

The Effect of Dental Implant in Jaw Fracture: A Systematic Review

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ABSTRACT

Background: Dental implants are cylindrical metallic screws inserted into the jawbone to replace missing teeth. Their location may affect the pattern of fractures that occur as a result of the traumatic forces to the mandible. We aimed to investigate possible influences of dental implants on jaw fractures.

Methods: We reviewed the literature on the effect of dental implants in jaw fractures. In this way, the articles available in the Scopus, PubMed, Elsevier and SID websites with similar topics in the 24-year period from 2000 to 2024 were selected and reviewed based on the inclusion and exclusion criteria. The articles were obtained by searching for sinus lift keywords Jaw fracture, Complications, and Dental implants.

Results: All studies conducted over a 24-year period were selected based on the inclusion criteria, and 5 studies related to mandibular fracture due to dental implant were selected and reviewed. Among the 5 reviewed studies, 1 study in 2022, 1 study in 2011, 1 study in 2010, 1 study in 2009 and 1 study in 2000 investigated the subject.

Conclusion: Although the probability of jaw fracture after dental implant surgery is rare, it is necessary to consider the possibility of these complications due to the serious injuries that are caused to people if it occurs.

KEYWORDS

Dental implants; Jaw fractures; Trauma; Complications; Mandibular Fractures

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INTRODUCTION

Despite the various biological and mechanical complications of dental implants, their use for jaw rehabilitation has received special attention¹⁻⁹. Jaw fracture is not a common occurrence associated with implants but is recognized as a potentially serious complication. This is particularly important in the mandible of patients with osteoporosis or osteosclerosis¹⁰⁻¹³. In the normal mandible, the volume of cortical bone is approximately 3.5 times less than that of cancellous bone¹⁴. Following tooth loss, the mandible experiences a significant reduction in bone height and volume. Although both the cortical and cancellous parts of the mandible are affected, the remaining atrophic areas become denser with increasing load from the existing mandible prosthesis. Therefore, an increase in cortical wall thickness and bone density

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occurs simultaneously with vertical bone resorption beneath the working prosthesis^{15, 16}. Thus, the atrophic compact mandible subsequently becomes susceptible to fracture due to external trauma or functional forces. In implant placement, efficient surgical technique and adequate blood supply are prerequisites for the bone compaction process¹⁷⁻¹⁹.

Atrophic mandibular fractures can occur even under normal function, due in part to bending of the mandible by physiological forces generated by the masticatory muscles²⁴. However, bicortical infiltration of the atrophic mandible may significantly reduce structural integrity due to loss of continuity at the inferior and lateral border²⁵⁻²⁹. Implant site preparation for large diameter implants may increase the risk of bone damage and thin the buccal and lingual cortex, creating an “egg shell” structure³⁰. After dental implants, minimizing risks, especially jaw fractures, is very important.

We aimed to systematically investigate the effect of dental implants on jaw fractures.

METHODS

We examined the results obtained from existing articles on the topic of reviewing the effect of dental implants on jaw fractures in the form of a review of the articles. Articles available in the Scopus, PubMed, Elsevier, and SID databases with similar topics were selected and reviewed based on the inclusion and exclusion criteria in the 24-year period from 2000 to the end of 2024. Articles were retrieved through keyword searches such as Jaw fracture, Complications, and Dental implants.

RESULTS

All studies conducted over a 24-year period were selected based on the inclusion criteria, and 6 studies related to mandibular fracture due to dental implant were selected (Table 1).

DISCUSSION

In the current studies, the most common causes of mandibular fractures are attributed to personal violence, motor vehicle accidents (MVAs), and falls^{36, 37}. The distribution of these three proposed causes of mandibular fracture could be affected by the social and economic status of the society in

which the study was conducted and yield different results. A large-scale multicenter study of the European Maxillofacial Trauma Project (EURMAT) showed differences in the causes of injury between countries³⁸. However, the overall trend in the epidemiology of maxillofacial trauma is notable, with individual attacks resulting from social violence increasing significantly in line with the increasing number of injuries resulting from road traffic accidents. Demographic changes due to an aging population may contribute to changes in the incidence of maxillofacial fractures, however, the proportion of falls increases with increasing age³⁸⁻⁴¹. The distribution and location of fractures in the mandible varies depending on the population studied^{42, 43}. The condylar process is the most common site of injury, with an incidence of 30–50%, followed by the anterior part of the mandible, such as the symphysis and paramedian region, the angle and body of the mandible, and especially the molar region⁴³⁻⁴⁵. The type of trauma plays a decisive role in the location of the fracture line. Fractures in the symphysis are caused by direct force on the chin. Fractures of the condylar process in the temporomandibular joint are caused exclusively by indirect force. However, collisions in which most of the force is directed laterally to the jaw with a blow are more likely to result in fractures of the angle and body⁴³. In fact, mandibular fractures occur mainly at weak points of the bone. They most often affect the condylar process, with its relatively thin articular neck, and the paramedian region, typically the canines, which are a vulnerable site due to their long and thick roots. The mandibular body and the thick roots of the molars are also prone to fracture. In the angle of the jaw, a wisdom tooth is often impacted, representing a weak point from internal or external forces^{46, 47}.

Similar fracture patterns have been observed in previous epidemiological studies. Considering these facts, the complete and partially edentulous cases in this study show typical patterns of mandibular fractures in which fracture lines are located along the roots of the incisors or premolars, often in combination with condylar fractures. Similar fracture patterns have been observed in previous epidemiological studies^{43, 45}. Considering these facts, the complete and partially edentulous cases in this study show typical patterns of mandibular fractures in which fracture lines are located along the roots of

Table 1. The findings of the research

Author	Year	Complication site	Complication type	Conclusion
Hino et al. ³¹	2022	Fracture line in relation to incisor roots	Mandibular fracture Simple	Over a nearly 5-year period, there were only 16 mandibular fractures with dental implants, representing a relatively low incidence of 4.1%. Given the small sample size of 16 cases, it is not possible to draw definitive conclusions. The preliminary results of this study suggest that dental implants after bone occlusion do not pose an increased risk of mandibular fracture when subjected to external force.
Soehardi et al. ³²	2011	Symphysis	Mandibular fracture Complicated	A mandible with a height of 10 mm or less, as measured at the symphysis, is at risk of fracture and associated complications. It is essential to provide appropriate informed consent regarding the benefits and risks of implant placement in the mandible.
Oh et al. ³³	2010	Anterior mandible	Mandibular fracture Simple	Placement of large diameter implants with bi-lobe penetration may compromise the structural integrity of the severely atrophic mandible. Therefore, CBCT planning is important for proper implant placement planning. Insufficient residual bone volume after placement of large-diameter implants increases stress concentration from functional loading, or thermal bone damage from implant surgery may contribute to mandibular fracture at the implant site. Implants may involve the lower mandible for stability, but bone volume and density must be considered when penetrating the inferior border of a severely atrophic mandible. Careful case selection, use of CT planning, and patient awareness of potential complications are prerequisites when considering this procedure.
Chrcanovic and Custódio ³⁴	2009	Implant site	Mandibular fracture Simple	Severe atrophy of the inferior alveolar process and underlying base bone often leads to problems with the lower denture. If implants are placed in such a mandible, mandibular fractures may occur during or after implant surgery, as implant placement weakens the already compromised mandible. After drilling the implant hole, a few millimeters of cortical bone should remain on both the labial and lingual areas. Three-dimensional surgical planning should be recommended at least in severely atrophic mandibles to prevent severe bone loss.
Raghoobar et al. ³⁵	2000	Implant site	Mandibular fracture Simple	Three of the patients required autogenous bone grafting for fracture repair, and 1 patient was managed with a reconstruction plate.

the incisors or premolars, often in combination with condylar fractures.

In general, condylar fractures were more common in Lühr classes I-II, with minimal to moderate atrophy similar to the dentate mandible. On the other hand, in the case of advanced atrophy, between Lühr classes II and III, fractures have a higher incidence rate in the paramedian region and in the body and angle of the mandible, where bone atrophy is pronounced. In the present study, a similar fracture pattern was observed in the edentulous mandible. Even in case 15, where the fracture line was in the area of dental implants, the implants were not affected by the fracture. In this study, fracture lines were identified at the implant site in only one case. In this case, a distinct bone resorption process was observed around the dental implant at the fracture site. Several studies have described this type of pathological fracture as associated with peri-implant bone loss⁴⁸⁻⁵⁰. Peri-implantitis gradually leads to loss of supporting bone and structural weakness of the mandible, which increases the risk of fracture.

Such pathological fractures can be initiated by minor trauma or normal chewing, especially when implants are placed biocortically⁵⁰. The use of radiotherapy and anti-resorptive drugs such as bisphosphonates are considered additional factors in the development of such pathological fractures⁴⁸. Our study, including a case of peri-implantitis, shows that unlike natural teeth, implants lack a weak point leading to mandibular fractures. Once dental implants are osseointegrated, fractures are unlikely to occur directly along the implant surface. This finding can be explained by the fact that teeth and dental implants have different supporting structures. In teeth, Charpy fibers are terminal anchors that insert into the root cementum and periosteum of the alveolar bone. Thus, teeth exhibit physiological tooth mobility and tissue displacement of approximately 25 μm ⁵¹⁻⁵. Micromovements produced by periodontal fibers facilitate force distribution across all root surfaces of the tooth, but may lead to fracture when the mandible is interrupted by external force. On the other hand, dental implants become rigidly ankylosed with the bone through osseointegration, which significantly reduces the possibility of tissue displacement.

It appears that dental implants - which have a rigid connection to the bone - might be more resistant to external forces and less likely to fracture.

Many studies conducted on dental implants have examined the loading and distribution of chewing forces on dental implants from a biomechanical perspective. To our knowledge, there are no findings on the exposure of dental implants to external forces. However, in orthopedic studies conducted, a similar observation was made using the example of femoral neck fractures. The femur is constantly exposed to mechanical load due to the patient's body weight, especially when a weight-bearing stage is removed. This stressful event can lead to a secondary fracture after primary surgical fracture treatment, in which a dynamic hip screw or a short titanium femoral component is inserted into the bone through the fractured femoral neck⁵³⁻⁵⁵. Therefore, the fracture line often occurs at the distal end—not at the direct site of the implant. Secondary fractures occur most frequently in the early phase, approximately 1.5 months after surgery, when the bone screw exhibits some micromotion due to the lack of bone integrity. When micromotion is resolved by increasing osseointegration, the incidence of secondary fractures is significantly reduced⁵³. The time during which micromotion persists may be considered consistent with the osseointegration healing period for dental implants.

It is possible that micromotion may play a role in fracture occurrence. Therefore, as shown in previous studies, mandibular fractures are commonly observed as a complication during and in the early stages of osseointegration⁵⁴. The present study showed that the type of accident and the nature of the injury follow distinct fracture patterns in the dentate and edentulous mandible. It may be assumed that internal and external forces do not have a particular effect on the occurrence of fracture lines along dental implants that have already been inserted with sufficient osseointegration.

CONCLUSION

Although the possibility of jaw fracture after dental implant surgery is rare, it is necessary to consider the possibility of these complications due to the serious injuries that can occur to people if they occur.

Only in mandibular fracture patterns, especially in areas prone to mandibular fracture, which include the anterior part of the mandible that has incisor teeth with long roots and symphysis, and in patients with osteoporosis or osteosclerosis, simple

fractures have been reported, the severity and type of complications were not significant, and only according to the report of Hino and colleagues in one patient, dental implants had a direct effect on jaw fracture.

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CONFLICT OF INTEREST

The authors declare there is no conflict of interest.

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