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Cone beam computed tomography assessment of the pterygomaxillary region and palatine canal for Le Fort I osteotomy

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Abstract. The aim of this study was to evaluate the anatomical linear measurements of the descending palatine canal and the pterygomaxillary fissure for Le Fort I preoperative planning. Seventy-five patients, comprising 46 females (61.3%) and 29 males (39.7%), underwent multi-slice computed tomography examinations performed for preoperative orthognathic surgical planning. The images were categorized according to sex, craniofacial side, and skeletal and craniofacial patterns. The anterior length between the descending palatine canal and the lateral wall of the piriform rim showed a higher mean value for males compared to females ($P = 0.0121$). The posterior distance also showed a difference between the sexes and the highest mean was observed in females ($P = 0.0295$). Comparing the posterior width for the skeletal patterns, a statistical difference was observed between classes I and III ($P = 0.0371$), and classes II and III ($P = 0.0094$). Regarding the craniofacial patterns, the brachycephalic ($P = 0.0078$) and mesocephalic ($P = 0.0015$) groups showed a greater posterior width in females. In conclusion, the patient's sex and aspects of the skeletal pattern and craniofacial pattern have an influence on the pterygomaxillary area and descending palatine canal anatomy. A preoperative computed tomography analysis involving this evaluation could reduce the risk of surgical complications.

Key words: Le Fort I osteotomy; maxillary artery; orthognathic surgery; computed tomography.

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Computed tomography (CT) images, along with virtual surgical preoperative planning, are important tools when performing surgical procedures. These tools potentially add new information to aid in patient management and to improve the surgical technique[1].

The Le Fort I osteotomy is usually indicated for the surgical correction of dentofacial deformities. Medical professionals can carry out procedures with greater safety by better understanding the anatomy of the maxillary blood supply, and by availing themselves of today's improved approaches and instruments.

However, surgical complications, such as major haemorrhage or skull fractures, may occur as a consequence of bone manipulation, mainly in connection with pterygomaxillary dysjunction[2–4].

Manipulation of the posterior maxilla bone following Le Fort I osteotomy may be a challenging procedure due to limited visualization, the proximity to anatomical structures such as the descending palatine artery, and the location of the pterygomaxillary region. In this regard, previous studies have reported a variety of techniques that may protect against complications and reduce the risk of injury to the patient[3,5–11]. In addition, some authors have highlighted that osteotomy of the medial or lateral maxillary sinus walls, pterygomaxillary dysjunction, and downfracturing of the maxilla must be performed with caution, since major bleeding from injuries to the descending palatine artery during these procedures is the most common cause of intraoperative and postoperative complications[7,12].

Today, osteotomies for pterygomaxillary disarticulation and the complete separation of the maxillary sinus walls are procedures that are avoided[9]. These approaches may increase the risk posed by surgery and the consequent susceptibility to bone fracture, haemorrhage, optic nerve damage, and arteriovenous fistula. Thus, knowledge of the anatomy in association with the appropriate surgical technique is necessary to increase the safety of Le Fort I osteotomies. Previous studies have analyzed these factors in relation to different populations, such as those of the USA[13], Thailand[14], and Japan[12]. However, there have been no reports in relation to Brazilian patients and there is also no evidence of any correlation between these aspects and the craniofacial side, patient's sex, and craniofacial morphology and patterns.

Therefore, the aim of this study was to evaluate the anatomical linear measurements of the descending palatine canal and the pterygomaxillary fissure for Le Fort I preoperative planning, as well as to assess the effects of the craniofacial side (left and right), patient's sex, and skeletal and craniofacial patterns.

Materials and methods

The design of this study was approved by the local research ethics committee of the University of Bahia Dental School. Seventy-five adult patients, comprising 46 females (61.3%) and 29 males (39.7%), underwent multi-slice computed tomography (MSCT) examinations, which were performed preoperatively for a random group of orthognathic surgery patients. Patients presenting syndromes, cleft lip and palate, signs of maxillary tumours, facial trauma or previous surgery, and reduced maxillary sinus development were excluded from the study.

The MSCT images were acquired with a 64-slice system (Light Speed VCT; GE Healthcare Bio-Sciences, Piscataway, NJ, USA), using the same settings: 120 kV, 200 mA, and 32-cm field of view, including observation of the full craniofacial complex. The axial slice thickness was 0.6 mm.

Image analysis

The right and left sides of the patient were considered separately when performing the evaluation, thus the sample comprised 150 images. These images were assessed individually under dim lighting by one previously calibrated observer using Dolphin Imaging software (version 11.7, Premium; Dolphin Imaging and Management Solutions, Chatsworth, CA, USA).

The images were adjusted to ensure a parallel Frankfort horizontal (FH) plane, in order to attain a standardized head position, using the frontozygomatic sutures as a reference for the frontal view and the orbital inferior margin as well as the porion landmark for the lateral view. The orbital floors were then aligned (Fig. 1).

An axial reconstruction was selected from each dataset for evaluation and the acquisition of measurements at 3 mm above the nasal floor, in accordance with a method proposed previously by Ueki et al.[12] (Fig. 2). The observer established the position of the descending palatine canal in this image, and a line was drawn parallel to the most concave point of the pterygomaxillary fissure (pterygomaxillary fissure line). The following measurements were then acquired, based on the method proposed by Ueki et al.[12]:

(1) Measurement A: anterior length (the distance between the most anterior point of the descending palatine canal and the most anterior point of the lateral wall of the piriform rim) (Fig. 3A).

Fig. 1. Three-dimensional reconstruction—frontal and lateral views of the standardized head position.