Selection of Internal Fixation Devices for Mandibular Fractures: How Much Fixation Is Enough?

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ABSTRACT

Internal fixation techniques for mandibular fracture vary considerably from one geographic location to the next, from region of the mandible to another, and from one surgeon to the next. This article presents factors that should be considered when choosing internal fixation schemes to apply to fractures of the mandible. Recommendations are based upon personal experience and outcome studies from the clinical literature.

KEYWORDS: Internal fixation, mandibular fracture

An often-debated topic is which internal fixation device(s) or scheme(s) should be selected to treat a given mandibular fracture. This debate continues today because of the differing treatment philosophies that profuse the literature and the discrepancy between the outcomes of biomechanical modeling and clinical practice. It is as true for mandibular fractures as for other topics in biomedical science that "there are many roads to Rome." A host of options are available and all work in the majority of instances. This makes a discussion on selection of fixation devices more difficult. However, there are some generalities that can be made that make the issue more understandable.

For the following discussion, I will assume that fractures will be treated open (with the possible exception of the condylar process), with no postoperative maxillomandibular fixation.

BIOMECHANIC STUDIES VERSUS CLINICAL OUTCOMES

There is a plethora of biomechanical tests that have been performed to determine where fixation devices should be applied to the fractured mandible and how much fixation is required. Some are based upon simple beam mechanics (two-dimensional)[1,2] and others are more complex, three-dimensional models.[3,4] All of them are flawed by two basic assumptions. The first is that normal bite forces must be countered by fixation devices. The models have always used normal bite forces in the testing apparatus. However, it has been shown that patients who have sustained fractures of the mandible do not generate normal bite forces for weeks or months after the injury.[5] Therefore, many fixation schemes devised in the laboratory are "overengineered" because they assume that internal fixation devices must resist normal biting forces.

The second erroneous assumption is that stability requirements generated in the laboratory should be used clinically. Although this may seem reasonable, the results from every study ever performed in the laboratory or in computer modeling have shown that two bone plates applied to a fracture are more stable than one. However, there has never been any statistically significant evidence from clinical studies that two plates perform better than one. In fact, the results of my own studies for fractures of the angle of the mandible show that two plates perform much poorer than does one.[6–10]

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One must therefore be very careful in applying treatment recommendations from laboratory studies to the patient. Fracture stability is only one factor in the treatment equation. There are many others, such as maintenance of blood supply that must also be considered when determining treatment recommendations.

RIGID VERSUS FUNCTIONALLY STABLE FIXATION

Rigid fixation is defined as internal fixation that is stable enough to prevent micromotion of the bony fragments under normal function. Whether or not we ever achieve that is unclear. However, it has been recognized that absolute rigidity of the bony fragments is not necessary for healing of the fracture to occur under functional loading. The term "functionally stable fixation" has been applied to those forms of internal fixation that are recognized as *not* being "rigid" but that satisfy the goals of maintaining fragment alignment and permitting healing during active use of the bone.

Unfortunately, functionally stable fixation in maxillofacial surgery is a spectrum that varies from one region of the mandible to another, from one fracture to the next, and from one patient to the next. For instance, a single 2.0-mm miniplate applied along the superior border of the mandibular angle might provide functionally stable fixation for isolated angle fractures but possibly not for an angle fracture that is combined with a contralateral condylar process fracture that is to be treated closed. Table 1 lists those fixation techniques that I consider rigid and those that I consider functionally stable.

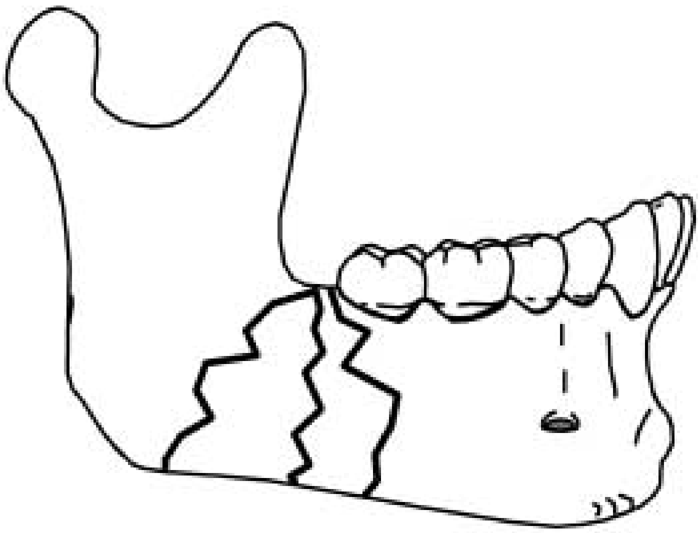
LOAD-BEARING VERSUS LOAD-SHARING FIXATION

The most simplistic way to discuss fixation schemes for mandibular fractures is to break them down into those fixation devices that are load bearing and those that share the loads with the bone on each side of the fracture (load sharing). Load-bearing fixation consists of devices that are of sufficient strength and rigidity that the device(s) can bear the entire loads applied to the mandible during functional activities. Injuries that require load-bearing fixation are comminuted fractures of the mandible, those fractures where there is very little bony interface because of atrophy, or those injuries that have resulted in a loss of a portion of the mandible (defect fractures). In such cases, the fixation device must bridge the area of comminution, minimal bone contact, or bone loss and bear all of the forces transmitted across the injured area that are generated by the masticatory system. The most commonly used load-bearing device is a mandibular reconstruction bone plate (Fig. 1). Such plates are relatively large, thick, and stiff. They use screws that are generally >2.0 mm in diameter (most commonly 2.3, 2.4, or 2.7 mm). When secured to the fragments on each side of the injured area by a minimum of three bone screws, reconstruction bone plates can provide temporary stability to the bone fragments. The bone plates are not prosthetic devices and will usually fail in time (several months to years later) by either loosening of the screws or fracturing of the plate but can provide stability until the comminuted fragments have consolidated and/or the missing bone is replaced with grafts.

Load-sharing fixation is any form of internal fixation that is of *in*sufficient stability to bear all of the functional loads applied across the fracture by the masticatory system. Such fixation device(s) requires solid bony fragments on each side of the fracture that can bear some of the functional loads. Fractures that can be stabilized adequately with load-sharing fixation devices are simple, linear fractures and constitute the majority of mandibular fractures. Fixation devices that are considered load sharing include the variety of 2.0-mm miniplating systems that are available from a number of manufacturers. Examples of load-sharing fixation for angle fractures are demonstrated in Figure 2. Lag screw techniques are also load sharing in that the bone that is compressed is sharing the functional loads with the screws. Simple, linear fractures can also be treated by load-bearing fixation, but the reverse is not true. Comminuted or defect fractures or those where a minimum of bone contact is present cannot be treated by load-sharing fixation because there is insufficient bone stock adjacent to the fracture to resist displacement by functional forces.

Table 1 Stability of Fixation Schemes

Rigid Fixation	Functionally Stable Fixation (Nonrigid)
Reconstruction bone plate (± arch bar)	One 4-hole 2.4-mm compression plate without arch bar
Two bone plates (miniplates, compression plates, or combinations of these) (± arch bar)	One 2.0-mm miniplate + arch bar
	One lag screw + arch bar
Two lag screws (± arch bar)	One 2.0-mm miniplate without arch bar for angle fracture
One bone plate *plus* one or more lag screws (± arch bar)	
One 4-hole 2.4-mm compression plate + arch bar	
One 6-hole 2.4-mm compression plate (± arch bar)	



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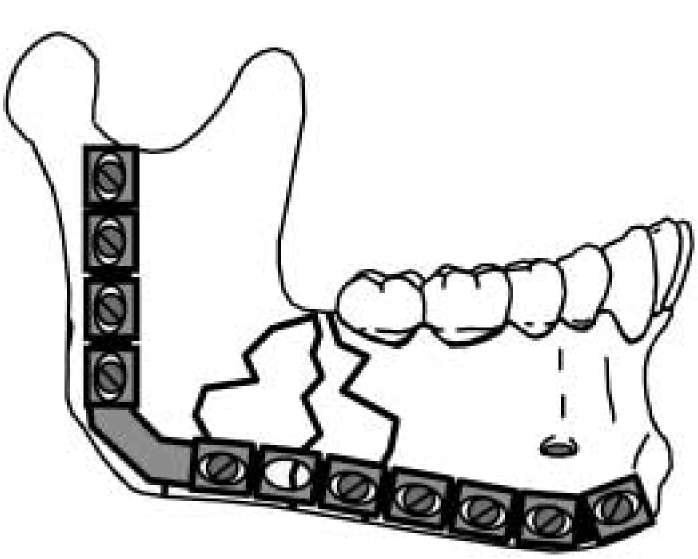

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Figure 1 (A) Comminuted fracture that requires load-bearing fixation. (B) Reconstruction bone plate applied across the fracture. Large pieces of comminuted bone fragments can also be secured to the plate, but it is not absolutely necessary to do so.

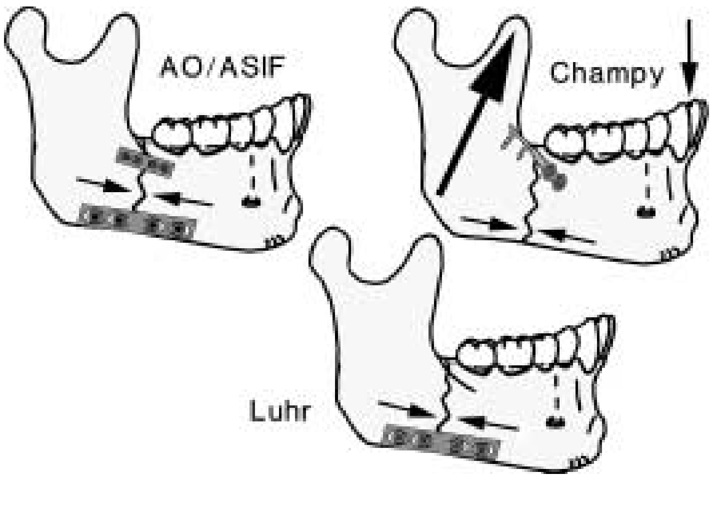

Figure 2 The three most commonly used fixation recommendations for fractures of the angle are all load sharing, where the bony buttresses take on a large part of the load. In the AO/ASIF and Luhr techniques, compression plates are employed, compressing the bone (load sharing) along the fracture. The load-sharing principle is most dramatically demonstrated in the Champy miniplate technique (upper right), where the miniplate located at the superior border converts functional forces into compressive forces at the inferior border of the mandible. It is necessary to have solid bony buttresses in that location to prevent overriding of the fragments under function (load sharing).

ONE-POINT VERSUS TWO-POINT FIXATION

Mandibular fractures can be treated by the application of fixation devices at one place along the fracture or at more than one point, generally two. To take mechanical advantage of more than one point of fixation, the fixation devices should be placed as far apart from one another as possible. Because fixation devices are applied to the lateral surface of the mandible, the ability to use two-point fixation requires that there be sufficient height of bone so that the fixation devices can be placed far apart from one another. For instance, an atrophic mandibular fracture where there is a vertical height of only 15 mm would not gain much mechanical advantage from placing two bone plates on the lateral surface. In such instances, a single, stronger bone plate should be applied below the inferior alveolar canal. For the majority of fractures in the dentulous mandibular body and symphysis, there is sufficient height of bone to place one load-sharing plate along the inferior and one along the superior aspect of the lateral cortex. However, the ability to do so will depend upon the local anatomy. If one chooses to use two load-sharing bone plates, one must be cognizant of the position of the tooth roots and the inferior alveolar/mental nerves. If there is insufficient room between the roots of the teeth and the inferior alveolar/mental nerve, one might choose to use a single stronger bone plate along the inferior border than to risk injury to the tooth roots or inferior alveolar/mental nerves when placing the second bone plate (Fig. 3).

A point of fixation that is extremely useful in fractures of the dentulous mandible comes from securing the teeth on each side of the fracture with an arch bar and possibly complemented with a compression (bridle) wire. This provides a very secure point of fixation in the mechanically advantageous region of the superior surface of the fracture (zone of tension or separation). One load-sharing plate applied at the inferior border combined with a stable arch bar secured to firmly anchored teeth produces a very stable form of two-point fixation. In such cases, the addition of a second bone plate just below the tooth roots may be unnecessary.

COMPRESSION VERSUS NONCOMPRESSION PLATES

There are many types of bone plates that are available for clinical use. In their most simplistic forms, plates are either compression plates or noncompression plates. Compression plates have the ability to compress the fractured bony margins, helping to bring them closer together, and imparting additional stability by increasing the frictional interlocking between them. Although these properties might be advantageous, the application of compression by a plate creates a dynamic force that can work to one's disadvantage if the plate is not perfectly applied. Potential problems from compression plates come in two main forms. In the first instance, there may be a geometric rearrangement of the fractured fragments over the first few weeks caused by the dissipation of the compressive loads that can alter the occlusion (Fig. 4). The occlusal change might be slight but occasionally perceptible. This is more prone to occur in fractures that are oblique. In such cases, longitudinal compression imparted by the plate might cause a slight slippage and overriding of the fracture fragments, altering the occlusion and possibly leading to loss of stability of the reconstruction. Thus, compression plates are safest to use in fractures where there is minimal obliquity and sound bony buttresses on each side of the fracture that can be compressed by the plate.

A second problem that can come from the improper application of compression plates is the ability of compression plates to cause widening of the mandible if not properly overbent prior to application of the first two screws.[11] In such cases, the lingual cortices may not

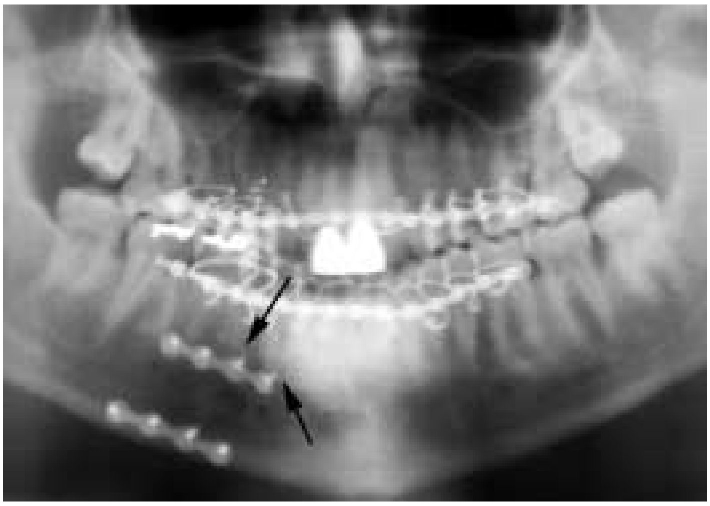

Figure 3 Fracture of the mandible body treated with two 2.0-mm miniplates. Note how close the screws in the upper bone plate are to the roots of the teeth (arrows). The only location where there is adequate space between the inner aspect of the outer cortex and the roots of the teeth to accommodate monocortical screws is in the molar region (external oblique ridge). The roots of the premolars, canines, and incisors are usually lying adjacent to the buccal cortex, making them susceptible to injury from screw insertion unless one can place them below the root apices.

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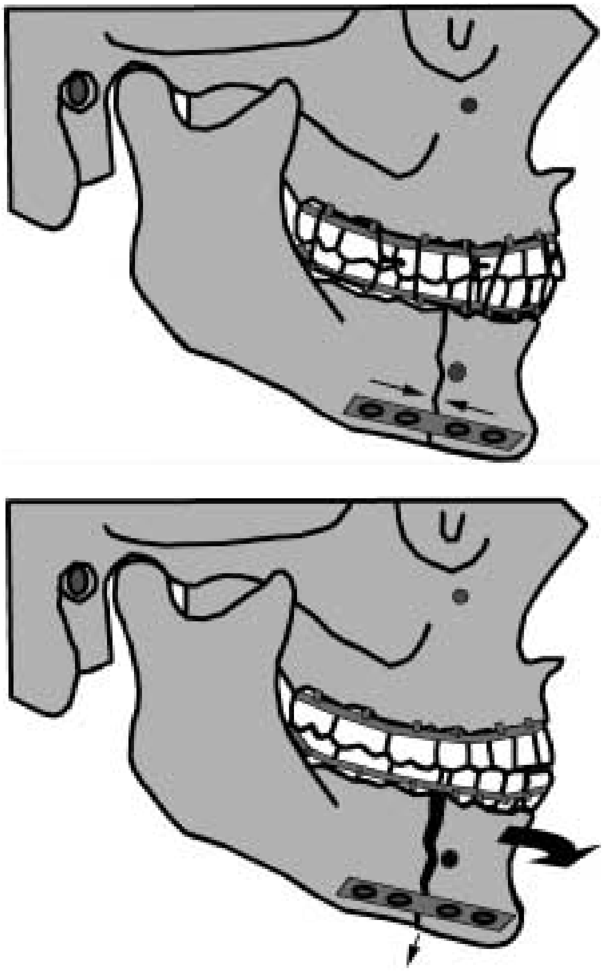

Figure 4 Compressive forces transmitted to the bone by a plate dissipated over time by changing the geometry of the construct, resulting in malocclusion. (A) Intraoperatively, the patient is in maxillomandibular fixation so the occlusion is normal. (B) Some time later, there has been a shifting of the segments from the application of the compressive force by the plate, resulting in malocclusion.

contact even though the buccal cortices appear perfectly reduced (Fig. 5A). To prevent this, one should first bend the compression plate to the exact contour of the properly reduced bone and then overbend the plate so that it is 1 to 2 mm off the bone in the area of the fracture (Fig. 5B). Overbending the compression plate allows it to apply compression to the lingual cortex and prevent the tendency for a gap to arise when it is applied to the buccal cortex (Fig. 5C). One must understand that even a small gap of the lingual cortex in the area of the symphysis will lead to a much greater increase in the width of the gonial angles. Such tendency does not occur when noncompression plates are applied to the properly reduced fracture.

Given the previous considerations, compression plates should be used sparingly and only in fractures with sound bony buttresses adjacent to the fracture gap. The plates must be applied carefully and precisely to prevent the potential complications just discussed.

LOCKING PLATE/SCREW SYSTEMS

Over the past 10 years, there has been an introduction of locking plate/screw systems into maxillofacial surgery. These plates function as internal fixators, achieving stability by locking the screw to the plate. There are several potential advantages to such fixation devices. Conventional bone plate/screw systems require precise adaptation of the plate to the underlying bone. Without this intimate contact, tightening of the screws will draw the bone segments toward the plate, resulting in alterations in the position of the osseous segments and the occlusal relationship. Locking plate/screw systems offer certain advantages over other plates in this regard. The most significant advantage may be that it becomes unnecessary for the plate to intimately contact the underlying bone in all areas. As the screws are tightened they "lock" to the plate, thus stabilizing the segments without the need to compress the bone to the plate (Fig. 6). This makes it impossible for the screw insertion to alter the reduction. This theoretical advantage is certainly more important when using large bone plates, such as reconstruction plates, which can be very difficult to perfectly adapt to the contours of the bone. Another theoretical advantage to the use of locking bone plate/screw systems is that the screws are unlikely to loosen from the bone. This means that, even if a screw is inserted into a fracture gap, loosening of the screw will not occur. The possible advantage to this property of a locking plate/screw system is a decreased incidence of inflammatory complications from loosening of the hardware. It is known that loose hardware propagates an inflammatory response and promotes infection. For the hardware or a locking plate/screw system to loosen, loosening of a screw from the plate or loosening of all of the screws from their bony insertions would have to occur. Both of these are unlikely. A third advantage to a

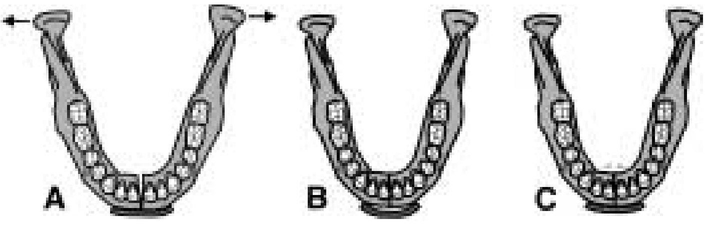

Figure 5 Widening of the mandible caused by compression plates. (A) A compression plate is applied to the outer cortex of the mandibular symphysis, and a gap has formed on the lingual cortex, causing lateral displacement of the condyles. (B) Overbending the bone plate prior to placing the first two (compression) screws maintains contact of the lingual and buccal cortices, preventing widening of the mandible (C).

Figure 6 Mechanism by which locking reconstruction plates create a "lock" between the screws and the plate. Cutaway shows that the inside of the hole in the plate is threaded to receive the threads on the undersurface of the bone screw.

locking screw/plate system is that the amount of stability provided across the fracture/osteotomy gap is greater than when standard nonlocking screws are used.[12,13]

Although the possible advantages of a locking plate/screw fixation system are theoretical, whether or not clinical results can be improved is not clear from the literature. However, given the potential advantages that locking plate/screw systems provide, such systems should be considered whenever noncompression plates are chosen for a fracture.

LAG SCREW FIXATION

The lag screw fixation technique consists of using screws to compress fracture fragments without the use of bone plates. To apply the lag screw technique, two sound bony cortices are required because this technique shares the loads with the bone. The hole in the cortex under the head of the screw is called the gliding hole. It is the same diameter as the screw, so the threads will not engage this cortex. The screw threads on the terminal end of the screw engage the opposite cortex. By tightening the screw, a tensile force is created within the screw that compresses the bony cortices together, tightly reducing the fracture (Fig. 7).

The use of lag screws has several advantages over the use of bone plates. Less hardware is used when compared with the use of plates, thus making it more cost-effective. When properly applied, lag screws are a very rigid method of internal fixation. Because there is no plate to be bent, the insertion of a lag screw is quicker and easier and the reduction is more accurate than when bone plates are used.

Fractures that lend themselves to the application of lag screws are those that are oblique in nature, providing the ability to place a screw from one cortex to the opposite one across the line of fracture. Any time there is an area of obliquity, one should always consider the application of lag screws rather than bone plates. However, a general principal of lag screw usage is that at least

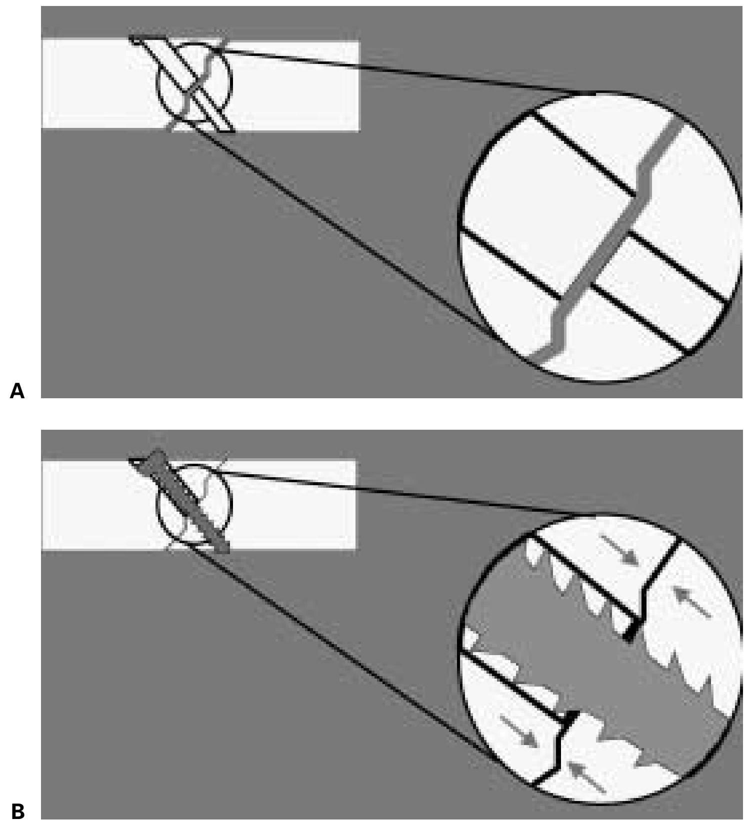

Figure 7 Technique of lag screw placement. (A) The outer cortex is drilled to the external diameter of the screw threads and is countersunk to receive the head of the screw. The inner cortex is drilled to the internal diameter of the screw. (B) Screw tightening creates compression of the bony interfaces because the head of the screw compresses the outer cortex against the inner cortex that is engaged by the screw threads.

two are necessary to provide stable fixation (an exception is at the angle, but that technique is not discussed here). Oblique fractures in the angle or mandibular body region are uncommon,[14] and therefore not many angle/body fractures can be treated with this technique. However, when sufficient obliquity exists, lag screws are a very effective means of fixation. The anterior mandible, from mental foramen to mental foramen, is uniquely suited to the application of lag screw fixation for three reasons.[15] The most important is the curvature of the anterior mandible. This allows placement of lag screws across the symphysis, from one side to the other for sagittal fractures (Fig. 8), and from anterior to posterior for oblique fractures. The second reason the anterior mandible is well suited to lag screw fixation is the thickness of the bony cortices, which provides extremely secure fixation when the screws are properly inserted. The other helpful reason is that there are no anatomic hazards below the apices of the teeth until the mental foramina are encountered. This makes lag screw placement extremely simple. Fortunately, there is usually ample space available for the routine placement of two screws in fractures of the anterior mandible.

One must understand completely that the lag screw technique of fixation is one that relies upon compression of bone fragments. If the intervening bone is unstable due to comminution or is missing, compressing across this area will cause displacement of the bone fragments, overriding of segments, and/or shortening of the fracture gap—resulting in problems with the occlusion. One should always place the lag screw in a direction that is perpendicular to the line of fracture to prevent overriding and displacement during tightening of the screws.

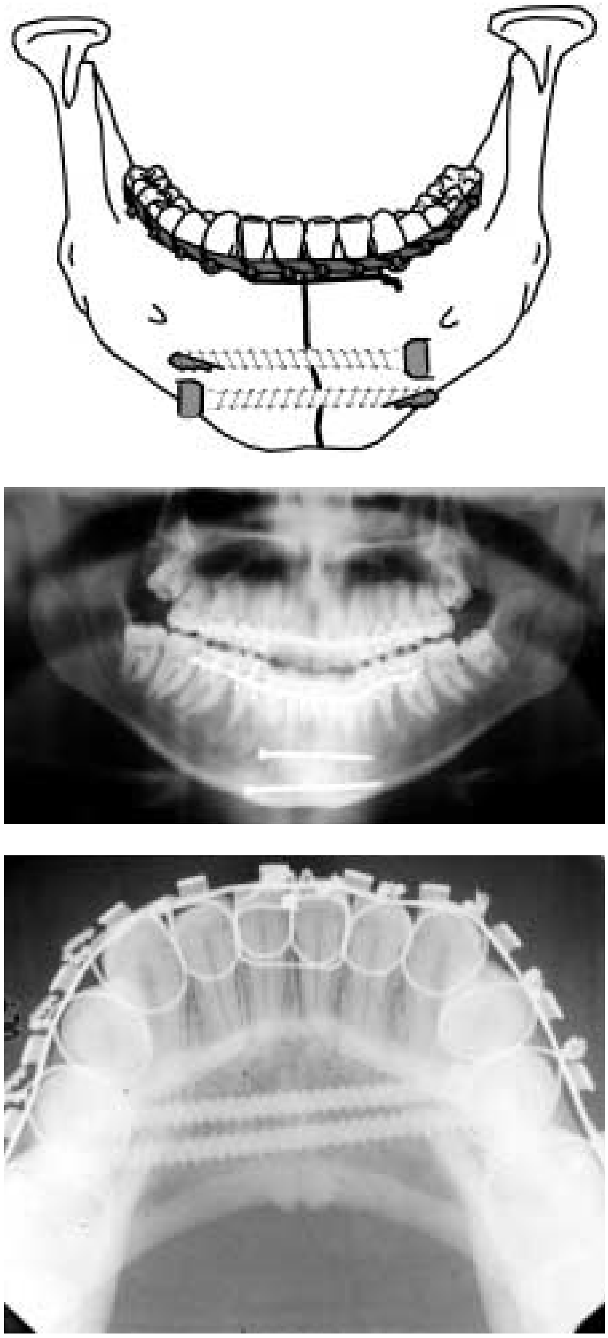

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Figure 8 Lag screw technique for anterior mandibular fractures. (A) Placement of two lag screws from one buccal cortex to the other for a sagittal fracture of the mandible. (B) Panoramic and (C) occlusal radiographs showing postoperative result.

PLATE FATIGUE

Bone plates may break under function, resulting in possible loss of fixation, infection, nonunion, and/or malunion. Plates break for a number of reasons, but most fracture in vivo because of fatigue. Plates used in maxillofacial surgery today are usually made of titanium. Titanium is a relatively biocompatible material and has material properties that are considered adequate for internal fixation when appropriate plates are selected. One of the undesirable properties of titanium is its brittleness (or lack of ductility) when compared with bone. One only has to bend a miniplate back and forth a few times to see how readily it will fracture. Placement of bone plates on areas of the mandible that are constantly and repeatedly deformed under function can result in fatigue fracture of the plates. Examples are the 2.0-mm miniplate or 2.0-mm adaptation plates applied to the condylar process or similar plates applied to the atrophic mandible (Fig. 9). The condylar process is constantly undergoing mediolateral tilting during opening and closing movements of the mandible. The atrophic mandible similarly undergoes “wishboning” during function.[16] The lesser the amount of bone stock present, the higher the magnitude of these movements. Thus, atrophic mandibles undergo much more wishboning that do large dentulous mandibles. Because of the small cross-sectional area of the condylar process, this area of the mandible similarly flexes during function.

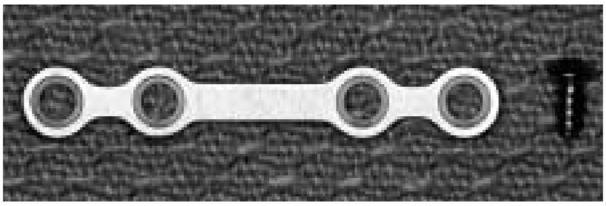

Figure 9 Standard 2.0-mm miniplate (the 2.0 mm refers to the size of the screw that this plate accomodates, *not* the size of the plate). This plate has very good tensile strength but readily fractures under cyclic loading.

Bone plates applied to such areas of the fractured mandible must be able to not only acutely withstand the deforming forces applied but also withstand the chronically applied cyclic loading until such time that the bone has healed. This is why several authors have recommended thicker, stronger 2.0-mm plates (mini-DCPs; Fig. 10) or *two* 2.0-mm miniplates for condylar process fractures[17–19] and reconstruction bone plates for atrophic mandibular fractures.[20] This problem with the atrophic mandible is the reason the AO/ASIF has recommended that "The weaker the bone, the stronger the plate must be."[20]

SINGLE VERSUS MULTIPLE MANDIBULAR FRACTURES

Because of the shape of the mandible, fractures of the mandible are often multiple. Most surveys show that just under 50% are isolated, the same amount are doubly fractured, and a small percentage have more than two fractures. Fixation requirements for double (or multiple) fractures differ from those for isolated fractures. One can use less rigid forms of fixation on isolated fractures because the forces generated during function are less complex than when a second or third fracture is present. For instance, there is minimal tendency for fractures of the symphysis, body, or angle to result in widening of the mandible unless fixation devices are incorrectly applied. The application of a single 2.0-mm miniplate along the lower border of the mandible combined with an arch bar is usually adequate fixation for isolated simple linear fractures of the symphysis and body regions. If an arch bar is not used or the teeth not sound, one should use either a stronger plate at the inferior border or add another 2.0-mm miniplate more superiorly along the lateral cortex. The application of a single 2.0-mm miniplate along the superior border is also adequate fixation for most isolated simple linear fractures of the angle region.[21] Lag screws can also be used instead of or in addition to plates where appropriate.

When two fractures are present, there is a greater tendency for the segments to displace because of the bilateral loss of support that occurs. Widening of the mandible must be prevented by applying adequate internal fixation to resist that tendency. With bilateral simple, linear fractures, one should always consider using a more rigid form of fixation on at least one of the fractures. For instance, when an angle fracture is combined with a contralateral body or symphysis fracture, one should consider treating the body/symphysis fracture with either two 2.0-mm miniplates or a stronger bone plate at the inferior border as well as using the arch bar as another point of fixation (Fig. 11). The angle fracture can then be treated with a single superior border 2.0-mm miniplate. Similarly, if an angle fracture is combined with a contralateral condylar process fracture, one should consider the application of more stable fixation at the angle if the condylar process is going to be treated closed using no maxillomandibular fixation (MMF) and functional therapy (Fig. 12). In that case, two 2.0-mm miniplates (or an alternative rigid treatment) should be considered. If the condylar process were to undergo open reduction and internal fixation, or if several weeks of MMF were to be used, then the angle fracture could be treated with

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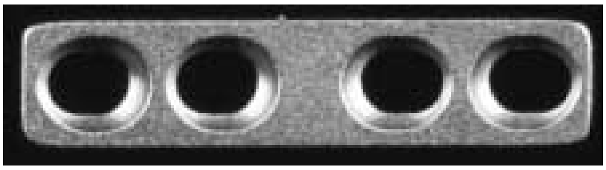

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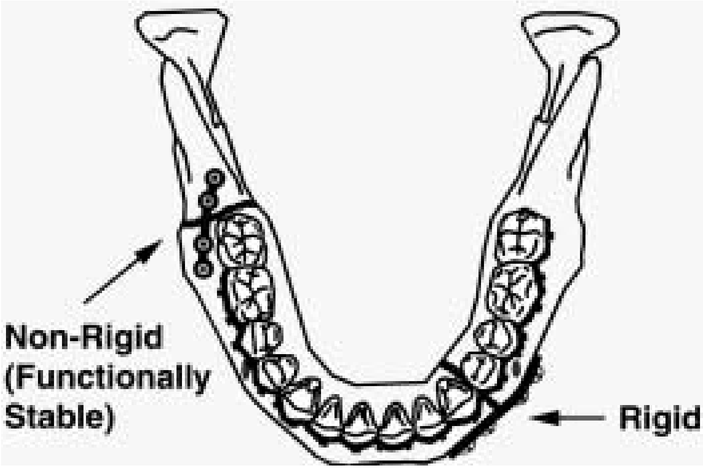
Figure 10 (A) Example of stronger 2.0-mm bone plate than the miniplate shown in Figure 9. This mini-DCP has a thicker cross-sectional area and a broader strap between the holes. (B) This plate is useful for fractures of the mandibular condylar process and rarely fractures for that application.



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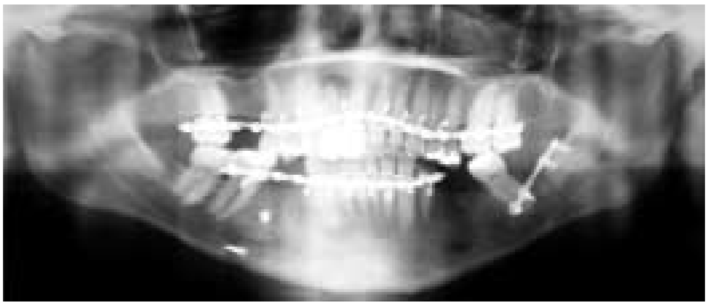

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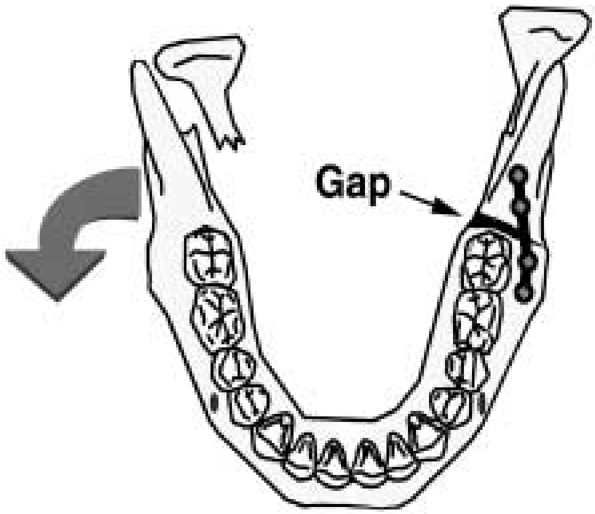
Figure 11 (A) Possible fixation scheme for right angle and left body fractures of the mandible. The more accessible body fracture is treated with a more "rigid" form of fixation (e.g., a thicker bone plate at the inferior border or two miniplates). The angle fracture can then be treated with a functionally stable form of fixation, which is easier to apply than would be a rigid technique at the angle. The angle fracture is thus treated as if it were an isolated fracture, with a single four-hole 2.0-mm miniplate. (B) Postoperative panoramic radiograph showing rigid fixation (two lag screws) applied to an oblique body fracture and functionally stable fixation (single four-hole 2.0-mm miniplate) applied to the contralateral angle fracture.



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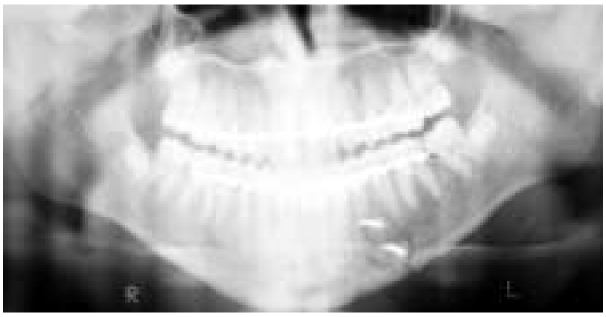

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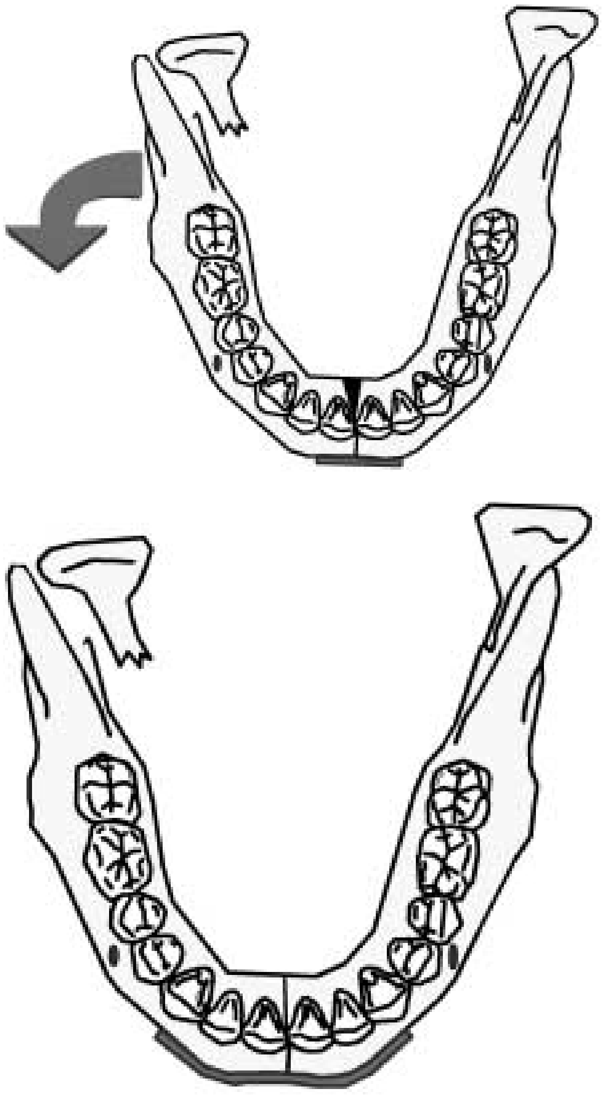
Figure 12 (A) Widening of mandible when an angle fracture treated without rigid fixation is combined with closed treatment of a contralateral condylar process fracture. The single 4-hole 2.0-mm miniplate that works very well in this location for isolated fractures of the mandibular angle may not be able to prevent the tendency for widening. (B) Postoperative panoramic radiograph showing a left body fracture of the mandible combined with a right condylar process fracture. The left body fracture was treated with rigid fixation (two lag screws) to prevent widening of the mandible that could occur with closed treatment of the right condylar process fracture.

a single superior border 2.0-mm miniplate (functionally stable but not rigid fixation).[21]

The fracture pattern that has the greatest tendency for widening is the midsymphysis fracture combined with condylar process fractures, especially when both condyles are fractured. In such cases, the musculature attached to the lingual surface of the mandible pulls the mandible posteriorly, and because there is no posterior support via the temporomandibular joints the lateral mandibular fragments open like a book. Such fractures must be carefully managed to first restore the mandibular width and then to maintain it. A short, thin bone plate, such as a 2.0-mm miniplate or even two 2.0-mm miniplates, may not offer sufficient resistance to the tendency to widen (Fig. 13A). If one chooses to treat the condylar process fracture(s) closed, very stable fixation must be applied across the reduced mandibular symphysis to retain the normal width of the mandible. This can achieved by several techniques, but the most stable is to use either a reconstruction plate applied across the symphysis (Fig. 13B) or, if the fracture is linear, two well-placed lag screws. The application of two thicker 2.0-mm bone plates (thicker than miniplates) would also suffice. If one chooses to open the condylar process fractures, then the symphysis fracture could be treated as an isolated symphysis fracture, usually with whatever technique the surgeon chooses.

REGIONAL DYNAMIC FORCES

Different regions of the mandible undergo different magnitudes and direction of forces. In simplistic terms, fractures of the angle under most functional situations tend to "open" at the superior border. Therefore, the application of fixation devices at the superior border is more effective in preventing this separation of fragments under function than applying them at the inferior border. There is little tendency for isolated fractures of the angle to have medial or lateral displacement during function, so the fixation requirement is mainly to pre-



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B

Figure 13 (A) Combination of a symphysis fracture treated with a single short bone plate and concomitant closed treatment of a condylar process fracture resulting in widening of the mandible. Because the bone plate is applied along the buccal cortex, it has a mechanical disadvantage in preventing widening of the mandible to occur. (B) To prevent this, a longer, thicker, stronger plate should be applied that "yokes" the mandible.

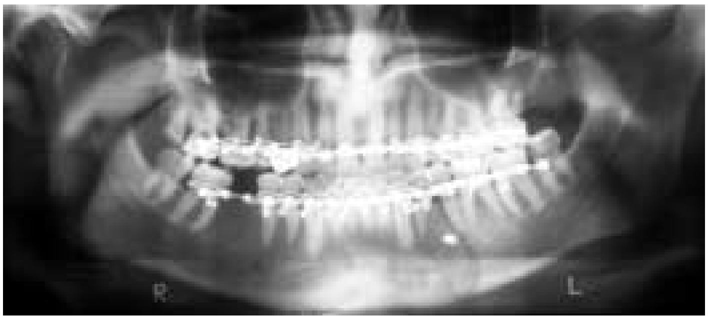

Figure 14 Postoperative panoramic radiograph showing an oblique isolated mandibular body fracture treated with a single 2.0-mm lag screw combined with a solid arch bar.

vent separation of the superior border. Relatively small plates can therefore adequately control this fracture. The Champy miniplate technique functions extremely well for this fracture and consists of a 2.0-mm miniplate applied with monocortical screws along the superior border (see Fig. 2).[21] Because metallic plates have high tensile strength, even thin plates work adequately at the angle to prevent the tendency for a gap to form at the superior border under function.

Isolated fractures of the mandibular body behave similarly under function, with a tendency for a gap to form at the superior surface, but the more anterior the fracture the more the tendency for torquing of the fragments to occur, causing misalignment of the inferior border. Although the arch bar may provide sufficient resistance to the tendency for a gap to form between the teeth under function, a plate or lag screws somewhere else on the body of the mandible is necessary to prevent the mediolateral displacement that accompanies the torquing motion under function. For isolated body fractures, this can be a relatively small plate, such as a 2.0-mm miniplate or even a single lag screw combined with a solid arch bar (Fig. 14).

The directions of forces that are distributed through the anterior mandible vary with the activity of the mandible. This means that the classical zones of tension on the superior and compression on the inferior surfaces of the mandible are not absolute.[3,4] Instead, the anterior mandible undergoes shearing and torsional (twisting) forces during functional activities.[21,22] Application of fixation devices must therefore take these factors into consideration. This is why most surgeons advocate two points of fixation in the symphysis: either two bone plates, two lag screws, or possibly one plate or lag screw combined with an arch bar.[22]

CONCLUSION

Although the number of plating sets and fixation schemes are numerous, one can usually treat most fractures with very few instrument sets. I treat the majority of fractures of the mandible with either lag screws, 2.0-mm miniplates, or reconstruction bone plates. There are, however, fractures where one may wish to use 2.0-mm screws but thicker plates (than miniplates such as the one shown in Fig. 9), for instance, condylar process fractures or fractures of the atrophic mandible. In those cases, I use thicker, stronger bone plates that accommodate 2.0-mm screws. For these situations, I am currently using a locking 2.0-mm bone plating set that has plates of varying length and thickness, allowing me to choose the appropriate bone plate for almost any location.

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