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Reduction of mandible fractures with direct bonding technique and orthodontic appliances: two case reports

CASE REPORT

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Abstract – Intermaxillary fixation (IMF) with the arch bars or looped wires has been widely used to treat mandible fractures. However, manipulation of these appliances takes time and the medical staff is endangered by wire stabbing injuries. A modified method, the direct bonding technique combined with orthodontic appliances, simplifies the IMF concept to overcome these problems. It is faster, safer and easier to apply while the response of patients, with respect to treatment results, ease of the living and oral hygiene is more favorable. This report presents two cases of mandible fractures treated according to this protocol which resulted in good outcomes as expected.

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Mandibular fractures represent the most common type of facial bone fractures. They account for 60–90% of all facial bone fracture cases (1, 2). The common causes have been reported to be traffic accidents, assaults or sometimes underlying pathologies (1–3).

Mandible fractures usually cause malocclusion due to a sudden loss of support from the bony architecture. A correct occlusion is a prerequisite for reduction of bone fragments (4) whether the intervention is performed by closed or open techniques. Most surgeons use intermaxillary fixation (IMF) to secure proper dental alignment and to provide stability to the mobile parts. Currently, Erich arch bars and looped wires are widely used for this purpose (3). The teeth are splinted by wires and approximation between segments can be carried out (3). However, many disadvantages have been noted. For example, complicated wire configurations and difficulty of application in the oral cavity are frequent complaints from practitioners. Moreover, glove perforation, which could put the medical staff at risk, is not uncommon during the manipulation and maintenance of the device (5). In addition, the bulky and sharp features of the device often result in patient discomfort, poor oral hygiene and even wound contamination.

Composite resin and direct bonding systems have been utilized in dentistry for many years (5, 6). These materials provide an aesthetic characteristic as well as physical property, bonding strength, and biocompatibility. The evolution of light-cured resin and direct bonding techniques has enabled clinicians to work in a safe and convenient environment. With the aim of eliminating the aforementioned problems associated with the use of arch bars, an innovation of a splinting method, the direct bonding technique combined with orthodontic appliances, was introduced into maxillofacial trauma treatment. We report two cases of mandible fractures treated successfully by applying this simplified IMF technique.

Materials and methods

This report was accomplished at the Dental Department of E-da hospital, Kaohsiung, Taiwan. Two patients, who suffered from mandibular fractures without significant change of the tooth alignment, for which basically close reduction was indicated, were included in the report.

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The innovation is derived from the existing orthodontic materials and bonding techniques. The composite bonding system and orthodontic attachments are prepared for use (Fig. 1). Before the treatment starts, oral and tooth cleaning are indicated if the patient can tolerate these procedures. Tooth polishing with pumice powder or sandblasting should be avoided to prevent the possibility of wound contamination. The teeth are rinsed and dried with airflow. Then, all the target surfaces are etched with 37% phosphoric acid for 15–30 s. Because bonding primer and composite resin are hydrophobic, moisture control with an angle wider and a powerful suction is crucial during the process of applying the bonding materials. The bonding agent (Ortho Solo, Ormco co., Orange, CA, USA) is applied to teeth surfaces then orthodontic brackets and tubes are bonded to teeth with light-cured composite resin (Enlight, Ormco co., Orange, CA, USA). The brackets function as attachments for practitioners to manipulate the movable parts and to draw the displaced fracture segment back to occlusion with elastics or wires.

Intermaxillary elastic bands are put on these bonding attachments for reduction of the occlusion. The number, location and direction of guiding elastics are given according to the clinician's clinical judgment. Occlusion could be guided gradually by the force of elastic pull. The interarch relationship, such as overbite, overjet, dental and skeletal midline, should be returned to the preinjury position. Then all elastics are substituted with steel wires and resin reinforcements. Although no anesthesia is required and the whole process is quite swift, the clinician should monitor the patient's physical condition because facial injury is a critical episode.

Removal of the whole appliance is similar to the method of removing braces when orthodontic treatment is completed. By using a removal plier, attachments, and resin blocks are squeezed on the tip and the whole appliance can be removed easily. Some resin remnants on the tooth surfaces can be trimmed off with a white stone bur. Professional maintenance is followed to ensure the quality of oral hygiene.

Case 1

A 19-year-old woman suffered from a facial injury during a traffic accident. Clinical inspection revealed intact dental arches but a deviated open bite. Panoramic film showed a left mandibular condylar fracture (Fig. 2). The surgeon decided to perform a close reduction of her occlusion with IMF. Brackets, tubes, and wires were bonded to her teeth by the orthodontist with the aforementioned techniques. The hooked wire was prepared as in normal orthodontic cases (Fig. 3). Her occlusion fitted perfectly when the guiding elastics were put onto the braces. The elastics were replaced immediately by steel wires when her occlusion was assured (Fig. 4). In addition to dental intercuspation, the photographs and statements of the patient's facial appearance were also important references. The whole procedure was quick and no anesthesia was required at the time of application.

Fig. 2. Preoperative panoramic film showed fracture of left condylar neck.

During the period of IMF, the patient could take a liquid diet and maintain oral care with a tooth brush and chlorhexidine solution. The IMF wires were removed after four weeks, but the orthodontic appliance was kept for mouth-opening exercises (Fig. 5). Self-training of the mouth-opening exercise with hand manipulation was taught to achieve jaw function rehabilitation. The appliances were removed by the orthodontist after her jaw motion and position recovered. From the beginning to the end of treatment, her oral hygiene was excellent. She was quite satisfied with the protocol.

Case 2

A 28-year-old woman was sent to the emergency room for a facial injury due to a vehicle collision. A right

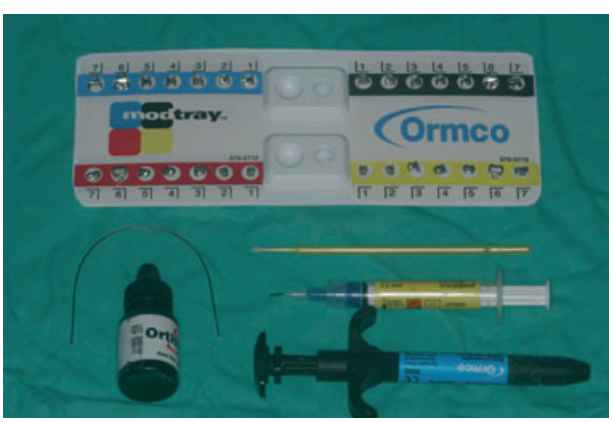

Fig. 1. The materials prepared for direct bonding technique.

Fig. 3. The condylar fracture resulted in anterior open bite. The appliances were already bonded to teeth.

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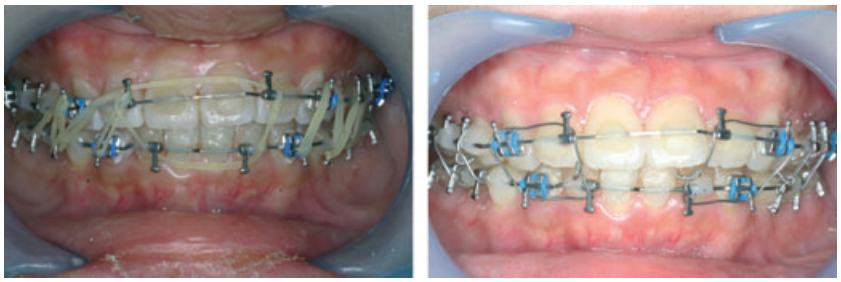

Fig. 4. The patient's occlusion was perfectly reduced by the traction of rubber bands (left). Steel wires replaced elastics for IMF immediately after the intercuspation was assured (right).

mandibular condyle, left parasymphyseal, and body fractures were found on the panoramic film and computerized tomograghy (CT) scan (Fig. 6). The surgeon decided to reduce her occlusion with IMF first, so the brackets were bonded to her teeth by the orthodontist. Only a few attachments were bonded to her molars and canines and the lower arch wire was inserted into the slots. Maximal intercuspation of the teeth was achieved while the elastics were placed. Simple wires replaced these rubber bands immediately. Composite resin was added onto the upper and lower teeth surfaces to reinforce the IMF (Fig. 7). To achieve anatomic reduction, the surgeon decided to performed surgical intervention to reduce her condyle, the major cause of malocclusion, in the following days. Intermaxillary fixation remained to stabilize the other two fractures, which were steady and displaced minimally, and the close reduction was adopted (Fig. 8). Three weeks later the appliance was removed. Her occlusion, oral hygiene and function were quite good at that time (Fig. 9). A three-month follow-up showed a stable jaw position and satisfying result.

Discussion

Arch bars have long been an important tool for the position and fixation of segments in maxillofacial surgery, including injuries, reconstruction, and orthognathic surgeries. However, there are many shortcomings, such as complicated procedures and discomfort. Orthodontists have used dental appliances for IMF in orthognathic surgery for decades (7, 8). During orthognathic surgery, the combination of hooked wires and brackets are used for IMF. The reason for using orthodontic appliances is that presurgical orthodontic treatment has already begun for dental decompensation, so all those materials have essentially existed in the oral cavity. This highlights the strength and durability of these appliances, which are excellent and can sustain fixation force. This report provides an improved approach by the direct bonding technique combined with simplified orthodontic appliances to achieve reduction of mandible fractures.

Fig. 5. Mouth opening reached 35 mm at 1 month follow-up. The appliances were still kept in the mouth for guiding opening exercise.

Initially we tried to bond a customized wire and brackets as in Case 1. The original thought was to fabricate a wire, acting as an arch bar, which would utilize the bonding technique to replace the interdental wires. However, adept orthodontic skills were needed to bend wires and solder hooks precisely. Later we found that the mandible body and dentoalveolar structure were intact in many cases of mandibular condyle fractures. Therefore, it was not necessary to put on complicated appliances or arch bars in this situation. Since the bonding system is reliable, orthodontic brackets and tubes that bonded to only a few strategical teeth were good enough to be anchors for IMF. Therefore, we placed two attachments for each quadrant of dentition to act as handles for the movement of the jaw. Simple splinting wires were placed as a interarch sling in Case 2. Composite resin was applied to the labial surface of the upper and lower teeth to hold the jaw in position. In the other words, these resin blocks act as realistic IMF. Theoretically the fixation force on the sustaining teeth could produce orthodontic teeth movement. However, resin reinforcement between the teeth can prevent this problem.

Baurmash conducted a series of reports on introducing bonded arch bars into the management of maxillomandibular injuries (9). At first he soldered meshes to Erich arch bars to enhance bonding strength, but it took some time to prepare this appliance. Later an invention of a specialized bonding bar became commercially available (9). Sindet-Pedersen and Jensen (10) used a similar method but substituted continuous bracket bars to fit the teeth. Utley put brackets onto each tooth and inserted an arch wire to splint them (11). However, bending a wire to fit perfectly into the slots is very difficult. The consequence of teeth movement is anticipated if the wire is not passive. In this report, we use fewer orthodontic brackets and tubes on molars and canines strategically. The other teeth were cemented to the arch wire or opposing teeth by means of composite

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Fig. 6. Preoperative panoramic film showed the right condyle, left parasymphyseal and body fractures (left). Computerized tomograghy (CT) showed marked displacement of the condyle (Right).

resin. If the doctor is worried about the bonding strength of the orthodontic appliance, the resin could be bonded between the upper and lower teeth directly to reinforce the structure.

Immobilization is the prerequisite requirement for the bone reduction and wound healing (12). Arch bars and looped wires act as a handle for securing mobile segments only by tightening the knots of wires attached to tooth surfaces. Because they can still move up and down and lack absolute stability, surgeons cannot control the position of segments accurately and malocclusion might follow. Since the resin becomes hard after polymerization, the interface between teeth and brackets would not move at all. Therefore, the direct bonding technique provides absolute immobilization of the fracture and bone healing can benefit from the accuracy and stability of the new approach.

The direct bonding technique simplifies the sophisticated wire configuration of previous methods. Each arch bar requires more than ten pieces of interdental wire to keep it in position. The application of wires essentially carries the risk of perforation of gloves and other accidents during interdental wires insertion (13, 14). For those cases with high infection rates like hepatitis, AIDS, etc., the threat to surgical staff may be lethal. Martinez-Gimeno reported that 19.8% of the mandibular fracture patients in their case review were HIV positive (15). The staff faces the danger while they focus on the surgical intervention. The psychological stress to the practitioners is enormous. Bonding resin is the substitution for traditional wires in our method. This not only saves the manipulation time but also enhances safety.

For the patients suffering from facial trauma, the direct bonding technique makes the IMF quicker and more comfortable. The appliance and teeth are bonded with resin adhesives, which is quite similar to common orthodontic treatment in dental clinics. The practitioner can spend less than half an hour to finish the bonding and splinting procedure (16). The removal is also simple in that it requires only squeezing of the resin block or brackets with dental pliers. Neither placement nor removal of the device requires anesthesia. Because there are no interdental wires, the appliance is simplified and significantly smaller. Its compact figure also prevents soft tissue from irritation and stabbing by the sharp edges. The patients adopted it well immediately after placement and seldom complained of a foreign body sensation in the mouth.

Poor oral hygiene associated with conventional arch bar and wiring concerns both doctors and patients (12). These appliances are placed on top of the gingival margin, where food debris and plaque tends to accumulate most easily. Food debris and dental plaque get stuck underneath the sophisticated wire and it becomes very difficult to maintain oral hygiene after meal. The incidence of caries, periodontal problems and oral wound infections rises. The direct bonding technique diminishes the need for interdental wires and the attachments are located away from the gingival margin, so oral hygiene is greatly improved compared to traditional methods.

As all the procedures are similar to orthodontic treatments in dental clinics, the patient's consciousness could remain clear throughout the whole procedure. Because the interdental wires, which cause soft tissue

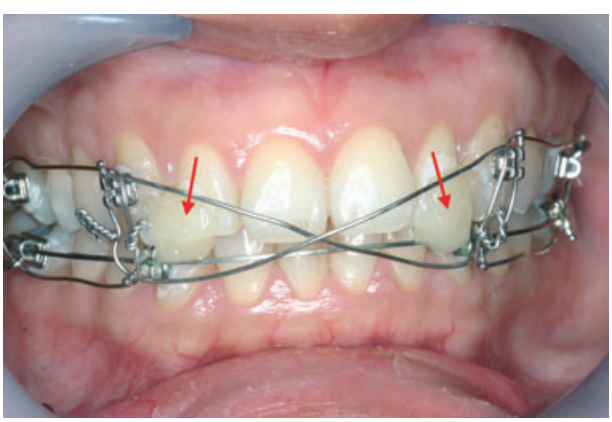

Fig. 7. IMF was finished with steel wires. Note the small resin blocks between upper and lower teeth (red arrows) to prevent unwanted teeth movement and provide reinforcement of the IMF.

Fig. 8. After surgical intervention, her right condyle was corrected with a resorbable plate. The other fracture sites were secured with IMF.

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Fig. 9. The occlusion was good while the appliance was removed.

impingement very often, are eliminated, no anesthesia is required for pain relief or emotional control in contrast to the use of conventional arch bars. This distinguishing feature is very useful to the cases for which close reduction is indicated. The patient joins in the procedure actively and the doctor can talk to the patient; therefore, the anxiety and psychosocial stress to the patient and family are reduced. Doctors can get the information about the original occlusion and profile from the statements of the patient in real time. If the treatment is performed in an operating room and under general anesthesia, the occlusal relationship is restored only from surgeons' experience and extrapolation. With this new method, the patient can double-check the condition at any time and ensure the correct result. This mechanism diminishes the probability of error in reconstruction and associated legal sequelae.

Some limitations of the direct bonding technique in traumatic cases were noticed. Although the bonding strength is well proved, it plummets immediately if saliva or blood invades the operative field. Thus the drying and isolation procedures are crucial because both composite resin and bonding agent are hydrophobic (17). Although allergic reactions to composite resins and their ingredients are rare, the dentist should be aware of the possibility and be vigilant in observing any adverse reactions after the resin placement (18). The number, position, surface condition and remaining structure of teeth are factors to influence manipulation. If the patient has lost most of their teeth, fixation via dentition may not be carried out. This approach is recommended only for the cases that still have most of their teeth distributed over all quadrants. Although the bonding strength is excellent when the composite resin touches enamel, it declines remarkably if the surface is dentin. Unfortunately, the patients of facial trauma often suffer from dental fractures at the same time. Consequently these appliances have to be fixed onto compromised teeth. Some patients have restored teeth, like porcelain and metal crowns, which would also make bonding strength slump significantly. Surface treatment prior to bonding procedures, like deglazing and use of a saline coupling agent, is suggested to overcome these problems (19).

Updated dental bonding technology, combined with orthodontic appliances, helps practitioners to treat traumatic cases. The direct-bonded orthodontic appliances could be considered as a guiding tool, while the composite resin acts as the fixation media, to replace conventional arch bars and looped wires. Treatment complexity and infection risk were reduced while oral hygiene and intensity of discomfort for patients were significantly improved. Although this report was limited to cases of mandible fractures, the method could also be used for other kinds of maxillofacial fractures. Further studies are required to examine the strategies and application of this new approach.

Conclusion

A new method, the direct bonding technique with orthodontic appliances as demonstrated, was described for the reduction of mandibular condyle fracture cases in this report. The optimistic outcome was as expected for this new method. It avoids the necessity of interdental wires insertion in conventional ways. Therefore, the practitioner can benefit from the elimination of difficulties, time consumption and penetration risk. It also reduces discomfort and stress on the patient and oral hygiene is greatly improved compared with arch bars or looped wires. It is a simplified, safe and swift method for the management of maxillomandibular injuries.

References

1. Haug RH, Prather J, Indresano T. An epidemiologic survey of facial fractures and concomitant injuries. J Oral Maxillofac Surg 1990;48:926–32.
2. Aksoy E, Unlu E, Sensoz O. A retrospective study on epidemiology and treatment of maxillofacial fractures. J Craniofac Surg 2002;13:772–5.
3. Barber HD, Bahram R, Woodbury SC, Silverstein KE, Fonseca RJ. Mandibular fractures. In: Fonseca RJ, Walker RV, Betts NJ, Barber HD, Powers MP, editors. Oral and maxillofacial trauma. St. Louis, MO: Elsevier; 2005. p. 479–522.
4. Kugel G, Ferrari M. The science of bonding: from first to sixth generation. J Am Dent Assoc 2000;131(Suppl.):20S–5S.
5. Godin MS, Lavernia CJ, Harris JP. Occult surgical glove perforations in otolaryngology-head and neck surgery. Arch Otolaryngol Head Neck Surg 1991;117:910–3.
6. Retief DH, Dreyer CJ, Gavron G. The direct bonding of orthodontic attachments to teeth by means of an epoxy resin adhesive. Am J Orthod 1970;58:21–40.
7. Fedok FG, Van Kooten DW, DeJoseph LM, McGinn J, Sobota B, Levin RJ et al. Plating techniques and plate orientation in repair of mandibular angle fractures: an *in vitro* study. Laryngoscope 1998;108:1218–24.
8. Hoyle BA. Orthodontic hardware for oral surgeons. Br J Oral Maxillofac Surg 1985;23:404–9.
9. Baurmash H, Farr D, Baurmash M. Direct bonding of arch bars in the management of maxillofacial injuries. J Oral Maxillofac Surgery 1988;46:813.
10. Sindet-Pedersen S, Jensen J. Intermaxilllary fixation of mandibular fractures with the bracket archbar. J Craniomaxillofac Surg 1990;18:297–8.
11. Utley DS, Utley JD, Koch RJ, Goode RL. Direct bonded orthodontic brackets for maxillomandibular fixation. Laryngoscope 1998;108:1338–45.
12. Oikarinen K. Clinical management of injuries to the maxilla, mandible, and alveolus. Dent Clin North Am 1995;39:113–31.

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13. Gaujac C, Ceccheti MM, Yonezaki F, Garcia IR Jr, Peres MP. Comparative analysis of 2 techniques of double-gloving protection during arch bar placement for intermaxillary fixation. J Oral Maxillofac Surg 2007;65:1922–5.
14. Pieper S, Schimmele S, Johnson J, Harper J. A prospective study of the efficacy of various gloving techniques in the application of Erich arch bars. J Oral Maxillofac Surg 1995;53:1174–6.
15. Martinez-Gimeno C, Acero-Sanz J, Martin-Sastre R, Navarro-Vila C. Maxillofacial trauma: influence of HIV infection. J Craniomaxillofac Surg 1992;20:297–302.
16. David LR, Bisseck M, Defranzo A, Marks M, Molnar J, Argenta LC. Cost-based analysis of the treatment of mandibular fractures in a tertiary care center. J Trauma 2003;55: 514–7.
17. Hajrassie MK, Khier SE. *In-vivo* and *in-vitro* comparison of bond strengths of orthodontic brackets bonded to enamel and debonded at various times. Am J Orthod Dentofacial Orthop 2007;131:384–90.
18. Fan PL, Meyer DM. FDI report on adverse reactions to resin-based materials. Int Dent J 2007;57:9–12.
19. Ajlouni R, Bishara SE, Oonsombat C, Soliman M, Laffoon J. The effect of porcelain surface conditioning on bonding orthodontic brackets. Angle Orthod 2005;75:858–64.

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