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Research Article

Multiple Correlation Model to Estimate Osteomyelitis in Dental Implant Candidate Patients

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Summary

Introduction

Osteomyelitis is an inflammatory infectious pathology that represents a public health problem due to the high morbidity associated with its high disabling potential and with a reserved short-term prognosis. The risk factors that favor the growth of a particular microorganism, in the maxilla or jaw after the placement of dental implants, include multiple general variables (age, sex, smoking and systemic diseases) as well as local variables (anatomical area, number of implants, type of osteomyelitis). The objective of this research is to perform a linear model to estimate the risk of osteomyelitis from the correlation of the multiple variables obtained from the review of the world literature.

Material and Methods

Descriptive, retrospective, cross-sectional study. A multiple correlation model was constructed to estimate osteomyelitis (OM) from the general variables and local variables obtained from the review of world literature in the last 10 years.

Results

The sample consisted of 38 patients with a minimum age of 43 years and a maximum age of 84 years and a mean of 61 years, 28 (73.6%) female patients and 10 (26.3%) males, 23 (60.5%) patients with systemic diseases and 15 (39.4%) healthy patients. Gender is related to osteomyelitis since the female sex has 13 times more risk of presenting osteomyelitis than the male gender. Age is related to osteomyelitis since at age over 60 there is 1 time more risk of osteomyelitis than those under 60 years of age. The presence of a systemic disease by itself was not statistically significant when performing the univariate logistic regression analysis, however, when performing the multivariate analysis arterial hypertension, diabetes, patients who smoke or consume immunosuppressive or immunomodulatory drugs if they are predisposed to osteomyelitis in 47% according to Cox and Snell and 64.7% according to Nagelkerke. With respect to the anatomical area, the jaw has 9 times more risk of osteomyelitis than the maxilla.

Conclusion

The variables selected to perform our analysis, if they can behave as risk factors for osteomyelitis. In the multivariate model, the predictors of systemic diseases are independent, even without collinearity, asthma, bronchitis and smoking are related to respiratory diseases, as well as the combination with arterial hypertension, since although the individual effect of each of the variables cannot be precisely identified, The multivariate effect translates into an increase in the estimated regression coefficient (13% more likely) to present osteomyelitis, this is known as non-perfect multicollinearity. There is no specific statistical method to estimate osteomyelitis in patients who are candidates for dental implants, however, the present multiple correlation model allows us to determine to what extent the general, local and concomitant factors reported in the literature increase the risk of presenting osteomyelitis.

Introduction

Described in 1852 by Droveignac, osteomyelitis is an infectious and inflammatory process where the cortex is affected, the periosteum and portion medullary bone, caused by inoculation, dissemination, or hematogenous of fungi, bacteria and/or Mycobacteria, which triggers permanent disability due to bone destruction and necrosis [1-5]. The occurrence of acute osteomyelitis in patients from developed countries is 8 per 100,000 patients per year, with a higher frequency in males of 2:1 compared to females. The most common etiology is secondary to trauma 64%, post-surgery 20%. Predisposing risk factors are divided into general factors, including age, sex, chronic systemic and autoimmune diseases, degree of nutrition (malnutrition-obesity), alcoholism, drug addiction, cancer, renal or hepatic failure and fLocal risk actors, how Anatomical area, surgical technique in the placement of implants. During acute infection, phagocytes try to contain microorganisms by generating toxic free radicals and releasing proteolytic enzymes, since some microorganisms have adhesins that allow them to bind to collagen and extend to vascular channels, raising intraosseous pressure and affecting blood flow., with progression to a chronic state, ischemic necrosis and separation of fragments vascularizados (bone sequestration), finally the development of a biofilm by staying in a dormant state within the osteoblasts and acquiring a very slow metabolic rate. Osteomyelitis is classified in various ways according to its chronicity in acute where the infectious process is less than 2 weeks; subacute when the duration ranges from 2 weeks to 3 months; chronic osteomyelitis with a persistence greater than 3 months. According to its pathogenesis in exogenous osteomyelitis due to the direct inoculation of bacteria after surgery or trauma; by hematogenous route when the causative agent enters through the blood to spread in the metaphysis of long bones mainly; secondary osteomyelitis, where infection originates in soft tissues and joints and can spread by continuity to the bone; Osteomyelitis by direct inoculation, as a result of open fractures, animal bites and puncture wounds. According to the anatomy and comorbidities, the classification described by Cierny-Mader allows osteomyelitis to be staged in stages and physiological state, however, this classification system can change dynamically depending on the patient's condition [6-8] (Figure 1 & 2).

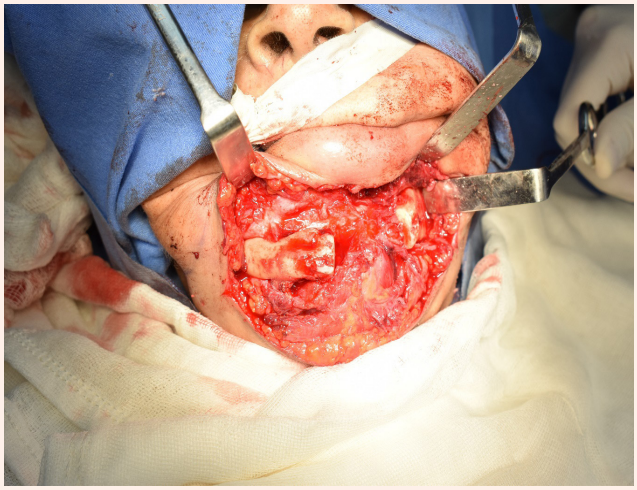


Figure 1: Block mandibular resection with safety margins.

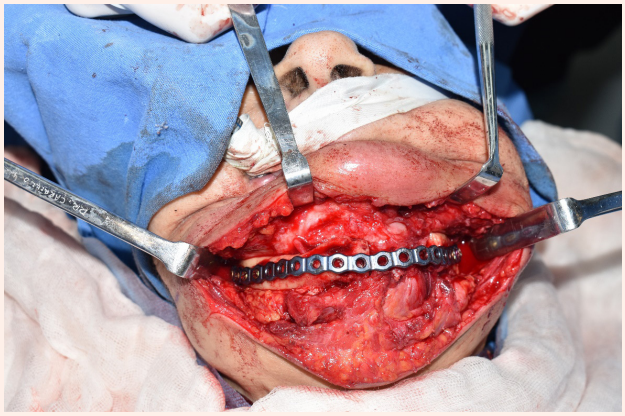


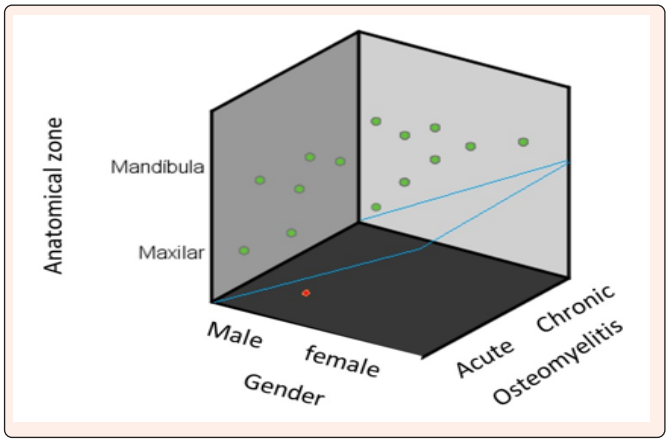
Figure 2: Placement of pre-formed reconstruction plate, system 2.0.

Materials and Methods

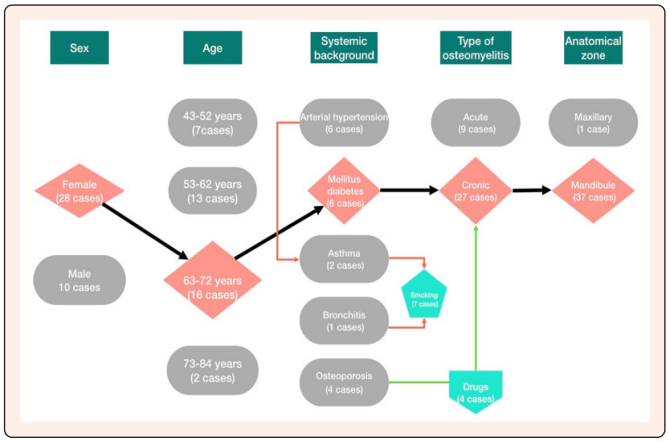
A search was made for research published in databases such as: Medline, Science Direct, Pubmed, on the relationship between osteomyelitis after implant placement in the last 8 years, obtaining 10 articles that met the inclusion criteria, the patients treated at the Darío Fernández Fierro hospital in 2022 were added. For the comparison of the nominal variables, multivariate logistic regression analysis was performed in order to obtain the odds ratio, which allows us to establish if some of the variables behave as a risk factor. The data were captured in a spreadsheet in the SPSS Statistics Version 25 program with which logistic regression analysis was performed.

Results

The sample consisted of 38 patients with a minimum age of 43 years and a maximum age of 84 years and a mean of 61 years, 28 (73.6%) female patients and 10 (26.3%) males, 23 (60.5%) patients with systemic diseases and 15 (39.4%) healthy patients. Themodel was adjusted, as the P value of the omnibus test was significant. The variables selected to perform our analysis, if they can behave as risk factors for osteomyelitis. The gender variable is related to osteomyelitis since the female gender has 13 times more risk of presenting osteomyelitis than the male gender. The age variable is related to osteomyelitis since at age over 60 there is 1 time more risk of osteomyelitis than those under 60 years of age. 23 patients (60.5%) had some systemic disease, 15 patients (39.4%) were in good health. Therefore, the presence of a systemic disease by itself was not statistically significant when performing the univariate logistic regression analysis, however, when performing the multivariate analysis arterial hypertension, diabetes, patients who smoke or who consume immunosuppressive or immunomodulatory drugs if they predispose to osteomyelitis in 47% according to Cox and Snell and 64.7% according to Nagelkerke. With respect to the anatomical area, the jaw has 9 times more risk of osteomyelitis than the maxilla.



The graphical representation shows that the multivariate regression model with the following equation: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + e$ tends to predict the jaw as the anatomical zone in a very high percentage, the female sex tends to be the predictor variable most frequently and the interaction with osteomyelitis chronically as a consequence.



Flowchart of the multiple correlation model to estimate osteomyelitis (OM) from general variables such as sex, age, systemic diseases; local variables such as the type of osteomyelitis and the anatomical area and concomitant factors such as smoking and drugs (bisphosphonates, immunosuppressants and immunomodulators).

Discussion

In relation to age and sex, we found that it occurs more frequently in twenty-eight women (73.6%) with a mean age of 61 years. Kellesarian et al.9 found that osteomyelitis is more prevalent among women compared to men in a 2:1 ratio and a mean age of 60.26 years. Chatelain et al. [10] found that women accounted for 100% of cases, with an average age of 59.8 years; Yahomlam et al. found 71.5% of cases in women with a mean age of 60.57 years. According to the above, there is a greater predisposition to osteomyelitis in women over 60 years of age. Regarding systemic diseases, fifteen patients (39.4%) were in good health and twenty-three patients (60.5%) had a history of some type of conditioning disease. Therefore, the presence of a history of systemic disease does not predispose to osteomyelitis. As for the area of placement of the implants, there is a greater predisposition that osteomyelitis is present in the jaw in 97.3% (thirty-seven cases) and reporting only one case (2.6%) in maxilla. Camps-Font et al. [11] mention a statistically significant association between mandibular location and dental implant failure. Commenting that it may be due to a minor irrigation, a macro and microarchitecture (thick cortical plates and small medullary spaces) that differs from the maxilla. Infections are considered a rare complication after dental implant placement, with a prevalence of 1.6% to 11.5% and usually occur within the first month. Camps Font et al. [12] mentions in a retrospective cohort study that

infections can affect 2.4% of implants after placement. Frequently, the etiologies are odontogenic and traumatic; however, hematogenous dissemination is also present. Patients with systemic diseases such as diabetes mellitus, malnutrition, neoplasia or immunodeficiency are usually affected. Yahalom et al. [13] and Semel et al. [14] also mention that implant-related osteomyelitis is a rare and serious complication.

Conclusion

In the multivariate model, the predictors of systemic diseases are independent, even without having cholinesiality, asthma, bronchitis and smoking are related to respiratory diseases, as well as the combination with arterial hypertension, since although the individual effect of each of the variables cannot be precisely identified, The multivariate effect translates into an increase in the estimated regression coefficient (13% more likely) to present osteomyelitis, this is known as non-perfect multicholinesiality. There is no specific statistical method to estimate osteomyelitis in patients who are candidates for dental implants, however, the present multiple correlation model allows us to determine to what extent the general, local and concomitant factors reported in the literature increase the risk of presenting osteomyelitis.

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