Mandibular Panoramic Radiograph Distortion Rate Determination

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Abstract

Aim The aim of this study was to evaluate the distortion rates of the mandible on panoramic radiographs and to prepare bone grafts close to the actual values with a preliminary study. In patients with mandibular defects due to any cause, the dimensions of the bone graft used to repair the defect are compatible with the original dimensions of the defect, allowing a better contour. However, bone grafts used in clinical applications are prepared empirically. As a result, functional problems may occur during reconstruction. The aim of this study was to determine the appropriate bone graft to use in patients undergoing jaw reconstruction.
Material and method Two groups were prepared in the study. In the first group one cm radiopaque wires were wrapped over the mandibles. In the other group, points of random length were marked with wires and panoramic radiographs were taken.
Results As a result of the statistical study, these deviations in each region of the mandible were found to be highly significant according to the "Student T" test (p value 0.001 for each region). Distortion rate is different in each region..
Conclusion In cases where jaw reconstruction is being considered, it may be helpful to calculate the appropriate dimensions for the healthy state of the jaw by determining the excision margins on panoramic radiographs. Preoperative determination of the size of the defects is important for both the surgeon and the patient in planning the operation and achieving optimal results. In this way, prolonged surgery can be avoided and a near-optimal result can be achieved in the patient's jaw.

Keywords Dentists, Distortion, Mandible, Orthopantomography, Radiology

Introduction

For mandibular defects, the bone to be used for repairs should have dimensions compatible with the original dimensions of the defect to achieve a better contour. Currently, bone grafts used for clinical applications are planned empirically, which can negatively affect the functional and cosmetic outcome of the reconstruction. The consequences of bone grafting with jaw repair, facial asymmetry creation, and treatment that render patients' functions inadequate are too significant to be underestimated. This benign disease requires jaw reconstruction at the lesion site where mandibular tumors were originally excised due to incalculable deformity dimensions resulting in delayed treatment. The size of the defect area varies based on regional fibrosis and muscle contractures during repairs (1,3,4).

When considering jaw repair in the same session, a panoramic radiograph may be used to determine the margins of excision. The healthy side of the jaw fitting these boundaries can be quite helpful for calculating the dimensions (3).

Material and Methods

This study was conducted to replicate the same procedures on the remaining jaw segment for patients who require secondary jaw repair, and to prepare a bone graft that matches the corresponding dimensions. We also intended to prepare a bone graft that accurately matches the required values through a preliminary study using panoramic radiographs.

The study involved the preparation of two groups. For the first group, mandibles were wrapped with 1 cm radiopaque wires. In the other group, wires were used to mark randomly selected points and then panoramic radiographs were taken.

We measured the lengths of the wires and their panoramic projections on the graph. Each mandibular region was evaluated separately, and we took the averages of actual and panoramic radiograph measurements. These values were separately evaluated statistically using Student's T-test.

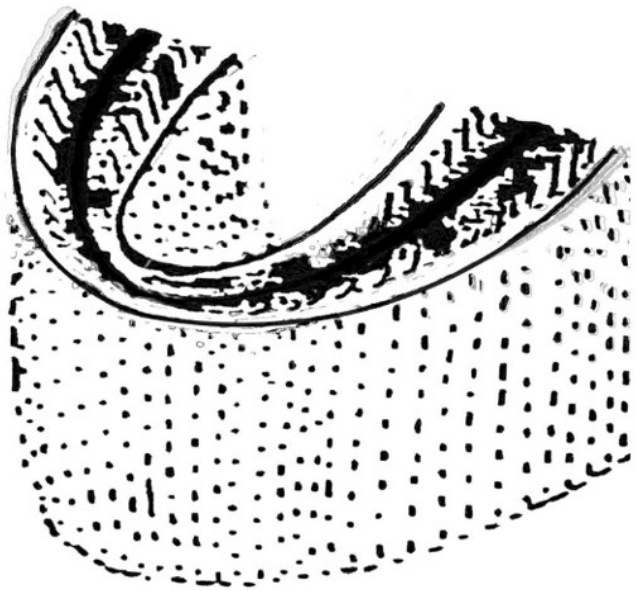

Figure 1: Showing the best and least distorted areas of the image with a black line on the panoramic radiograph.

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Results

The statistical study revealed that the deviations in each region of the mandible were highly significant, with a p-value of 0.001 for each region according to the Student T-test. The distortion rate differs in each region. For instance, the measurements in the mentum area show significantly different values compared to the other regions provided. "1" unit of length in the mentum area loses approximately 27-35% of its actual value in radiographs. This is also probably because of the movement of the mandible, the amount of image distortion is directly proportional (5).

As these deviations near the corpus region, which is immediately adjacent to the foramen mentale, the ratio approaches 1:1. In the angulus and inter-corpus regions, we observe an increase of approximately 12-20% in the panoramic radiograph measurement value. Our studies suggest that mandible curvature is one of the factors affecting the difference in graphic values other than the mentum region (Figure 1).

As a result, the ratio in the angulus region increases with the increase of this angle. Consequently, the angulus appears more deformed in angled and young mandibular. The ramus region is one of the areas where the image shows a maximum increase of 20-30% compared to the actual values

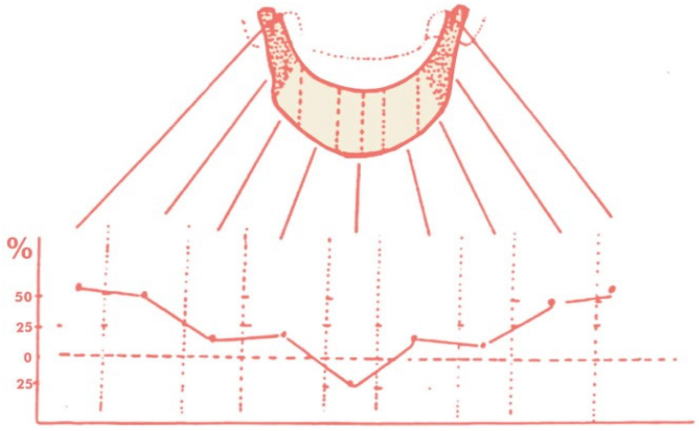

Figure 2: Showing the amount of distortion in radiographs according to regions (%).

Discussion

Panoramic radiographs present a comprehensive anatomical region but lack fine details (1,2). Magnification, geometric distortion gives the image of overlapping teeth, especially in the premolar region (3) (Figure 2). In addition to differences in visual size, there are also regional differences in the appearance of the radiopaque wires. For both foramen in the area between the mentale, it was observed that the image was much fainter depending on the amount of beam. However, both the angulus and ramus can be visualized more evidently. This brings attention to the fact that panoramic radiographs may overlook fracture lines or other minor lesions in the mentum region. In this current study, the distance between the X-ray device and the mandible bone was arranged as if soft tissue was present, same as in vivo. This approach made the study of cadaveric bone in vivo produce precise results, such as the 'real' value. However, the radiation absorption of the whole head in the living organism is neglected and not taken into account.

Conclusion

In cases where the primary operation was carried out in another clinic or the resected bone's size was not measured, the actual size of the bone defect during primary resection remains unknown. Furthermore, during the operative procedure, movements and muscle strength of the jaw's attached muscles cause changes to the bone defect's actual shape. For these types of defects, the optimal results during surgery are achieved by planning the operation based on the defect's size, which should be determined during the preoperative phase. This is important for both the surgeon and the patient. Hence, this can help in preventing prolonged operation time and achieving near-ideal outcomes for the patient's jaw.

Declarations

Author Contributions: *Conception/Design of Study- E.A.A., M.M.; Data Acquisition- E.A.A., M.M.; Data Analysis/Interpretation- E.A.A., M.M.; Drafting Manuscript- E.A.A., M.M.; Critical Revision of Manuscript- E.A.A., M.M.; Final Approval and Accountability- E.A.A., M.M.; Material and Technical Support- E.A.A., M.M.; Supervision- E.A.A.*

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