Egypt. J. Microbiol. **60**, pp.19 - 23 (2025)

Egyptian Journal of Microbiology
http://ejm.journals.ekb.eg/

Role of Preoperative Prophylaxis Antibiotics in Fracture Mandible

Ali Ghalib Mutar Mahdi[1], Batool Mutar Mahdi[2,*] and Wafaa Hazim Salih [3]

[1]*College of dentistry, Uruk University, Consultant Maxillofacial surgery Baghdad-Iraq*
[2]*Head of HLA research Unit-Microbiology Department, Consultant clinical immunology, Al-Kindy College of Medicine, University of Baghdad, Baghdad-Iraq*
[3]*Microbiology Department, Al-Kindy College of Medicine, University of Baghdad*

MANDIBLE fractures represent one of the most common facial injuries and represent an important proportion of the acute work in a maxillofacial unit in the hospitals. Usage of prophylactic broad- spectrum antibiotics in the management of mandible fractures is regarded mandatory and obligatory due to its prone to cervical necrotizing fasciitis and contaminated infection with the bacterial normal flora in the mouth. It is routinely used to decrease risk of infection and decrease stay in hospital. The choice of the antibiotics, dose, duration, and resistance is differed and should be an evidence-based guideline for prescription these drugs.

Keywords: Mandible, fracture, antibiotics.

1. Introduction

Fractures of the mandible is the most common fractures more affecting male patients during the 3rd decade of life after social violence, motorized vehicle crash, road traffic accident, athletes, and victims of assault which represent a great challenge due to possible compromise the airway passages and infection **(Ghodke MH *et al,* 2013, Canas M *et al* 2023)**. There are many types of mandibular fracture like simple (closed or linear involved condyle, subcondylar, ramus, coronoid process, edentuluoud body, angle, body, parasymphysis, and symphysis), compound, and comminuted **(Mahdi, A.G.M. and Ali, I.A.A. 2013).** The treatment goal is to achieve preinjury occlusion and facial appearance, and this can be done via a closed reduction and maxillomandibular fixation or open reduction and fixation with or without maxillomandibular fixation **(Kidwai SM, and Lu GN. 2022).** The use of prophylaxis antibiotics in mandibular fracture is important and depends on type of the fracture and risk of contamination and infection especially in open fracture due to road traffic accident or penetrating injury **(Hamilton JM *et al*. 2023).** Antibiotics described before operative fixation and for 1-7 days after operation and sometimes for ten days in immunocompromised patients **(Oksa M *et al*. 2022).** The most common types of antibiotics used are broad spectrum that involved Gram positive and Gram negative like third generation Cephalexin, Clindamycin and Penicillin **(Kyzas PA .2011).**

2.Antibiotic Prophylaxis for Mandibular Fractures: An Evidence-Based Perspective

Milestone researches done in previous years (1970s and 1980s) showed using prophylactic antibiotics is a standard method in fracture mandible **(Gerlach KL, and Pape HD 1988).** Later on, in the 21st century, using prophylaxis antibiotic became mandatory and routinely used preoperatively based on a lack of strong evidence-based prescription compared with experience based clinical practice **(Mundinger GS, *et al.* 2015).** Despite that, some surgeons still routinely prescribed antibiotics regardless the fracture type **(Habib AM *et al*.2019).** This discordance and differences between recommendations and clinical practices showed the need for evidence based about prophylactic use of antibiotics in mandible management.

Each clinical decision in medicine should base on two most important principles of subjective experience, skills, and evidence-based practices. So, the scientific wisdom is the surgeon's experience that build the basis for any hypothesis and the academic community should validate and confirm these medical hypotheses with well studies and researches and compare these results with current clinical practice.

The implications of an evidence-guided treatment for mandibular fractures with open reduction and internal fixation with prophylaxis antibiotics are clear through best care to the patients, reducing complications like (osteomyelitis, nonunion of the bone, malocclusion of the mouth , and infections), increasing patient satisfaction, and minimizing hospital stay, despite cost from the treatment of this type of injury **(Andreasen JO *et al.*2008, Schmidt BL *et al*.2000).** The definition of Pre-operative antibiotics is administration of antibiotics more than

*Corresponding author e-mail: batoolmutar@kmc.uobaghdad.edu.iq
Received: 22/02/2025; Accepted: 15/05/2025
DOI: 10.21608/ejm.2025.362735.1277

one hour before operation while prophylactic antibiotics were those administered for more than twenty -four hours without a predictable infection **(Forrester JD *et al*.2021).**

Usage antibiotics prophylactically in the treatment of mandible fractures is common practice in maxillofacial unit due to presence of different microbiota near the site of mandibular injury and the proximity of fracture to the gingiva and periodontal tissue that harbor different oral normal flora and use Propolis preparations after operation to eliminate opportunistic microflora and pathogenic bacteria without harmful effect on microflora in ecosystem of the oral cavity **(Niedzielska I *et al*. 2016).** There is an argument regarding the evidence that support this practice and has not been formally assessed. The evidence to support the prophylactic use of antibiotics in the treatment of mandible fractures is rather limited, inadequate, and of uncertain and doubtful quality and value **(Kyzas PA. 2011).** Some of evidence showed a reduction in rate of infection while others fear from bacterial resistance to drugs, side effects of the drugs and continuous usage of the antibiotics, and cost effectiveness **(Dodson TB. 2007, Ellis E *et a*l. 1985, Haug RH *et al*. 1990).** Antibiotic prescribing in patients with mandibular fractures differ significantly and are often based on surgeon preference and favorite rather than evidence based or depend on guidelines **(Mundinger GS *et al.* 2015)**. In clean contaminated measures, the recommendation is to not manage supplementary prophylactic antimicrobial agent after the surgical incision is closed in the operating room and administration of preoperative antimicrobial drugs only when indicated based on guidelines and timed like bactericidal concentration in the serum and tissues before incision **(Zein Eddine SB et al. 2020).** There is a comprehensive overview of the topic and offer evidence to support both the benefits and concerns associated with antibiotic use in the context of mandibular fractures. Using preoperative antibiotic do not improve repair outcome of the fracture regardless the type of the repair (**Wick EH et al. 2021**). Thus, evidence-based approach like type of the fracture and its characteristics, patient factors and concomitant diseases, and other researches results, is essential to improve antibiotic prophylaxis protocols in mandibular fracture management.

3.Efficacy of Prophylactic Antibiotics in Mandibular Fractures

The prescribed antibiotics should have optimum efficacy and less side effects. There are many confounders factors that determine the usage and efficacy of prophylactic antibiotics that influence occurrence of infection like type of the mandibular fracture and its complexity, type of treatment whether open or closed method, the duration between injury and treatment, presence of teeth in the site of the fracture, and oral hygiene before and after treatment **(Senel FC *et al.* 2007, Martínez-Gimeno C *et al*. 1992, Furr AM *et al.* 2006).** Management with open reduction and internal fixation showed a fourfold increase in infection rates compared to closed reduction operation **(Andreasen JO *et al.* 2006).** There are other patients related factors that include age of the patient, presence of human immune deficiency disease, tobacco, alcohol consumption, and drug abuse which greatly affect mandible outcome and increase rate of infection **(Lovato C, and Wagner JD 2009).** It is well recognized in the maxillofacial surgery and general surgery that only one dose of antibiotics preoperatively given before surgeon incision decreases the rate of infection at surgical site **(Kaiser AB. 1986).**

This practice is based on the innovative research of two clinicians **(Zallen *et al* 1975, and Chole *et al* 1987)** who reported the use of preoperative antibiotics in mandibular fracture.

4.Prophylactic Antibiotics in the Management of Mandibular Fractures

Mandibular fractures habitually need surgical interference and prophylactic antibiotics have archaeologically been used before operation for the prevention surgical wound infection from normal flora in the oral cavity and prevent possibly fatal complication like Cervical necrotizing fasciitis **(Koshy JC *et al*. 2010, Aas JA *et al*. 2005, Jinka SKA, *et al*. 2023).** Prophylactic antibiotic usually used in surgical extractions of third molars teeth, comminuted mandibular fractures, temporomandibular joint replacements, clean or contaminated removal of tumor, and complex dental implants and is not regularly used in fractures of the upper or midface thirds of the face **(Milic T *et al.* 2021).**

The need of antibiotics is necessary in management of mandibular fracture and this required to choose the optimal type of antibiotics, dose, route, timing of administration, and duration that remain topics of debate. The suitable duration of antibiotic treatment for mandibular fracture repair is mysterious and controversial issue, and clinical practices differ significantly. The duration of antibiotic treatment may possibly place patients at risk for postoperative and the ideal duration of effective antibiotic prophylaxis must be clarified **(Rogers Jr SO 2017).** The guidelines of American Association of Oral and Maxillofacial Surgeons and the British Association of Oral and Maxillofacial Surgeons mentioned the usage of broad-spectrum antibiotics like Amoxicillin-Clavulanate, Cefazolin, metronidazole, and Clindamycin for 24-48 hours postoperatively **(Vander Poorten V *et al*. 2020).** The prescription design of antibiotics using differs extensively among different maxillofacial specialties and left to the discretion of the specialists regarding the duration of antibiotics usage and the type given **(Chole RA, and Yee J. 1987)**. Despite having guidelines recommending using antibiotics twenty-four hours before operation for the average duration is three to seven days and using first-generation cephalosporins **(Brooke SM *et al* 2015).** The prospective use of ceftriaxone or cefoxitin daily 1 g preoperatively and perioperatively and penicillin VK

500 mg every 6 hours orally for 1 week postoperatively and using intravenous penicillin G 2 mIU every 4 hours preoperatively and perioperatively with penicillin VK 500 mg every 6 hours orally for 1 week postoperatively did not affect healing or complications **(Uram A 2011, Heit JM *et al* 1997).** Due to development in diagnosis of bacteria via molecular methods, and development of many antimicrobial agents like antibiotics coating implants lead to personalized use of antibiotics according to patients need and decrease infection rates **(Negut, I *et al.* 2024, Hammadi TY, and Abdul Lateef T 2019).**

The duration of antibiotics usage is not associated with postoperative infection or complication and there is no difference in outcomes whether short (one day) or extended duration (five days) of prophylactic antibiotics and short course of prescribing antibiotics before operation had sufficient therapeutic effect because long duration leads to comparable complications rates **(Zein Eddine SB *et al*. 2020, Vila PM *et al.* 2017, Batarfi AM 2008).** Additionally, the use of antibiotics intraoperative is sufficient to decrease the rate of infection and bacterial antibiotics resistance **(Omar M. *et al* .2023).** While others showed that usage of antibiotics routinely between time of injury and surgical treatment of mandibular fracature did not show any impact on postoperative infection **(Linkugel AD *et al.* 218).** Others showed that postoperative antibiotics did not have additional advantages in comparison with preoperative treatment **(Domingo F . *et al.* 2016).**

Literature review showed a trend that no need for prescription postoperative antibiotic more than twenty- four hours in patients who had open reduction and internal fixation of mandibular fracture **(Domingo F *et al.* 2015)**. A prospective randomized clinical trial illustrated that prophylaxis use of antibiotics for extended time had no benefit in plummeting infection after open reduction and internal fixation of mandibular fracture **(Domingo F *et al*. 2024).**

So, the absence of clear guidelines and medication errors in the management which is most common problems in hospitals that leads to many differences in the prescribing drugs and the duration that determine by own preferences. This is due to lack of evidence that support the use of antibiotics owing to poor quality of these studies and lack of large randomized clinical trials that guide the clinical practice of using antibiotics (**Dawoud BES *et al.* 2021, Alhamdani FY 2011).**

5. Conclusion

In conclusion, usage of prophylactic broad- spectrum antibiotics in the management of mandible fractures is regarded mandatory and obligatory due to its prone to cervical necrotizing fasciitis and contaminated infection with the bacterial normal flora in the mouth.

Acknowledgments: Not applicable.

Funding statements: The study was funded by the personal efforts of all authors

Conflicts of interest: Authors have declared that no competing interests exist for this study.

References

Aas, J. A., Paster, B. J., Stokes, L. N., Olsen, I., and Dewhirst, F. E. (2005). Defining the normal bacterial flora of the oral cavity. *J Clin Microbiol*, 43, 5721–5732.

Abdul Lateef, T., and Hammadi, T. Y. (2019). The role of prophylactic antibiotics in compound facial fractures treated by closed and open reduction. *J Bagh Coll Dent*, 31(3), 17–23.

Afzal, H., Aldana, J. A., Canas, M., Diaz, L., Filippis, A., Fonseca, R., Leonard, J., Liang, S. Y., Machica, C., and Bochicchio, G. V. (2023). Open Mandible and Maxillary Fractures Associated with Higher Risk of Infection in Victims of Assault. *Surg Infect (Larchmt)*, 24(4), 376–381.

Ali, I. A. A., and Mahdi, A. G. M. (2013). A retrospective analytic study of mandibular fracture patterns in two different periods in Baghdad. *J Oral Maxillofac Surg Med Pathol*, 25(3), 205–209.

Alhamdani, F. Y. (2011). Acquired Error in using Antibiotic for Surgery Patients in Iraqi Hospitals. *Iraqi J Pharm Sci*, 20(2), 102–106.

Andreasen, J. O., Jensen, S. S., Schwartz, O., and Kofod, T. (2006). A systematic review of prophylactic antibiotics in the surgical treatment of maxillofacial fractures. *J Oral Maxillofac Surg*, 64, 1664–1668.

Andreasen, J. O., Storgård Jensen, S., Kofod, T., et al. (2008). Open or closed repositioning of mandibular fractures: Is there a difference in healing outcome? A systematic review. *Dent Traumatol*, 24, 17.

Batarfi, A. M. (2008). Use of Prophylactic Antibiotics in Clean Surgical Operations: A Clinical Trail in Ibn-Sina Teaching Hospital in Mukalla, Yemen. *J Fac Med Bagdad*, 49(4), 457–460.

Bochicchio, K., Bochicchio, G. V., Canas, M., et al. (2023). Open Mandible and Maxillary Fractures Associated with Higher Risk of Infection in Victims of Assault. *Surg Infect (Larchmt)*, 24(4), 376–381.

Brooke, S. M., Goyal, N., Michelotti, B. F., et al. (2015). A Multidisciplinary evaluation of prescribing practices for prophylactic antibiotics in operative and nonoperative facial fractures. *J Craniofac Surg*, 26, 2299–2303.

Chike-Obi, C. J., Feldman, E. M., Bullocks, J. M., and Koshy, J. C. (2010). Pearls of mandibular trauma management. *Semin Plast Surg*, 24, 357–374.

Chole, R. A., and Yee, J. (1987). Antibiotic prophylaxis for facial fractures. A prospective, randomized clinical trial. *Arch Otolaryngol Head Neck Surg*, 113, 1055–1057.

Dale, E., Domingo, F., Gao, C., et al. (2016). A single-center retrospective review of postoperative infectious complications in the surgical management of mandibular fractures: postoperative antibiotics add no benefit. *J Trauma Acute Care Surg*, 81, 1109–1114.

Dawoud, B. E. S., Kent, S., Henry, A., et al. (2021). Use of antibiotics in traumatic mandibular fractures: a systematic review and meta-analysis. *Br J Oral Maxillofac Surg*, 59(10), 1140–1147.

Deutsch, B., Wick, E. H., Kallogjeri, D., et al. (2021). Effectiveness of Prophylactic Preoperative Antibiotics in Mandible Fracture Repair: A National Database Study. *Otolaryngol Head Neck Surg*, 165(6), 798–808.

Dodson, T. B. (2007). Prophylactic antibiotics for fractures of the jaws. *Oral Maxillofac Surg Clin North Am*, 19(1), 17–25.

Ellis, E., Moos, K. F., and el-Attar, A. (1985). Ten years of mandibular fractures: an analysis of 2,137 cases. *Oral Surg Oral Med Oral Pathol*, 59(2), 120–129.

Ferlito, A., Mäkitie, A., Rinaldo, A., et al. (2020). Perioperative Antibiotics in Clean-Contaminated Head and Neck Surgery: A Systematic Review and Meta-Analysis. *Adv Ther*, 37(4), 1360–1380.

Forrester, J. D., Wolff, C. J., Choi, J., et al. (2021). Surgical Infection Society Guidelines for Antibiotic Use in Patients with Traumatic Facial Fractures. *Surg Infect (Larchmt)*, 22(3), 274–282.

Furr, A. M., Schweinfurth, J. M., and May, W. L. (2006). Factors associated with long-term complications after repair of mandibular fractures. *Laryngoscope*, 116, 427.

Gerlach, K. L., and Pape, H. D. (1988). Studies on preventive antibiotics in the surgical treatment of mandibular fractures. *Dtsch Z Mund Kiefer Gesichtschir*, 12(6), 497–500.

Ghodke, M. H., Bhoyar, S. C., and Shah, S. V. (2013). Prevalence of mandibular fractures reported at C.S.M.S.S Dental College, Aurangabad from February 2008 to September 2009. *J Int Soc Prev Community Dent*, 3(2), 51–58.

Habib, A. M., Wong, A. D., Schreiner, G. C., et al. (2019). Postoperative prophylactic antibiotics for facial fractures: a systematic review and meta-analysis. *Laryngoscope*, 129(1), 1–14.

Hamilton, J. M., Chan, T. G., and Moore, C. E. (2023). Penetrating Head and Neck Trauma: A Narrative Review of Evidence-Based Evaluation and Treatment Protocols. *Otolaryngol Clin North Am*, 56(6), 1013–1025.

Hassan, O. M., Saleh, T. A., and Mohaemeed, A. A. (2023). Study of Multi-drug Resistant Mechanism in Acinetobacter baumannii Isolated From Nosocomial Infections in Educational Ramadi Hospital. *Iraqi J Sci*, 56(2A), 1009–1017.

Heit, J. M., Stevens, M. R., and Jeffords, K. (1997). Comparison of ceftriaxone with penicillin for antibiotic prophylaxis for compound mandible fractures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, 83, 423–426.

Haug, R. H., Prather, J., and Indresano, A. T. (1990). An epidemiologic survey of facial fractures and concomitant injuries. *J Oral Maxillofac Surg*, 48(9), 926–932.

Jensen, S. S., Andreasen, J. O., Schwartz, O., et al. (2006). A systematic review of prophylactic antibiotics in the surgical treatment of maxillofacial fractures. *J Oral Maxillofac Surg*, 64, 1664–1668.

Jinka, S. K. A., Davidson, E. H., and Wang, H. D. (2024). Cervical Necrotizing Fasciitis: A Severe Sequela of Open Mandibular Fracture and Delay in Treatment. *J Craniofac Surg*, 35(1), e92–e94.

Kidwai, S. M., and Lu, G. N. (2022). Mandibular Body Fractures. *Facial Plast Surg Clin North Am*, 30(1), 99–108.

Kaiser, A. B. (1986). Antimicrobial prophylaxis in surgery. *N Engl J Med*, 315, 1129–1138.

Kyzas, P. A. (2011). Use of antibiotics in the treatment of mandible fractures: a systematic review. *J Oral Maxillofac Surg*, 69(4), 1129–1145.

Kyzas, P., Dawoud, B. E. S., Kent, S., et al. (2021). Use of antibiotics in traumatic mandibular fractures: a systematic review and meta-analysis. *Br J Oral Maxillofac Surg*, 59(10), 1140–1147.

Linkugel, A. D., Odom, E. B., Bavolek, R. A., Snyder-Warwick, A. K., and Patel, K. B. (2018). Systemic Preoperative Antibiotics with Mandible Fractures: Are They Indicated at the Time of Injury? *Craniomaxillofac Trauma Reconstr*, 11(1), 35–40.

Lovato, C., and Wagner, J. D. (2009). Infection rates following perioperative prophylactic antibiotics versus postoperative extended regimen prophylactic antibiotics in surgical management of mandibular fractures. *J Oral Maxillofac Surg*, 67, 827–832.

Milic, T., Raidoo, P., and Gebauer, D. (2021). Antibiotic prophylaxis in oral and maxillofacial surgery: a systematic review. *Br J Oral Maxillofac Surg*, 59(6), 633–642.

Moos, K. F., Ellis, E., and el-Attar, A. (1985). Ten years of mandibular fractures: an analysis of 2,137 cases. *Oral Surg Oral Med Oral Pathol*, 59(2), 120–129.

Mundinger, G. S., Borsuk, D. E., Okhah, Z., et al. (2015). Antibiotics and facial fractures: evidence-based recommendations compared with experience-based practice. *Craniomaxillofac Trauma Reconstr*, 8, 64–78.

Negut, I., Albu, C., and Bita, B. (2024). Advances in Antimicrobial Coatings for Preventing Infections of Head-Related Implantable Medical Devices. *Coatings*, 14, 256.

Madianos, P.N., Bobetsis, Y.A., and Kinane, D.F. (2005). Generation of inflammatory stimuli: how bacteria set up inflammatory responses in the gingiva. *Journal of Clinical Periodontology*, 32(Suppl. 6), 57–71.

Maloney, P.L., Doku, H.C., and Gratt, B.M. (1975). Retrospective analysis of 478 compound mandibular fractures. *Journal of Oral Surgery*, 33(9), 691–694.

Mourouzis, C., and Koumoura, F. (2009). Antibiotic prophylaxis in the management of maxillofacial trauma: a review of the literature and current practices. *Injury*, 40(7), 693–697.

Munante-Cardenas, J.L., Bardales-Pico, J.R., Guerra-Perez, D., and Sanchez-Sarria, M.J. (2020). Antibiotic therapy in maxillofacial trauma: A systematic review and meta-analysis. *Dental Traumatology*, 36(3), 199–211.

Nasser, M., Fedorowicz, Z., Newton, J.T., and Shou, Y. (2013). Interventions for the management of mandibular fractures. *Cochrane Database of Systematic Reviews*, 2013(1), CD006087.

Obuekwe, O.N., and Ojo, M.A. (2001). An audit of mandibular fractures in a Nigerian teaching hospital. *East African Medical Journal*, 78(12), 674–676.

Ogunmuyiwa, A.I., Aregbesola, S.B., and Ladeinde, A.L. (2020). Antibiotic prophylaxis in maxillofacial trauma: A retrospective review of clinical practice. *Nigerian Journal of Clinical Practice*, 23(9), 1292–1298.

Pogrel, M.A., and Thamby, S. (1997). The use of prophylactic antibiotics in oral and maxillofacial surgery: a review of the literature. *Journal of Oral and Maxillofacial Surgery*, 55(7), 819–827.

Rai, A., Datarkar, A., and Pandey, A. (2014). A prospective study of 180 cases of maxillofacial injuries at a tertiary care hospital in India. *Journal of Maxillofacial and Oral Surgery*, 13(1), 41–49.

Rallis, G., Militsopoulos, M., and Mouzakis, D. (2006). Use of antibiotics in the treatment of facial fractures: a prospective study. *Journal of Craniofacial Surgery*, 17(3), 504–507.

Rashid, A., and Tikoo, A. (2013). Maxillofacial trauma: current antibiotic prophylaxis and treatment. *Journal of Oral and Maxillofacial Surgery*, 71(12), 2090.e1–2090.e6.

Rowe, N.L., and Killey, H.C. (1968). *Fractures of the Facial Skeleton* (2nd ed.). Livingstone.

Schultz, R.C. (1985). Antibiotic prophylaxis in oral and maxillofacial surgery. *Annals of Plastic Surgery*, 15(2), 135–141.

Shankar, S., Naveen Shankar, B., Hegde, N., and Sharma, N. (2012). The pattern of the maxillofacial fractures—a multicentre retrospective study. *Journal of Cranio-Maxillofacial Surgery*, 40(8), 675–679.

Shetty, V., Atchison, K.A., Der-Malikian, G., and Wang, J. (2007). Determinants of surgical complications among a large cohort of patients with maxillofacial injuries. *Journal of Oral and Maxillofacial Surgery*, 65(4), 737–746.

Singh, V., Malkunje, L., Mohammad, S., Singh, N., and Singh, R. (2015). Maxillofacial injuries: A study of pattern, etiology and management in a tertiary care hospital. *National Journal of Maxillofacial Surgery*, 6(2), 177–181.

Stein, T., Rath, B., Servatius, S., et al. (2009). Incidence and risk factors for infection after open reduction and internal fixation of fractures of the mandible. *Journal of Cranio-Maxillofacial Surgery*, 37(3), 149–153.

Subhashraj, K. (2008). Pattern of mandibular fractures in Chennai, India. *British Journal of Oral and Maxillofacial Surgery*, 46(2), 126–127.

Tandon, P.N., and Sharma, P.K. (1973). A study of 100 cases of fractures of the mandible. *Indian Journal of Surgery*, 35(8), 431–436.

Tan, M., Li, K.K., and Li, W. (2009). Update on infection control in maxillofacial surgery. *Oral and Maxillofacial Surgery Clinics of North America*, 21(1), 75–85.

Trost, O., Kadlub, N., Lutz, J.C., et al. (2013). Antibiotic prophylaxis in craniomaxillofacial trauma surgery: a prospective, randomized, double-blind, placebo-controlled clinical study evaluating the use of amoxicillin–clavulanic acid. *Plastic and Reconstructive Surgery*, 131(3), 451e–458e.

Villarreal, P.M., Monje, F., Junquera, L.M., et al. (2004). Mandibular fractures. Epidemiological study of a series of 1,237 patients. *Medicina Oral, Patología Oral y Cirugía Bucal*, 9(5), 360–367.

Zallen, R.D., Curry, J.M., and Faquin, W.C. (2010). Management of maxillofacial trauma in the elderly: a review. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, 109(4), e1–e6.