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Systematic Review
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Three-dimensional strut plate for the treatment of mandibular fractures: a systematic review

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Abstract. The treatment of mandibular fractures by open reduction and internal fixation is very variable. Thus, there are many controversies about the best fixation system in terms of stability, functional recovery, and postoperative complications. This systematic review sought scientific evidence regarding the best indication for the use of three-dimensional (3D) plates in the treatment of mandibular fractures. A systematic search of the PubMed/MEDLINE, Elsevier/Scopus, and Cochrane Library databases was conducted to include articles published up until November 2016. Following the application of the inclusion criteria, 25 scientific articles were selected for detailed analysis. These studies included a total of 1036 patients (mean age 29 years), with a higher prevalence of males. The anatomical location most involved was the mandibular angle. The success rate of 3D plates was high at this location compared to other methods of fixation. In conclusion, the use of 3D plates for the treatment of mandibular fractures is recommended, since they result in little or no displacement between bone fragments.

Key words: mandible fracture; miniplate osteosynthesis; grid plate; 3D miniplate; internal rigid fixation; standard miniplate.

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Mandibular fractures are frequent in facial trauma and represent between 35.54%[1] and 44.2%[2] of all facial fractures. This high incidence is a result of the mandibular anatomy and characteristics. The mandibular bone includes fragile areas due to the presence of third molars in the mandibular angle and bone narrowing in the subcondylar region. It constitutes the lower third of the face, and possesses certain mobility due to the presence of the temporomandibular joints. These fractures result in functional problems (speech, chewing, and swallowing), as well as social problems due to aesthetic discrepancies[3]. The ideal treatment for mandibular fractures should aim at a perfect anatomical reduction, stable fixation, and satisfactory future function of the mandible with the least possible repercussions for the joints[4].

Rigid internal fixation (RIF) was initially used in the oral and maxillofacial area in the late 1970s[5], and since the work of Michelet et al.[6] and Champy et al.[7], osteosynthesis using miniplates has become an indispensable method of fixation in maxillofacial surgery[5]. Techniques of open reduction for mandibular fractures have changed and diversified greatly in recent decades[3,8], however there is still no consensus regarding the best method of treatment[9,10]. These methods include the use of lag screws[11], reconstruction Plates[12], dynamic compression Plates[13], miniplates[14,15], locking Plates[14], and three-dimensional (3D) Plates[16,17].

Issues related to the stability provided by the various fixation systems, especially in mandibular angle fractures, have become a key point of debate among surgeons[4]. Therefore, it is prudent to consider the factors that may justify the use of one type of fixation over another, such as the patient's age, the location and level of the fracture line, degree of displacement, severity of mandibular involvement, degree of alteration in occlusion, and the experience of the surgeon, as well as to inform the patients about the possible advantages and disadvantages of the treatment alternatives[18].

Among the fixation systems and techniques, the use of 3D plates for the treatment of mandibular fractures is relatively new, introduced by Farmand in 1992[3,5,19,20]. The basic concept of the 3D system is the use of a geometrically closed quadrangular or rectangular plate fixed with screws to provide stability in the three dimensions[10,21]. The principle of this fixation is supported by the idea that the devices are not positioned in the trajectory lines of compression and tension forces, but in the weaker structure lines[21,22].

The objective of this study was to perform a systematic review of the literature on the treatment of mandibular fractures with 3D plates, in order to answer the following question: What is the scientific evidence regarding the indication for this technique?

Materials and methods

This systematic review was performed according to the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[23] and the *Cochrane Handbook for Systematic Reviews of Interventions*[24].

Search strategy and selection criteria

The initial bibliographic research was performed in the MEDLINE (via PubMed), Elsevier (via Scopus), and Cochrane Library databases, using four lines of search elements: (1) ''grid plate'' AND ''mandibular fracture''; (2) ''3d plate'' AND ''mandibular fracture''; (3) ''3 dimensional plate'' AND ''mandibular fracture''; (4) ''strut plate'' AND ''mandibular fracture''.

For the initial selection, three independent reviewers (JCSO, JSDM, and LBM) reviewed the title and/or abstract of the articles against established inclusion criteria: studies performed in human beings; specific studies on the use of 3D plates for the treatment of mandibular fractures; published in the English language; type of study: case series and retrospective and prospective clinical trials. There was no restriction on date of publication.

After the initial selection, the three examiners reviewed the full texts of the selected articles and identified those for inclusion in the final review using the same eligibility criteria.

Data extraction

The examiners independently extracted the data from the articles included in the final review. The data extracted were the type of study, number of patients and fractures, location and displacement of the fracture, surgical approach, type of 3D plate used, complications, and success rate (%). In order to standardize the success rate of the studies, the cases in which re-operation was required for the removal of fixation material, there was bad union or non-union, fixation failure, or an unsatisfactory postoperative condition, such as inadequate occlusion, as well as those in which there was a need for maxillomandibular fixation (MMF) or there was occlusal wear, were considered as failures. Discrepancies in data extraction between the reviewers were resolved by further discussion. Data were analyzed using descriptive statistics.

Quality assessment

The evaluation of methodological quality was performed using the PRISMA statement criteria[23], in order to verify the strength of the available scientific evidence in the current literature for use in clinical decision-making. The classification of potential risk of bias in each study followed pre-established criteria used in previous reviews[25]: random selection in the population (sample); definition of inclusion/exclusion criteria; report of patient loss to follow-up; validated measurements; statistical analysis.

Studies that presented all of the above criteria were classified as having a low risk of bias, those that lacked one criterion were classified as having a moderate risk of bias, and those that lacked two or more criteria were classified as having a high risk of bias.

Results

The electronic search was conducted in November 2016 and identified 281 articles. Eighty-two were determined to be relevant after reading the title and/or abstract. After removing duplicates, the complete texts of 27 articles were evaluated against the previously established criteria. Two of these articles did not meet the inclusion criteria and were excluded from the study. The final review included 25 articles. The year of publication of the articles selected ranged from 2005 to 2016. Figure 1shows the flowchart of the article selection process.

Among the articles selected for the final review, 16 reported prospective studies[3–5,9,10,18,21,22,26–33], seven reported retrospective studies[8,17,34–38], and two reported

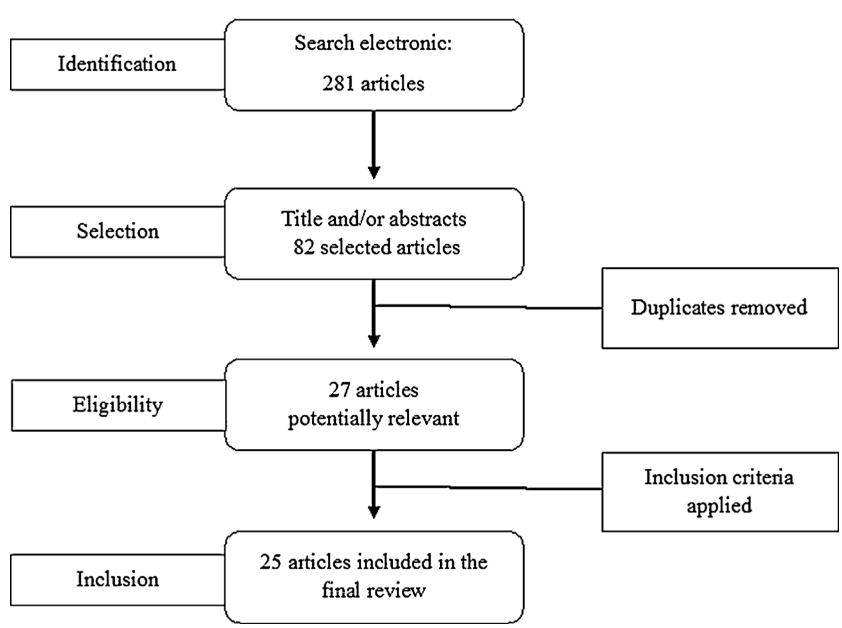

Fig. 1. Flowchart of the systematic review process.

Table 1. Evaluation of study quality.

Year	Author	Randomized sample selection	Defined inclusion/exclusion criteria	Report of loss to follow-up	Valid measurements	Statistical analysis	Potential risk of bias
2016	Sawatari et al.[34]	No	Yes	Yes	Yes	No	High
2016	Kanubaddy et al.[30]	Yes	Yes	No	Yes	Yes	Moderate
2016	Pandey et al.[26]	No	Yes	No	Yes	No	High
2015	Al-Moraissi et al.[31]	Yes	Yes	Yes	Yes	Yes	Low
2015	Chaudhary et al.[27]	No	Yes	No	Yes	Yes	High
2015	Sikora et al.[18]	No	Yes	No	Yes	No	High
2014	Balakrishnan et al.[39]	No	Yes	No	No	No	High
2014	Chhabaria et al.[28]	No	Yes	No	Yes	No	High
2014	Sehgal et al.[3]	Yes	Yes	No	Yes	Yes	Moderate
2013	Moore et al.[37]	No	Yes	No	Yes	Yes	High
2013	Prasad et al.[29]	No	Yes	No	Yes	No	High
2013	Guy et al.[17]	No	Yes	Yes	Yes	Yes	Moderate
2013	Vineeth et al.[4]	Yes	Yes	No	Yes	Yes	Moderate
2013	Xue et al.[10]	Yes	Yes	Yes	Yes	Yes	Low
2013	Wolfswinkel et al.[8]	No	Yes	No	Yes	Yes	High
2012	Hofer et al.[38]	No	No	No	Yes	Yes	High
2012	Jain et al.[32]	Yes	Yes	Yes	Yes	Yes	Low
2012	Khalifa et al.[33]	Yes	No	No	Yes	Yes	High
2012	Malhotra et al.[21]	Yes	Yes	No	Yes	Yes	Moderate
2012	Singh et al.[5]	Yes	Yes	No	Yes	Yes	Moderate
2011	Hochuli-Vieira et al.[16]	No	Yes	No	Yes	No	High
2010	Jain et al.[22]	Yes	Yes	No	No	Yes	High
2009	Bui et al.[35]	No	Yes	No	Yes	No	High
2007	Zix et al.[9]	No	Yes	No	Yes	No	High
2005	Guimond et al.[36]	No	Yes	No	Yes	No	High

case series[16,39]. Regarding the evaluation of quality, three studies presented a low risk of bias[10,31,32], six a moderate risk[3–5,17,21,30], and 16 a high risk[8,9,16,18,22,26–29,33–39] (Table 1). Moreover, 11 studies exclusively concerned mandibular fractures treated using 3D plates (Table 2)[8,9,16,26–29,34–36,39], and 14 studies compared 3D plates with other treatment methods, mainly a 2.0-mm fixation plate system (Table 3)[3–5,10,17,18,21,22,30–33,37,38].

The studies included a total of 1036 patients, with 3D plates being used in 816 patients. The mean age of patients enrolled in the studies was 29 years, and no study included children. Regarding the sex distribution, there was a higher prevalence of male subjects in the studies that specified sex (647 male, 91 female); some studies did not specify the data for sex[18,29,32,34].

The main causes of the mandibular fractures were traffic accidents, assaults, and interpersonal violence. For the 841 fractures treated with 3D plates, the most commonly involved anatomical site was the angle region, with 666 fractures, followed by 52 condyle fractures (subcondylar region), 18 fractures in the anterior region (symphysis and parasymphysis), and 2 body fractures[5,32].

Regarding the descriptive studies using 3D plates (Table 2), of those fractures with a reported level of displacement ($n = 349$), 131 showed no displacement and 184 showed mild displacement[9,28,34–36]. The intraoral approach was the method of choice for the treatment of 555 mandibular angle fractures; 34 mandibular angle fractures were treated via extraoral/facial approach, without damage to the facial nerve. Regarding cases of failure, the fixation devices had to be removed in 31 cases, due to infection, non-union, or plate fracture.

In the comparative studies between 3D plates and other fixation methods (Table 3), three of the 25 studies included reported a higher rate of postoperative complications in fractures treated with 3D plates, regardless of the fracture location[10,22,32].

The lowest success rate of 3D plates was found for the anterior region of the mandible, with a success rate of 77.8%, while the success rate in the angle region was 78.2%. The main complications observed were inferior alveolar nerve disorders and failure/necessity for removal of the fixation material (Table 4). Regarding the cases treated with conventional fixation systems, the main complication was the need for postoperative MMF (Table 5).

Table 2. Descriptive analysis of studies using three-dimensional plates included in the review.

Year	Author	Type of study	Number of patients/fractures	Type of plate	Classification of fracture	Surgical access	Complications	Success (%)
2016	Sawatari et al.[34]	Retrospective	222/222	3D rectangular	222 angle fracture: 129 no displacement 78 moderate displacement 15 severe displacement	Intraoral	19 IAN impairment 15 fixation removal 10 dehiscence 10 infection 9 trismus 3 malocclusion	91.8
2016	Pandey et al.[26]	Prospective	15/15	3D grid	15 angle fracture: 14 with displacement 1 no displacement	Intraoral	5 dehiscence	100.0
2015	Chaudhary et al.[27]	Prospective	15/15	Trapezoidal condylar	15 subcondylar fracture	Facial	No complications	100.0
2014	Balakrishnan et al.[39]	Case series	6/12	3D plate: 10 quadrangular 2 rectangular	7 parasymphysis fracture 3 subcondylar fracture 2 angle fracture	NR	NR	100.0
2014	Chhabaria et al.[28]	Prospective	20/21	3D strut grid	21 angle fracture: 16 severe displacement 5 mild displacement	19 Facial (retromandibular) 2 Intraoral	3 IAN impairment (temporary) 2 infection	100.0
2013	Prasad et al.[29]	Prospective	18/20	3D grid	9 parasymphysis fracture 7 angle fracture 2 symphysis fracture 2 body fracture	Intraoral	3 infection 2 IAN impairment 2 inadequate occlusion	90.0
2013	Wolfswinkel et al.[8]	Retrospective	34/36	3D rectangular	36 angle fracture	Intraoral	3 infection with fixation removal 1 re-operated for non-union	88.9
2011	Hochuli-Vieira et al.[16]	Case series	45/45	3D rectangular	45 angle fracture Displacement <1 cm	Intraoral	4 fixation unsatisfactory 2 mobility 2 infection 1 inadequate reduction	88.9
2009	Bui et al.[35]	Retrospective	49/49	3D strut rectangular	49 angle fracture: Mild displacement	Intraoral	4 infection	100.0
2007	Zix et al.[9]	Prospective	20/20	3D straight, 3D strut	20 angle fracture: 16 mild displacement 2 moderate displacement 2 severe displacement	Intraoral	2 dehiscence 2 IAN impairment 1 fixation fracture	95.0
2005	Guimond et al.[36]	Retrospective	37/37	3D strut rectangular	37 angle fracture: 2 no displacement 17 mild displacement 17 moderate displacement 1 severe displacement	Intraoral	2 infection 1 dehiscence	100.0

3D, three-dimensional; IAN, inferior alveolar nerve; NR, not reported in the article.

Table 3. Descriptive analysis of studies comparing three-dimensional plates and other methods of fixation.

Year	Author	Type of study	Number of patients/fractures	Type of plate	Classification of fracture	Surgical access	Complications	Success (%)
2016	Kanubaddy et al.[30]	Prospective	30/30	G1, $n = 15$ 3D strut rectangular G2, $n = 15$ One Plate 2.0 mm	30 angle fracture	Facial (submandibular)	G1: no complications G2: 1 infection	G1: 100.0 G2: 100.0
2015	Al-Moraissi et al.[31]	Prospective	20/20	G1, $n = 10$ 3D strut grid G2, $n = 10$ One Plate 2.0 mm	20 angle fracture: Linear Displacement <1 cm	Intraoral	G1: 1 infection, 2 palpable plates G2: 1 infection, 1 failure, 1 dehiscence	G1: 100.0 G2: 90.0
2015	Sikora et al.[18]	Prospective	38/38	G1, $n = 34$ 3D plate: 28 delta, 6 trapezoidal G2, $n = 4$ One Plate 2.0 mm	38 condyle fracture: 32 lateral displacement 6 medial displacement	Facial (transparotid)	G1: 1 screw loss G2: 2 failure, 3 screw loss	G1: 97.0 G2: 50.0
2014	Sehgal et al.[3]	Prospective	30/53	G1, $n = 25$ 3D grid G2, $n = 28$ Two Plates 2.0 mm	16 parasymphysis fracture 3 symphysis fracture 11 body fracture 10 condyle fracture (+3 treated conservatively) 10 angle fracture G1:[a] 10 severe displacement 5 moderate displacement G2:[a] 8 severe displacement 7 moderate displacement	NR	G1: 1 dehiscence G2: no complications	G1: 100.0 G2: 100.0
2013	Moore et al.[37]	Retrospective	104/106	G1, $n = 73$ 3D strut grid G2, $n = 33$ Champy	106 angle fracture	Intraoral	G1: 6 fixation removal G2: 6 fixation removal	G1: 91.8 G2: 81.8
2013	Guy et al.[17]	Retrospective	90/90	G1, $n = 68$ 3D strut grid G2, $n = 22$ Champy, two Plates 2.0 mm, reconstruction plate, MMF	90 angle fracture	NR	G1:7 re-operated, 6 IAN impairment, 4 dehiscence, 4 non/bad union, 3 infection, 2 malocclusion, 1 failure G2: 3 re-operated, 3 IAN impairment, 2 infection, 2 dehiscence, 2 bad union, 2 malocclusion, 1 failure	G1: 79.4 G2: 63.6
2013	Vineeth et al.[4]	Prospective	20/20	G1, $n = 10$ 3D grid G2, $n = 10$ Champy	20 angle fracture: 20 unfavourable 4 severe displacement	Intraoral	G1: 2 IAN impairment, 1 postop. MMF G2: 3 postop. MMF, 2 infection, 1 fixation removal, 1 IAN impairment	G1: 90.0 G2: 60.0
2013	Xue et al.[10]	Prospective	13/13	G1, $n = 6$ 3D grid G2, $n = 7$ Champy	13 angle fracture	Intraoral	G1: 1 fixation removal, 1 dehiscence G2: 1 fixation removal, 1 fixation palpable	G1: 83.3 G2: 85.7

2012	Hofer et al.[38]	Retrospective	60/60	G1, $n = 30$ 3D grid G2, $n = 30$ Champy	60 angle fracture	Intraoral	G1: no complications G2: 3 infection, 3 dehiscence, 2 fixation removal	G1: 100.0 G2: 93.3
2012	Jain et al.[32]	Prospective	20/20	G1, $n = 10$ 3D locking grid G2, $n = 10$ Two Plates 2.0 mm	Symphysis fracture Parasymphysis fracture	Intraoral	G1: 2 inadequate occlusion G2: 1 inadequate occlusion	G1: 80.0 G2: 90.0
2012	Khalifa et al.[33]	Prospective	20/20	G1, $n = 10$ 3D rectangular G2, $n = 10$ Two Plates 2.0 mm	17 parasymphysis fracture 3 symphysis fracture	Intraoral	G1: 2 mobility, 2 malocclusion G2: 3 mobility, 2 malocclusion, 1 dehiscence	G1: 90.0 G2: 80.0
2012	Malhotra et al.[21]	Prospective	20/25	G1, $n = 10$[b] 3D rectangular G2, $n = 10$[b] Two Plates 2.0 mm	15 parasymphysis fracture 6 symphysis fracture 3 angle fracture 1 body fracture	Intraoral	G1: 1 infection, 1 malocclusion G2: 3 malocclusion, 2 infection, 1 radiographic gap	G1: 90.0 G2: 70.0
2012	Singh et al.[5]	Prospective	50/56	G1, $n = 28$ 3D rectangular G2, $n = 28$ Two Plates 2.0 mm, Champy	Symphysis fracture Parasymphysis fracture Angle fracture	Intraoral	G1: 8 postoperative MMF, 4 IAN impairment, 2 infection, 1 fixation removal G2: 17 postoperative MMF, 5 IAN impairment, 3 infection	G1: 67.8 G2: 39.2
2010	Jain et al.[22]	Prospective	40/40	G1, $n = 20$ 3D rectangular G2, $n = 20$ Two Plates 2.0 mm, Champy	18 parasymphysis fracture 10 body fracture 8 symphysis fracture 4 angle fracture	Intraoral	G1: 4 unsatisfactory fixation, 2 mobility, 2 infection, 1 unsatisfactory reduction G2: 1 unsatisfactory fixation	G1: 75.0 G2: 95.0

G1, group 1; G2, group 2; 3D, three-dimensional; NR, not reported in the article; IAN, inferior alveolar nerve; postop., postoperative; MMF, maxillomandibular fixation.
[a] Displacement at the patient level and not at the fracture level.
[b] Number of patients treated and not number of fractures treated.

Discussion

There are many options for the treatment of mandibular fractures by open reduction and internal fixation, depending mainly on the location and degree of displacement of the fractures. These factors may affect the surgeon's decision, and as demonstrated by this systematic review, there is no consensus on the indication and predictability of the outcome in relation to the use of 3D plates for mandibular fractures.

3D plates are so named due to their action in maintaining the fractured fragments such that they are rigidly resistant to forces in three dimensions, i.e. shear, bending, and twisting forces[19,31]. Another possible advantage of 3D plates described in the literature is their ease of handling and application at the surgical site[9,35], requiring less intraoperative time. However, this was not confirmed by the present review, and there was no statistically significant difference in the comparative studies that evaluated the operative time[5,10,17,22,30–33,38]. Furthermore, in a study by Xue et al., the average surgical time using 3D plates was longer than that for the Champy technique in mandibular angle fractures[10].

In this review, it was not possible to verify the fracture pattern in all studies, so it was not possible to correlate the degree of displacement with the efficacy of the fixation system. However, from the data collected, a strong tendency towards the use of 3D plates in fractures with little or no displacement, regardless of their location, and with good result predictability, was observed. Nevertheless, in cases of mandibular angle fracture, these devices should be used with care, as demonstrated in some studies[4,9,34].

Cases of infection not related to fixation failure/removal were not included, as this complication does not represent the failure of treatment and could be related to the surgical approach, dehiscence, and postoperative care. The presence of teeth in the fracture line could not be accounted for and evaluated, since most of the articles did not report the number of teeth removed during the operation. The decision to remove or maintain teeth in the fracture line is based on variables such as tooth and alveolar bone condition, clinical situation, time, and type of treatment[40]. When the surgical techniques and protocols recommended in the literature are observed, the possibility of infection as an eventual postoperative complication is reduced[41].

Among the descriptive studies, the lowest success rate was 88.9%. This rate was observed in two studies, one retrospective

Table 4. Description of treatment in 816 patients treated by means of three-dimensional plates.

Characteristics		Fracture					
		Angle	Condyle	Body	Symphysis/parasymphysis	Not specified	Total
	Fractures (*n*)	666	52	2	18	103[a]	841
Displacement							
	Present	322	–	–	18	–	337 [340]
	Severe	34	–	–	–	10	44
	Moderate	142	–	–	–	–	147 [142]
	Small	146	–	–	–	–	146
	Absent	132	–	–	–	–	132
Surgical access							
	Intraoral	555	–	–	18	80	655 [653]
	Facial	34	49	–	–	–	83
Complications							
	IAN impairment	32	–	–	–	4	36
	Fixation failure/removal	31	–	–	–	5	36
	Infection	27	–	–	–	5	32
	Dehiscence	23	–	–	–	1	24
	Trismus	9	–	–	–	–	9
	Inadequate occlusion	5	–	–	4	1	10
	Re-operated	8	–	–	–	–	8
	Non-union	5	–	–	–	–	5
	Mobility	2	–	–	–	–	2
	Inadequate reduction	1	–	–	–	1	2
	Palpable plate	1	–	–	–	–	1
	Screw loss	–	1	–	–	–	1
	Postoperative MMF	1	–	–	–	8	9
	Total complications	145	1	–	4	25	175
Success							
	Success (*n*)	521	52 [51]	2	14	76 [78]	666
	Success rate (%)	78.2	100.0 [98.1]	100.00	77.8	73.8 [75.7]	79.2

IAN, inferior alveolar nerve; MMF, maxillomandibular fixation.
[a] Articles did not correlate fracture site with treatment.

Table 5. Description of treatment in 220 patients treated by conventional means.

Characteristics		Fracture				
		Angle	Condyle	Symphysis/parasymphysis	Not specified	Total
	Fractures (*n*)	127	4	–	111[a]	242
Displacement						
	Present	10	4	–	15	29
	Severe	–	–	–	8	8
	Moderate	–	–	–	7	7
	Small	–	–	–	–	–
	Absent	–	–	–	–	–
Surgical access						
	Intraoral	90	–	20	58	168 [148]
	Facial	15	4	–	–	19
Complications						
	IAN impairment	4	–	–	5	9
	Fixation failure/removal	12	2	–	1	15
	Infection	9	–	–	5	14
	Dehiscence	6	–	1	–	7
	Trismus	–	–	–	–	–
	Inadequate occlusion	2	–	3	3	8 [5]
	Re-operated	3	–	–	–	3
	Non-union	2	–	–	–	2
	Mobility	–	–	3	–	3 [-]
	Inadequate reduction	–	–	–	–	–
	Palpable plate	1	–	–	–	1
	Screw loss	–	3	–	–	3
	Postoperative MMF	3	–	–	17	20
	Total complications	42	5	7	31	85 [78]
Success						
Characteristics	Success (*n*)	97	2	17	60	176 [159]
	Success rate (%)	76.4	50.0	85.0	69.8 [54.1]	74.3 [65.7]

IAN, inferior alveolar nerve; MMF, maxillomandibular fixation.
[a] Articles did not correlate fracture site with treatment.

study[8] and one case series study[16], both evaluating the use of 3D plates in mandibular angle fractures. In these studies, five cases of infection were verified, with fixation material removal in three of them. Furthermore there was the removal of fixation material that was unsatisfactory, an inadequate reduction of the fracture, and a re-operation due to non-union, as well as two cases of mandibular mobility. Some authors argue that fracture mobility is a causal factor for postoperative infections, which may have a decreased incidence with improved fracture stabilization with more stable devices[9]. However, Ellis has stated that there is an inverse relationship between fixation rigidity and the incidence of complications[15].

Regarding the comparative studies, the 3D plates showed better performance in comparison to the alternative methods of fixation (a 2.0-mm plate, 2×2.0 mm plates, reconstruction plate, or MMF), most probably due to the stability gained in the three directions[42] and resistance to torque and malleability[35,39]. The success rate with the use of 3D plates was greater than 80% except in three comparative studies[5,17,22].

Some studies have reported that the use of 3D plates results in minimal damage to the inferior alveolar nerve (IAN)[17,35]. Nevertheless this is not always the case: of the three studies in which IAN impairment was detected postoperatively[4,5,17], two presented a greater number of patients with sensory alterations treated with 3D Plates[4,17]. These studies used subjective tests to detect IAN disorders. Furthermore, this evaluation becomes difficult, because alterations in the IAN can be caused by displacement of the fracture[36] (with IAN impairment present preoperatively) or by the manipulation used to reduce the fracture intraoperatively[16,38].

On analyzing the data, it was noticed that the 3D plates performed better in regions such as the condyle, with good success rates. The success rates were comparatively lower in the areas of higher tension forces, mainly dentate areas. Further studies are needed to confirm this finding.

In this review, there was a lack of information and standardization among the studies, making it difficult to draw conclusions with solid evidence on the indications for the use of 3D plates in the treatment of mandibular fractures. However, through this systematic review, with cautious interpretation of the results, it is suggested that more randomized, prospective and controlled clinical studies are performed to develop a safe protocol for the use of 3D plates in mandibular fractures.

3D plates can be used with some degree of safety in non-displaced or mildly displaced fractures, even in the region of the mandibular angle. There is clear demystification of some advantages of these 3D plates, but they are a viable option.

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Competing interests

None.

Ethical approval

Not applicable.

Patient consent

Not applicable.

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