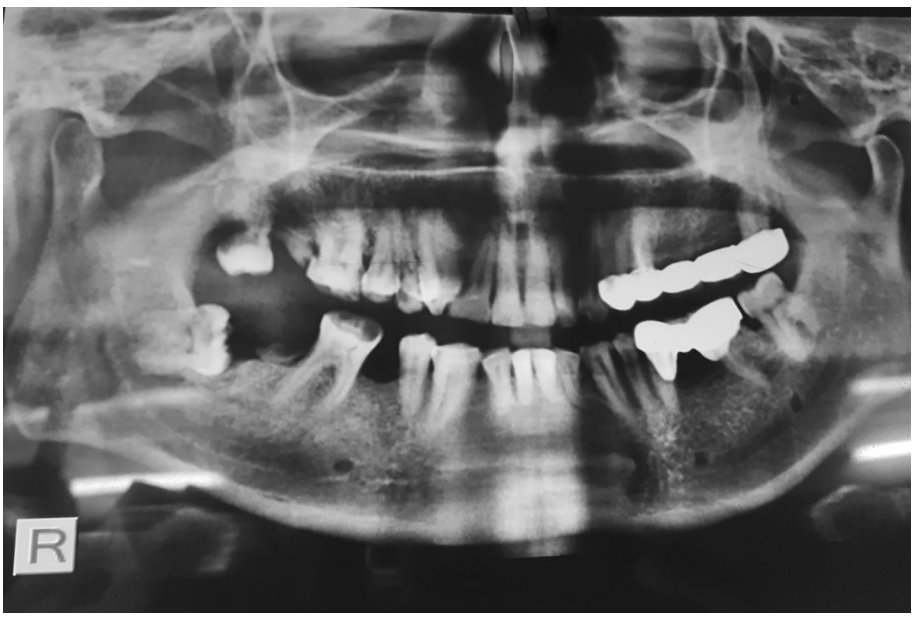

Fig. 4 Preoperative OPG showing left subcondylar fracture

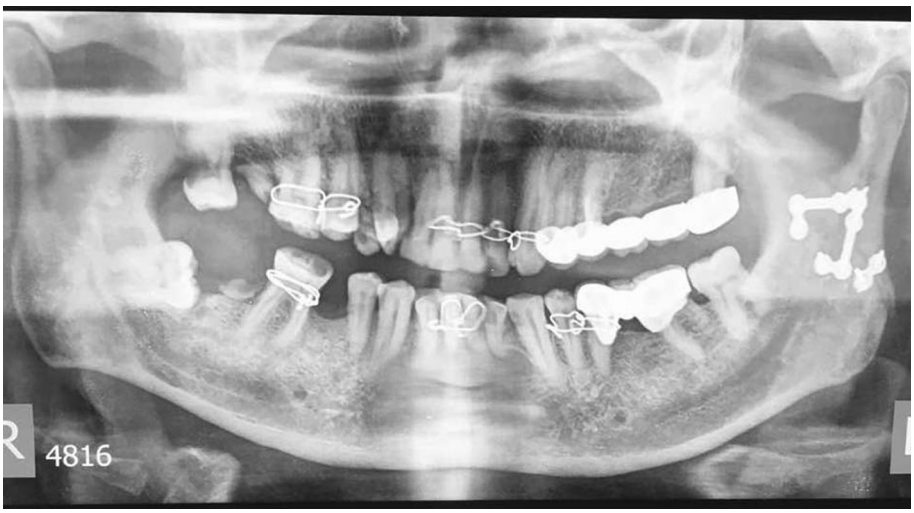

Fig. 5 Postoperative OPG showing left subcondylar fracture fixed with L-shaped plate on plate with additional fragment fixed with a 2-hole plate

- *Complications*

Assessed up to 3 months.

a. Nonunion: Persistent mobility between fracture segments on clinical manipulations.
b. Mal-union: Based on clinical and radiographic assessment.
c. Infections: Case to be considered infected having discharge with positive culture test.
d. Occlusal discrepancies: Based on clinical examination and information obtained from the patient.

The above-described findings were recorded in each patient.

Results

	Patient sequence	Clinical stability	Postoperative occlusal discrepancy	Other Major complication	Radiological assessment of reduction
Group I	1	+	Present	None	++
	2	++	Nil	None	+++
	3	+	Present	None	++
	4	+	Present	None	++
	5	++	Nil	None	+++
Group II	1	+++	Nil	None	+++
	2	+++	Nil	None	+++
	3	+++	Nil	None	+++
	4	+++	Nil	None	+++
	5	+++	Nil	None	+++

Key: + Average, ++ Good, +++ Very Good.

Discussion

A proper surgical treatment of condylar neck and subcondylar fractures is mandatory to avoid long-term severe drawbacks such as asymmetry, temporomandibular joint (TMJ) dysfunction with pain, malocclusion with retrognathia, open bite, reduced protrusion and laterotrusion, or fibro-osseous or osseous ankylosis [1]. Valeti et al. [4] affirm that belief.

Choi et al. [5] in 2012 and Spinzia et al. [6] after an extensive review of the existing literature devised and proposed that unless impossible all extracapsular condylar fracture occurring in patients whose age is more than 8 years should be treated surgically.

Stable fixation is very important as the interfragmentary mobility can lead to nonunion, fibrous union or temporomandibular disorders [3].

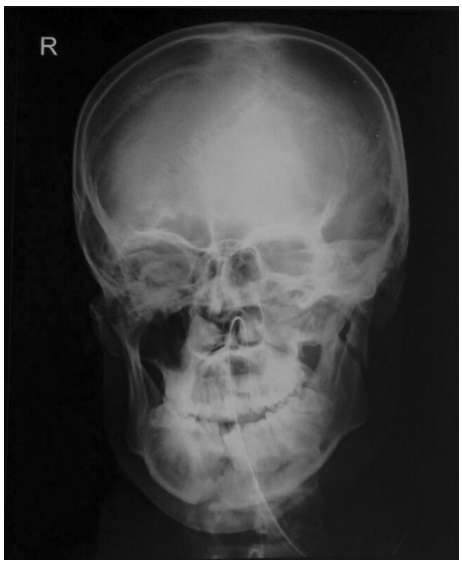

Fig. 6 PA mandible showing left subcondylar and right parasymphysis fracture

Luhr and AO/ASIF [5] advocates felt that miniplates did not offer adequate stabilization of the fractures, thereby necessitating the need of further inter-maxillary fixation. Farmand and Dupoirieux [6] presented 3-D plates with quadrangular shape formed by joining two miniplates with interconnecting crossbars. Because of the quadrangular configuration of the plates, they provided good stability and resistance to torsional forces. Easy use, good resistance against torque forces and compact form of the plates were some of their advantages.

Cortelazzi et al. [1] experienced that ORIF of condylar fractures is still prone to complications; such as plate bending and screws loosening, resulting in inadequate stability at a rate of 4–20%. The osteosynthesis device has to be rigid enough to withstand physiologic masticatory forces applied on the condylar region, and the plate design has to fit the strain pattern occurring in the condylar region during function.

The use of a single straight 4-hole miniplate, placed vertically, aligned to the condylar axis is not adequate. It neither respects the principle of functionally stable osteosynthesis nor prevents secondary displacement with fracture line diastasis along the sigmoid notch and plate fracture [2]. Answers to the aforestated difficulties were sought after thorough significant research done by Parascondoloet al [7] and Choi et al. [8] which suggested that double miniplate was found to be the most stable. This thought was opposed because it could be sometimes difficult to insert four screws in the smaller condylar segment and can be particularly challenging in minimally invasive approaches to the condylar fracture. [3].

To overcome problems faced with two plate systems, 3D plates (like L plate, Y plate, delta plate, lambda plate, trapezoidal plate and matrix mandibular strut plate) were introduced into maxillofacial surgery.

3D plates can handle changing loads and hold the fracture fragments rigidly by resisting the forces in three dimensions, namely shearing, bending and torsional forces; they are easy to place in confined spaces and can be anatomically adapted. However, there adaptation is a bit difficult [3, 9].

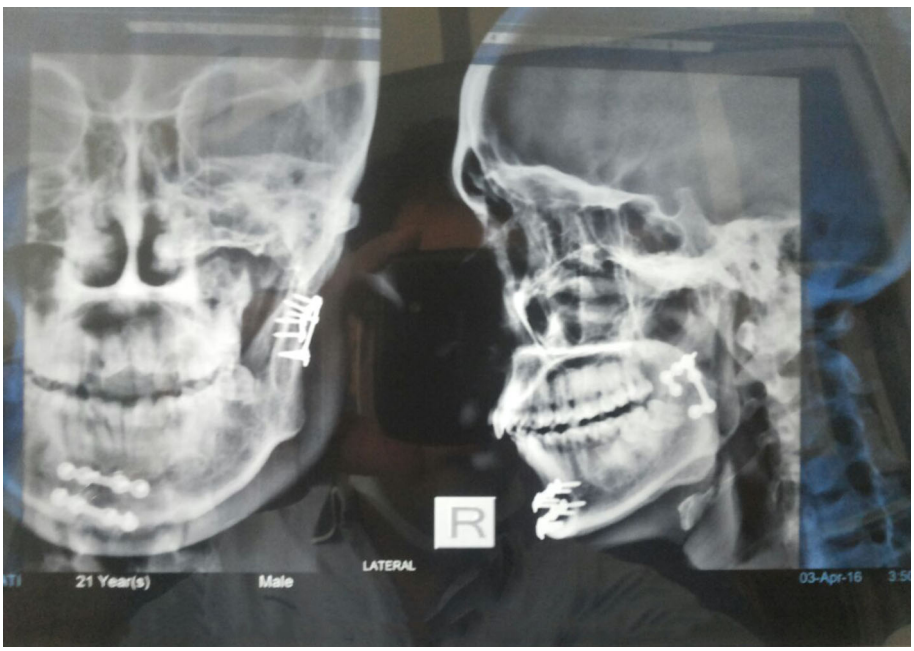

Fig. 7 Postoperative PA and lateral view showing left subcondylar fracture fixed with L-shaped plate on plate and parasymphysis fracture fixed with conventional miniplates

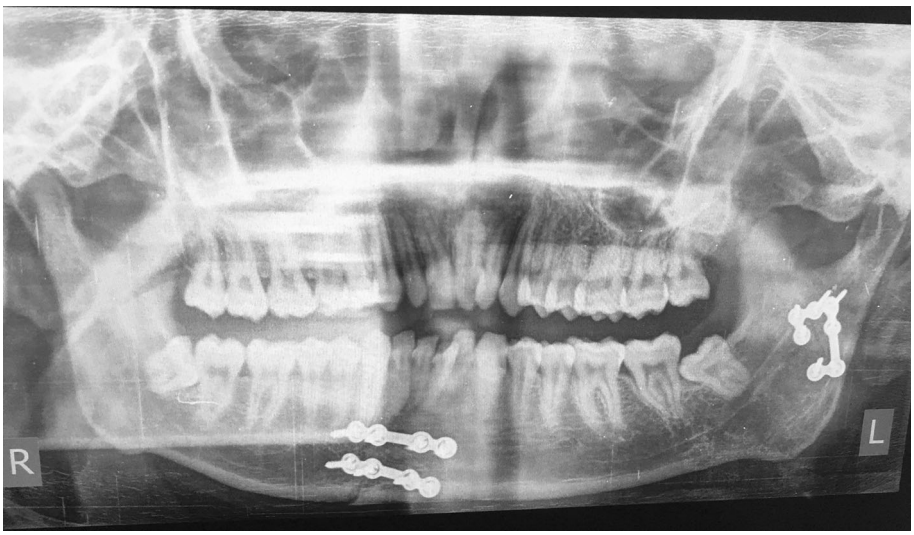

Fig. 8 Postoperative OPG view showing left subcondylar fracture fixed with L-shaped plate on plate and parasymphysis fracture fixed with conventional miniplates. (Same patient as of Figs. 6 and 7)

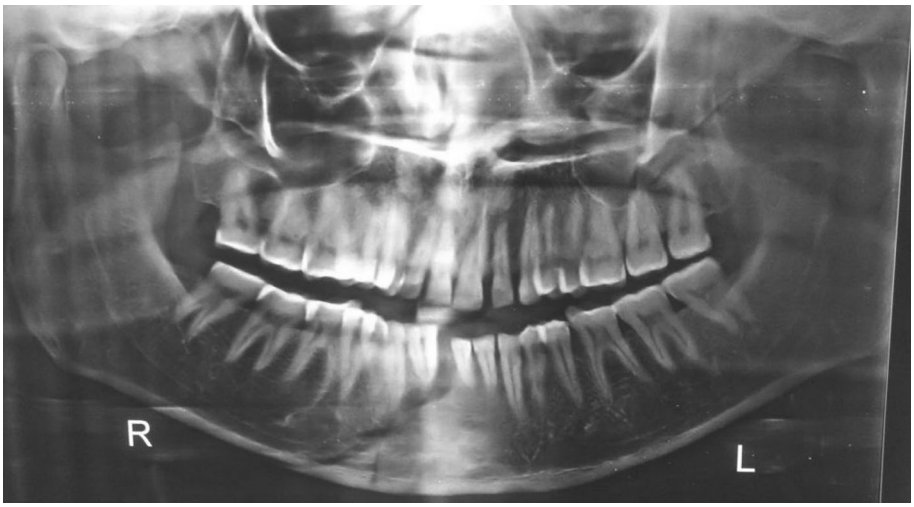

Fig. 9 Preoperative OPG showing left subcondylar fracture and parasymphysis fracture

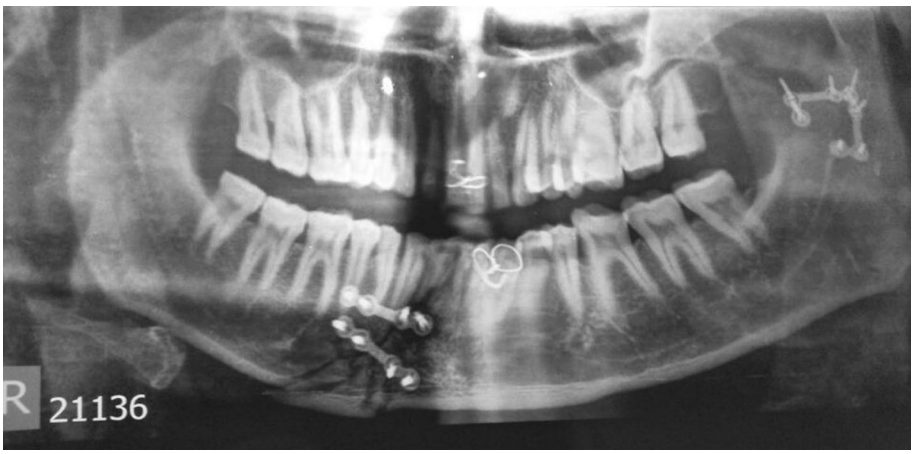

Fig. 10 Postoperative OPG showing left subcondylar fracture fixed with L-shaped plate on plate and parasymphysis fracture fixed with conventional miniplates

Intraoperatively, when single-plate fixation was evaluated, clinically minor mobility of the fractured segment was noticed; wherein, when two plates were used there was absolutely no mobility between the fractured segments.

The plate over plate system we propose has varied advantages

1. Adaptation is not difficult as the plate alignment can be adjusted intraoperatively.

2. No added armamentarium required

Conclusion

The findings of this prospective clinical trial that 2 L-shaped miniplates placed one over another are effective in the treatment of mandibular subcondylar fractures, and overall complication rates are lesser as compared to conventional miniplates. The plate on plate system is easy to use. Thus, plate on plate can be used as an alternative to conventional miniplates. The system is reliable and effective treatment modality for mandibular subcondylar fractures. We intend to further this study in vitro taking into consideration the biomechanical load and subjecting to finite element analysis.

Compliance with Ethical Standards

Conflict of interest Authors have no conflict of interest.

Research Involving Human Participants All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standard.

Informed Consent Informed consent from patient taken for study.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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