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The Role of Antibiotic Therapy in the Management of Facial Fractures: A Systematic Review

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ABSTRACT

Purpose: The administration of prophylactic doses of antibiotics is a standard procedure in the treatment of maxillofacial fractures. Maxillofacial fractures occur most frequently, and antibiotic therapy is often overused before and after surgery. Despite numerous studies, there are still no clear-cut treatment regimens. The present study aimed to empirically evaluate this aspect.

Materials and methods: The authors conducted an extensive review of articles available in PubMed, Google Scholar, UpToDate, Science Direct, and Cochrane databases. The keywords mandibular fractures, maxillary fractures, antibiotic prophylaxis, antibacterial agents, postoperative antibiotic prophylaxis, mandible fracture; antibiotics, open reduction, internal fixation. Studies published between 1970 and 2021 were included in the review.

Results: Adding postoperative antibiotic prophylaxis to the standard preoperative and/or perioperative antibiotic regimens showed no significant reduction in the risk of surgical site infections. Similarly, no difference was observed in infection risk when the analysis focused specifically on mandibular fractures or procedures involving open surgical techniques. We should also take into account the patient's general diseases that increase the risk of infection. The situation in which prophylaxis unequivocally needs to be applied is the connection of the fracture gap with the oral cavity (open fractures) or sinuses.

Conclusion: The evidence for prophylactic antibiotic use in maxillofacial fractures is weak and inconsistent, with no clear recommendations on type, dose, or duration. Each treatment should be individualized and tailored to the particular clinical case. Particular attention should be paid to the patient's medical condition, comorbidities, and the type and extent of the injury. Routine antibiotic therapy in patients belonging to the low-risk group carries negative consequences, such as the development of antibiotic-positivity.

Keywords: Mandibular fractures, maxillary fractures, antibiotic prophylaxis, antibacterial agents, postoperative antibiotic prophylaxis, mandible fracture; antibiotics, open reduction, internal fixation.

INTRODUCTION

Maxillofacial surgery primarily focuses on treating fractures of the facial skeleton. Many cases arise from accidents, assaults, or other traumatic injuries and often require surgical intervention. The mandible is the most commonly affected area in these fractures. (1, 2). Maxillofacial trauma is associated with a high risk of infection due to its anatomical proximity to the oral cavity, sinuses, and skin. In cases of acute or chronic sinusitis or impaired sinus drainage, patients with traumatic fractures of the maxillary, orbital, ethmoid, and frontal sinuses may face an elevated risk of infection and subsequent complications (3,4).

Additionally, dental fractures that communicate with the oral cavity and its microbial flora, as well as open fractures exposed to the skin, are significantly more susceptible to infection, potentially complicating fracture healing and repair (5,6,7,8).

Lastly, open reduction and internal fixation (ORIF) procedures carry up to a fourfold higher risk of infection compared to closed reduction techniques. (9,10).

To mitigate this risk, preventive and therapeutic antibiotic treatments are routinely used. The risk of infection in fractures is greatly influenced by the presence of comorbidities, including disorders affecting various body systems. (11, 12, 13).

The type of antibiotic, the duration of treatment, and the necessity of their use in certain clinical situations are still being researched. Antibiotic prophylaxis for craniofacial fractures is still a practice, research is still ongoing on the necessity of its use, and there is much discussion as to whether it is being overused. Overprescription and misuse of antibiotics significantly contribute to the growing problem of antimicrobial resistance, toxicity, allergic reactions, and dangerous

drug interactions (8,14,15), which raises concerns within the medical community. This review critically examines the role of antibiotic therapy in the treatment of craniofacial fractures, to determine appropriate management while minimizing side effects, particularly antibiotic resistance.

MATERIALS & METHODS

For the purpose of conducting the review, studies that best described the analyzed problem were selected from a wide range of research. These studies consisted of a selection of available analyses previously conducted by various researchers worldwide.

The research took into account a wide range of both randomized and non-randomized studies focusing on the application of antibiotic therapy in patients suffering from maxillofacial fractures. To review the literature on the topic of the role of Antibiotic Therapy in the Management of Facial Fractures, outcomes Pubmed, Google Scholar, Science Direct were searched using the following keywords: mandibular fractures, maxillary fractures, antibiotic prophylaxis, antibacterial agents, postoperative antibiotic prophylaxis, mandible fracture; antibiotics, open reduction, internal fixation. Studies published between 1998 and 2021 were included.

RESULTS

The comparative analysis included descriptions of treatments for patients undergoing open reduction and internal fixation (ORIF), which is currently the standard procedure, as well as closed reduction (CR) and intermaxillary fixation (IMF). ORIF has been shown to reduce complications, improve patient satisfaction, and shorten hospital stays (16,17), despite its higher cost (18,19).

Panayiotis A. Kyzas qualified 31 studies the systematic review , nine of them were RCTs and were further analyzed. A total of 954 patients were analyzed in 9 RCTs.

Treatment varied from study to study (ORIF, CR, MMF, or both), but most patients received ORIF. The author highlights two main groups of antibiotics used: penicillins and cephalosporins. However, in 42% of the analyzed studies, the specific type of antibiotic was not mentioned. Nearly half of the studies (15 out of 31, or 48%) did not specify the route of

administration, and the majority (23 out of 31, or 74%) did not provide details on antibiotic dosage.

Despite these gaps in data, the quantitative analysis indicates that postoperative infection rates ranged from 4.5% to 62% in studies where no antibiotics were used. In contrast, studies where antibiotics were administered post-surgery reported infection rates ranging from 1.9% to 29.4%. Based on the analysis, it can be suggested that prophylactic antibiotic therapy has a positive impact on postoperative healing. However, the study does not provide a definitive stance on the routine use of antibiotics. Predictably, penicillins and cephalosporins were the most commonly used antibiotic classes (16).

Dawoud, et al. presented 16 studies involving a total of 3,285 patients, 7 of which were randomized controlled trials (RCTs). The remaining 9 were retrospective studies based on randomization. The analysis highlighted significant differences in factors such as timing, dosage, and duration of treatment. The groups were divided into those who received antibiotic prophylaxis and those who did not. Another division is concerned with the timing of antibiotic administration. However, the findings do not provide a clear basis for making definitive recommendations regarding prescribed antibiotic therapy (17).

Multiple fractures in the craniofacial region are a situation in which antibiotic prophylaxis is required (18). In the case of mandibular and alveolar fractures, penicillins and their derivatives and also third-generation cephalosporins are used. Many clinical situations do not require antibiotic therapy, but it is definitely overused, even if the fracture is not complicated but antibiotic therapy is used only to reduce the possibility of infection (19-22). There is no basis for the use of antibiotics for the first 72 hours, except in situations where complications such as abscesses or osteitis develop. Then it is no longer prophylaxis, and we should start talking about treatment (23-25). There are no specific guidelines for orbital fractures (26) The situation in which prophylaxis unequivocally needs to be applied is the connection of the fracture gap with the oral cavity (open fractures) or sinuses. In this case, we should reach for cephalosporins (27).

TABLE. 1 CLASSIFICATION OF SURGICAL WOUNDS ACCORDING TO THE RISK OF CONTAMINATION INFECTION (28-32)

TYPE I	clean wounds (no disruption of mucosa such as the oral cavity)	No prophylaxis or prophylaxis no longer than 24 hours with amoxicillin- clavulanate as there is no benefit in using postoperative antibiotics.
TYPE II	clean-contaminated wounds (disruption of mucosa such as the oral cavity or surgery in an inflamed area)	Prophylaxis against gram + and anaerobic bacteria (amoxicillin-clavulanate, cefazolin + anaerobicid (clindamycin or metronidazol). o Amoxicillin-clavulanate 2 g, repeat dose if long term surgery 1g/4h. o Allergy to betalactamics. Clindamycin 600 mg + gentamycin 120 mg), repeat dose if long term surgery every 4h.
TYPE III	contaminated wounds (oncological surgery in which both oral cavity and neck contact)	Prophylaxis against gram +, anaerobc bacteria and also gram –, which are not covered in clean and clean contaminated surgeries, using drugs such as ampicillin-sulbactam or piperacillin-tazobactam: o Amoxicillin-clavulanate 2 g, repeat dose if long term surgery 1 g/4h. o Clindamycin 600 mg + cefazolin 2 g, repeat dose of clindamycin every 6h and 1 g/8h of cefazolin if long term surgery.
TYPE IV	dirty and infected wounds	Antibiotic treatment always, not prophylaxis.

The study shows that not only antibiotics are over-prescribed, but their use in the postoperative period does not have the desired effect - reducing the risk of developing infections. There is a significant difference between daily practice and the evidence supporting the prescription of prophylactic postoperative antibiotics for facial fractures (3, 33-36). However, it is worth considering following an antibiotic in cases of: HIV, diabetes, immunosuppression, and addictions. As the study shows, these factors increase infections occurring after postoperative treatment (37-40). Research shows that the duration of postoperative antibiotic therapy beyond 24h, does not reduce infection rates (5,8,15,41,42). Therefore, whenever prescribing any antibiotic to a patient, and planning a therapy that is expected to last more than 24 hours, we should consider the rationale for administering the drug versus the effects that the therapy will have, and whether there is a real reason to use it. Patients often put pressure on the doctor and expect to prescribe an antibiotic, despite the lack of justification. Thinking that antibiotics speed up the healing process.

Guidelines for orthopedic surgeons limit the duration of prophylactic antibiotic therapy to 48 hours after wound closure (43). However, these guidelines do not fully apply to patients with craniofacial fractures. Fractures in orthopedics, have a different pattern and are not prone to infection from the surrounding tissues as in the craniofacial. In the case of maxillofacial surgery, we are mostly talking about a clean contaminated wound, which is impossible to clean thoroughly, and not a clean wound as in orthopedics.
There are still no specific guidelines for prophylaxis of orbital fractures (26, 44-48). There are two paths of management, some authors recommend antibiotic therapy in all cases (46), while another recommends use only when an open fracture and orbital emphysema occur (47).

Recommendations of the Working Group of the Polish Dental Association and the National Antibiotic Protection Program regarding the use of antibiotics in dentistry (48).

Detailed recommendation regarding antibiotic prophylaxis of infections in fractures of the jawbones. Routine use of antibiotic prophylaxis is not recommended for closed fractures (e.g. condylar process or mandibular ramus) in immunocompetent patients, provided they are treated conservatively or surgically with an extraoral approach. Antibiotic prophylaxis is recommended only in the case of:
– open fractures (e.g. of the mandibular body)
– fractures treated with delay

– pathological fractures
– fractures treated surgically via intraoral access
– comminuted fractures
– fractures with communication with the nasal cavity or paranasal sinuses
– fractures occurring in immunocompetent patients, after consultation with the physician treating the underlying disease.

This recommendation recommends a single administration of clindamycin: adults at a dose of 600 mg, and children - 20 mg/kg b.w. (49)

CONCLUSION

In our opinion, the prevention related to preoperative and intraoperative antibiotic therapy is becoming increasingly ambiguous. There is insufficient data to definitively consider this type of antibiotic therapy as justified and necessary to implement as a standard treatment. Analyzing the available data, it can be clearly stated that prophylactic antibiotic therapy before and during surgery is recommended in cases of mandible fractures (due to the connection with the oral cavity) and maxillary fractures (due to the presence of sinuses). These are clear examples of where such antibiotic therapy is advised.

A completely different approach should be applied to recommendations for postoperative prophylactic antibiotic therapy. The data collected in this study are more conclusive. Prophylactic antibiotic therapy should be limited to cases where its necessity can be clearly established, where the cause of the injury is known, coexisting medical conditions are identified. Administering prophylactic doses of antibiotics without medical indication results in complications in the treatment of patients, such as the development of resistance and weakening of the body. Additionally, the economic aspect of unnecessary antibiotic use must be taken into account in this analysis.

The evidence for using prophylactic antibiotics in treating maxillofacial fractures is not strong and remains unclear. Some observational studies show possible benefits, but these findings are often based on low-quality research or small randomized controlled trials (RCTs) with inconsistent results. Additionally, there is no clear guidance on the best type, dose, or duration of antibiotics due to differences in the studies.

Treatment decisions should be tailored to the individual patient, considering their overall health, specific conditions such as smoking, diabetes, or a weakened immune system, and the cause

and severity of their injuries. In many low-risk cases, routine use of prophylactic antibiotics may not be necessary and could contribute to the growing problem of antibiotic resistance, making future infections harder to treat.

Because antibiotics can cause side effects and increase healthcare costs, it is recommended to use them more cautiously and based on evidence. The lack of strong data highlights the need for large, well-designed studies to create clear guidelines for using antibiotics in maxillofacial surgery.

The prophylactic use of antibiotics in traumatic mandibular fractures remains a subject of ongoing research. While numerous systematic reviews have been conducted, many of them are incomplete, poorly prepared, or inaccurately presented. Drawing conclusions that could influence treatment methods is, at this stage, nearly impossible.

DISCLOSURE

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REFERENCES

1. Rogers SN, Naylor R, Potter L, et al: Three years' experience of collaborative care pathways on a maxillofacial ward. Br J Oral Maxillofac Surg 38:132, 2000.
2. Erdmann D, Follmar KE, Debruijn M, et al: A retrospective analysis of facial fracture etiologies. Ann Plast Surg 60:398, 2008.
3. Mundinger GS, Borsuk DE, Okhah Z, et al. Antibiotics and facial fractures: evidence-based recommendations compared with experience based practice. Craniomaxillofac Trauma Reconstr 2015;8:64–78.
4. Ben Simon GJ, Bush S, Selva D, McNab AA. Orbital cellulitis: a rare complication after orbital blowout fracture. Ophthalmology 2005;112:2030– 2034.
5. Lauder A, Jalisi S, Spiegel J, Stram J, Devaiah A. Antibiotic prophylaxis in the management of complex midface and frontal sinus trauma. Laryngoscope 2010;120:1940–1945.
6. Chole RA, Yee J. Antibiotic prophylaxis for facial fractures. A prospective, randomized clinical trial. Arch Otolaryngol Head Neck Surg 1987;113: 1055–1057.
7. Ellis E III. Outcomes of patients with teeth in the line of mandibular angle fractures treated with stable internal fixation. J Oral Maxillofacial Surg 2002;60:863–865; discussion 866.

8. Schaller B, Soong PL, Zix J, Iizuka T, Lieger O. The role of postoperative prophylactic antibiotics in the treatment of facial fractures: a randomized, double-blind, placebo-controlled pilot clinical study. Part 2: mandibular fractures in 59 patients. Br J Oral Maxillofac Surg 2013;51:803– 807.
9. Shridharani SM, Berli J, Manson PN, Tufaro AP, Rodriguez ED. The role of postoperative antibiotics in mandible fractures: a systematic review of the literature. Ann Plast Surg 2015;75:353–357.
10. Andreasen JO, Jensen SS, Schwartz O, Hillerup Y. A systematic review of prophylactic antibiotics in the surgical treatment of maxillofacial fractures. J Oral Maxillofac Surg 2006;64:1664–1668.
11. Kyzas PA: Evidence-based oral and maxillofacial surgery. J Oral Maxillofac Surg 66:973, 2008.
12. Vranos G, Tatsioni A, Polyzoidis K, et al: Randomized trials of neurosurgical interventions: A systematic appraisal. Neurosurgery 55:18, 2004.
13. Curry JI, Reeves B, Stringer MD: Randomized controlled trials in pediatric surgery: Could we do better? J Pediatr Surg 38:556, 2003.
14. Gerlach K, Pape H. Perioperative antibiotic prophylaxis in mandibular fracture treatment. Chemioterapia 1987;6(2 suppl):568.
15. Zix J, Schaller B, Iizuka T, Lieger O. The role of postoperative prophylacic antibiotics in the treatment of facial fractures: a randomised, double- blind, placebo-controlled pilot clinical study. Part 1: orbital fractures in 62 patients. Br J Oral Maxillofac Surg 2012;51:332–336.
16. Kyzas, P.A., Use of antibiotics in the treatment of mandible fractures: a systematic review. J Oral Maxillofac Surg, 2011. 69(4): p. 1129- 45.
17. B ES Dawoud, S Kent, A Henry, J Wareing, H Chaudry, on behalf of MTReC, Panayiotis Kyzas, The use of antibiotics in traumatic mandibular fractures: A systematic review and meta-analysis. J Oral Maxillofac Surg;2021:Dec;59(10):1140-1147.
18. Maloney PL, Lincoln RE, Coyne CP. A protocol for the management of compound mandibular fractures based on the time from injury to treatment. J Oral Maxillofac Surg 2001;59:879-84.

19. Abubaker AO, Rollert MK. Postoperative antibiotic prophylaxis in mandibular fractures: A preliminary randomized, double-blind, and placebo-controlled clinical study. J Oral Maxillofac Surg 2001;59:1415-9.
20. Andreasen JO, Andreasen FM, Mejare I, Cvek M. Healing of 400 intra-alveolar root fractures. 2. Effect of treatment factors such as treatment delay, repositioning, splinting type and period and antibiotics. Dent Traumatol 2004;20:203-11.
21. Ghazal G, Jaquiery C, Hammer B. Non-surgical treatment of mandibular fractures-survey of 28 patients. Int J Oral Maxillofac Surg. 2004;33:141-5.
22. Heit JM, Stevens MR, Jeffords K. Comparison of ceftriaxone with penicillin for antibiotic prophylaxis for compound mandible fractures. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;83:423-6.
23. Bruno JR, Kempers KG, Silverstein K. Treatment of traumatic mandibular nonunion. J Craniomaxillofac Trauma 1999;5:27-32.
24. Dhariwal DK, Gibbons AJ, Murphy M, Llewelyn J, Gregory MC. A two year review of the treatment and complications of mandibular angle fractures. J R Army Med Corps. 2002;148:115-7.
25. Teenier TJ, Smith BR. Management of complications associated with mandible fracture treatment. Atlas Oral Maxillofac Surg Clin North Am. 1997;5:181-209.
26. Courtney DJ, Thomas S, Whitfield PH. Isolated orbital blowout fractures: survey and review. Br J Oral Maxillofac Surg 2000;38:496-504.
27. Torrielli F, Camurati R, Cervar MF, Tel A. Fractures with loss of substance of the middle and upper third of the face: nosographic classification, surgical indications and the prevention of meningeal infections with the new antibiotic, cefuroxime. Minerva Stomatol 1980;29:163-82.
28. Grassi RF, Pappalardo S, De Benedittis M, Petruzzi M, Giannetti L, Cappello V, Baglio OA. Drugs in oral surgery. Brief guidelines for adult patients. Minerva Stomatol 2004;53:337-44.
29. Mueller SC, Henkel KO, Neumann J, Hehl EM, Gundlach KK, Drewelow B. Perioperative antibiotic prophylaxis in maxillofacial surgery: penetration of clindamycin into various tissues. J Craniomaxillofac Surg 1999;27:172-6.
30. Peterson L. Antibiotic prophylaxis against wound infections in oral and maxillofacial surgery. J Oral Maxillofac Surg 1990;48:617-20.
31. Paterson JA, Cardo VA Jr, Stratigos GT. An examination of antibiotic prophylaxis in oral and maxillofacial surgery. J Oral Surg. 1970;28:753-9.

32. Weed HG. Antimicrobial prophylaxis in the surgical patient. Med Clin North Am 2003;87:59-75.
33. Furr AM, Schweinfurth JM, May WL. Factors associated with long-term complications after repair of mandibular fractures. Laryngoscope 2006;116(3): 427–30.
34. Adalarasan S, Mohan A, Pasupathy S. Prophylactic antibiotics in maxillofacial fractures: a requisite? J Craniofac Surg 2010;21(4):1009–11.
35. Morris LM, Kellman RM. Are prophylactic antibiotics useful in the management of facial fractures? Laryngoscope 2014;124(6):1282–4.
36. Domingo F, Dale E, Gao C, et al. 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 2016;81(6): 1109–14.
37. Senel FC, Jessen GS, Melo MD, et al. Infection following treatment of mandible fractures: the role of immunosuppression and polysubstance abuse. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103(1):38–42.
38. Passeri LA, Ellis E 3rd, Sinn DP. Relationship of sub- stance abuse to complications with mandibular fractures. J Oral Maxillofac Surg 1993;51(1):22–5.
39. Odom EB, Snyder-Warwick AK. Mandible fracture complications and infection: the influence of demographics and modifiable factors. Plast Reconstr Surg 2016;138(2):282e–9e.
40. Ward NH 3rd, Wainwright DJ. Outcomes research: Mandibular fractures in the diabetic population. J Craniomaxillofac Surg 2016;44(7):763–9.
41. Soong PL, Schaller B, Zix J, et al. The role of postoperative prophylactic antibiotics in the treatment of facial fractures: a randomised, double-blind, placebo-controlled pilot clinical study. Part 3: Le Fort and zygomatic fractures in 94 patients. Br J Oral Maxillofac Surg 2014;52(4):329–33.
42. Miles BA, Potter JK, Ellis E 3rd. The efficacy of post- operative antibiotic regimens in the open treatment of mandibular fractures: a prospective randomized trial. J Oral Maxillofac Surg 2006;64(4):576–82.
43. Luchette FA, Bone LB, Born CT, DeLong Jr. WG, Hoff WS, Mullins D, et al. East practice management guidelines work group: practice management guidelines for prophylactic antibiotic use in open fractures. Eastern Association for the Surgery of Trauma; 2000. www.east.org.

44. Holds JB. Orbital infections and inflammatory disease. *Curr Opin Ophthalmol* 1992;3:657–63.
45. Paterson AW, Barnard NA, Irvine GH. Naso-orbital fracture leading to orbital cellulitis, and visual loss as a complication of chronic sinusitis. *Br J Oral Maxillofac Surg* 1994;32:80–2.
46. Shuttleworth GN, David DB, Potts MJ, Bell CN, Guest PG. Lesson of the week: orbital trauma. Do not blow your nose. *BMJ* 1999;318:1054–5.
47. Newlands C, Baggs PR, Kendrick R. Orbital trauma. Antibiotic prophylaxis needs to be given only in certain circumstances. *BMJ* 1999;319:516–7.
48. Westfall CT, Shore JW. Isolated fractures of the orbital floor: risk of infection and the role of antibiotic prophylaxis. *Ophthalmic Surg* 1991;22:409–11.
49. Kaczmarzyk T, Babiuch K, Bołtacz- Rzepkowska E i wsp.: Rekomendacje Grupy Roboczej Polskiego Towarzystwa Stomatologicznego i Narodowego Programu Ochrony Antybiotyków w zakresie stosowania antybiotyków w stomatologii. Wyd. Narodowy Instytut Leków, Warszawa, ISBN: 978-83-9496-36-1-3, www. Antybiotyki.edu. pl.