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New Innovations In Mandibular Fracture Fixation-the 2.0 Lock System - An Advancement In Dentistry- A Review

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Abstract
The field of mandibular reconstruction and fractures has evolved dramatically over the past fifty years. Numerous advances in microsurgical technique, plating technology and instrumentation, Refinements in technique continue to improve the functional and aesthetic outcomes of oromandibular reconstruction. Rigid internal fixation with plates & screws is now standard treatment of fractures. The latest innovations are self drilling ,self-tapping screws, locking mini-plates .These screws offer the prospect of less instrumentration and faster application. Preclinical testing has shown them to be substantially more retentive in cancellous bone, a significant advance in cancellous block bone grafting. Locking 2.0 miniplates utilize double threaded screws which both lock to the bone and the plate creating a mini-internal fixator. Locking 2.0 miniplates utilize double threaded screws which both lock to the bone and the plate creating a mini-internal fixator. This results in a more rigid construct with less distortion of the fracture or osteotomy, screws which do not loosen and less interference with bone circulation since the plate is not pressed tightly against the bone. Locking miniplates are designed for midface application in the repair of fractures, osteotomies and defects. Three configurations in a variety of shapes and lengths are available for mandibular surgery. The thinner and medium varieties are useful in transoral plating of fractures utilizing the Champy technique. The heavier, longer variety are used in unilateral edentulous fractures in the symphysis and parasymphysis as well as an aid to tumor resection and reconstruction with both free and vascularized grafts. They are not designed to replace the heavier 2.4 locking construction plates designed for complex fractures or extensive reconstructions.{1}. This review discusses the current state-of-the-art techniques for mandibular reconstruction and highlights the latest innovations in technique.

Key Words
Locking miniplates, Self-drilling screws, Mandible fracturtes.

Introduction:

The face is crucial , injuries to face results in divesting physical and emotional sequelae . Fractures of mandible occur more commonly than any other fractures of facial skeleton[1],[2]. In the 21st century,the near total abolition of maxillomandibular fixation in the mandibular is the major step in the evolution of maxillofacial trauma management due to advent of various plating systems.[3]. Over the past 20 years, rigid internal fixation with plates and screws has become the standard for the treatment of fractures, osteotomies and reconstruction of the craniomaxillofacial skeleton. The devices continue to evolve with the latest innovations being selfdrilling, self-tapping screws and locking miniplates[4]. Modern traumatology stated with development of osteosynthesis.

Miniplate fixation of manibular fracture has become a standard treatment

Miniplate fixation of mandible fractures along lines of osteosynthesis has become the most widely used technique. The stability of conventional bone plating systems is achieved when the head of the screw compress the fixation plate to the bone as the screw is tightened .Invariably overtime the cortex of the bone adjacent to the plate will resorb.If the plate is not contoured precisely and is not in intimate contact with the bone ,the race between fracture healing and cortex resoption will be lost and result in unstable fixation . The introduction of Locking plate/Screw system for the treatment of mandibular fractures and continuity has offered certain advantages over other plating systems. Miniplate fixation of mandibular fractures has become a standard treatment as these plates function as internal fixators, achieving stability by Locking the screw to the plate. A unique advantage to Locking Screw/Plate systems is that it becomes unnecessary for the plate to have intimate contact with the underlying bone, making plate adaptation easier[2]. Recently a 2.0 mm bone plate/screw system became available with simple locking mechanism between the plate and the screw. This plating system was originally designed by Synthes Paoli PA .The locking miniplates have been developed to overcome the frequent complications of popular non-compression miniplates ,such as loosening of the screws and splaying of the fragments, especially in the angle of the mandible. The plates used in the facial fractures are usually of 1-2mm in thickness, the screws with outer diameter of 2mm.The screws are self-tapping or self-drilling and tapping. Since the plates need not be adopted Precisely to the underlying bone, there is no excessive bending of the plates and there is less pressure over the periosteum.

The locking plates do not depend on the friction between the plate and the bone for stability and hence act as fixator .The self-drilling principle also has the added advantage of avoiding the necessity to drill a hole thus shortening the process of osteosynthesis and requiring less instrumentation. It should be noted that self-drilling screws may be difficult to apply in extremely dense bone such as the mandible[1]. There are case reports in the literature investigating the effects of locking miniplates Lazow &Julius Berger [2002] conducted a study to assess the efficacy of intraoral treatment of mandibular fractures using a 2.0mm miniplate and 2 weeks of maxillomandibular fixation.They concluded that the use of a single 2.0mm miniplate adapted along Champy's line of ideal osteosynthesis, stabilized with 4 monocortical screws and 2 weeks of MMF is a viable treatment modality for mandibular fractures. Edward A,Ellis III(1999) evaluated eighty one patients with fractures of the mandibular angle Were treated by open reduction and internal fixation using one non-compression miniplates With 2.0mm selfthreading screws placed through a transoral incision.They concluded that the Use of a single miniplate for fractures of the angle of the mandible is a simple ,reliable technique with a relatively small number of major complications [6] Edward Ellis and John Graham (2002) examined the use of a 2.0-mm locking bone plate/screw system in mandibular surgery. A total of 80 fractures in 59 patients were treated with the 2.0-mm locking plate/screw system. They found that 2.0-mm locking plate/screw system is simple to use and provides sound fixation in all cases.[7] Richard H. Haug, Chad C. Street and Michele Goltz (2002) did a study to determine whether the degree of plate adaptation and effects of locking influenced the mechanical behaviour of the plate/screw/substrate system for 2.0 Locking system. [8] Ralf Gutwald, Brian Alpert[1] and Rainer Schmelzeisen (2003) tested and compared a new internal Mini-Locking-System with conventional 2.0 mm Miniplates.

Standardised osteotomies in the angular region of 16 human cadaver mandibles were fixed with a 6-hole-plate at the oblique line. They observed that loading forces were transmitted without the need of plate friction directly from bone over the screws to the plate resulting in higher stability in case of new internal Mini mm locking plates and standard 2.0-mm plates in treating mandible fractures.[9] Chad P. Collins, Galia Pirinjian-Leonard, Andrew Tolas, and Rafael Alcalde. (2004) compared the standard 2.0-mm

Monocortical Plates to 2.0-mm locking plates in the treatment of mandible fractures[8]. A prospective randomized clinical trial was conducted They found similar short-term complication rates with both 2.0--mm monocortical superior border plates and 2.4-mm reconstruction plates secured at the inferior border intended to stabilize simulated mandibular angle fractures. They evaluated the degree of adaptation (amount of offset) affecting the mechanical behaviour of the nonlocking systems and found no effect on the locking systems. Rigid internal fixation with plates and screws is now standard for the treatment of fractures, osteotomies and reconstruction of the craniomaxillofacial skeleton. The latest innovations are self-drilling, self-tapping screws and locking miniplates. These screws offer the prospect of less instrumentation and faster application. Preclinical testing has shown them to be substantially more retentive in cancellous bone, a significant advance in cancellous block bone grafting. Locking 2.0 miniplates utilize double threaded screws which both lock to the bone and the plate creating a mini-internal fixator. This results in a more rigid construct with less distortion of the fracture or osteotomy, screws which do not loosen and less interference with bone circulation since the plate is not pressed tightly against the bone. Locking miniplates are designed for midface application in the repair of fractures, osteotomies and defects.

Ayman Chritah, Stewart K. Lazow andJulius R. Berger, (2005) assessed a 2.0-mm Locking Miniplate/screw system in the treatment of mandibular fractures with a 1 week of maxillomandibular fixation [10]. They found 2.0-mm locking plates placed along Champy's line of ideal osteosynthesis with four 8-mm monocortical locking screws plus 1 week of maxillomandibular fixation a reliable and effective treatment modality for mandibular fractures P.D.RIBERO-Junior,O.Magro-Filho[2010] in vitro evaluation of conventional and locking miniplates /screw systems for the treatment of mandibular fractures found locking plate/screw system provided significantly greater resistance to displacement than conventional ones. Locking Miniplates offered more resistance than conventional miniplates. Long locking miniplates provided Greater stability than short ones..Smith(1991) evaluated retrospectively the success rate of rigid fixation used to treat 16 consecutive comminuted fractures of the mandible in 15 patients.They suggests that rigid fixation of comminuted mandibular fractures is a viable treatment that satisfies the necessary for reestablishment of form and function with minimal morbidity.[13] Tomihisa Nagasao,Akiko Kimura,Junpei Miyamato (2006) performed a comparative study to determine the most stable Fixation method for mandibular symphysis fractures by comparing the mechanical characters created on a 3-dimensional finite element model and fixed at different positions with different numbers of plates.

Thangavelu A.(2004) studied the 3D plating system on 8 patients with maxillofacial trauma and concluded that 3Dplates can be used in case of unstable fractures of the maxillofacial region.[16]

Guimond et al (2005)retrospectively evaluated complication rate with the use of a 3D plating with 2mm curved angle strut plate for mandibular angle fracture fixation in 37 patients with non-comminuted mandibular angle fractures.They concluded that percutaneous fication of non-comminuted mandibular angle fracture with a curved 2.0mm 3D strut plate.Juergen Zix,Olivier Lieger(2007) evaluated the clinical usefulness of 2mm 3 dimensional miniplate for open reduction and monocortical fixation of mandibular angle fracture patients with Non-communited mandibular angle fractures.They found hardware failure,infection,sensory disturbance of the inferior alveolar nerve[17]. Akiko Kimura(2006) performed a comparative study to determine the most stable fixation method for maandibular symphysis fractures by comparing the mechanical characterestics of fractures created on a 3-D finite model and fixed at different positions with different no.of plates [18]. Vivek Shetty et al(1995)compared initial mechanical

stability and functional capability of sex contemporary internal fixation system used to fix mandibular angle fractures[19] .Smith (1993) evaluated retrospectively the success rate of rigid fixation used to treat 16 consecutive comminuted fractures of the mandible in 15 patients This Study suggests that rigid fixation of comminuted mandibular fractures is a viable treatment that Satisfies the necessity for reestablishment of form and function with minimal morbidity.[20] Wittenberg M.(1995) in a prospective study evaluated the 3Dplate for fixation of mandibular angle fractures they suggested that it provides adequate fixation for mandibular angle fractures.[21]

Conclusion:

The locking miniplate system incorporates lock principle in their conception & design. The locking miniplate system contributes to simplicity & comfort in their managing, incorporating many of its biomechanics. Locking plate/screw system proved to be more rigid than conventional Plate/ screw system, thereby reducing the need and duration of IMF. Oromandibular reconstruction, although a challenge for the head and neck reconstructive surgeon, is now reliable and highly successful plate system with its advantages of improved handling characterestics ,increased stability, shorter surgical time and preservation of bony perfusion is a viable alternative to conventional miniplates in the management of mandibular fractures .

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