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A Three-Dimensional Study of Bone Gain Following Decompression of Benign Osteolytic Odontogenic Lesions: A Report of Ten Cases

Diatta Mamadou[1,2*], Soumboundou Sankoung[3], Kane Mouhammad[1], Ndeye Fatou Allé Fall[1], Khadim Seck[1], Gassama Bintou Catherine[1], Kounta Alpha[1], Sogue Assane[1], Ba Abdou[1], Tamba Babacar[1,2]

[1]Oral Surgery Department, Institute of Odontology and Stomatology, Cheikh Anta Diop University, Dakar, Senegal
[2]Odontostomatology Department, Idrissa Pouye General Hospital, Dakar, Senegal
[3]Legal Dentistry Service, Institute of Odontology and Stomatology, Cheikh Anta Diop University, Dakar, Senegal
Email: *diattamap@gmail.com, *mamadou19.diatta@ucad.edu.sn

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Abstract

Introduction: Benign odontogenic lesions present with variable radiographic features, ranging from osteocondensing to osteolytic forms. Osteolytic forms can grow to a considerable size, causing aesthetic and/or functional impairment. The therapeutic approach involving decompression allows for bone gain. The need for knowledge regarding bone gain following the placement of a decompression drain prompted this study. The aim of this study was to perform a three-dimensional analysis of the bone gain achieved following the placement of a decompression drain in the treatment of benign osteolytic odontogenic lesions. Materials and Methods: The study involved 10 patients who underwent cone-beam computed tomography (CBCT) scans before and after the placement of a decompression drain, using 3D Slicer software to calculate bone gain following segmentation. Results: The mean bone volume before decompression was 31907.23 ± 11642.59 and the mean bone volume after decompression was 40177.66 ± 1680.33. The bone gain achieved after decompression was greater in women than in men. A decompression period of 6 to 10 months appears to be optimal for achieving greater bone gain. Discussion: Decompression is a conservative technique that promotes a reduction in lesion volume through bone regrowth in the management of benign osteolytic odontogenic lesions. Conclusion: The 3D segmentation used in this study enabled an assessment of bone gain following decompression of benign osteolytic odontogenic lesions. The follow-up period required for optimal bone gain following the placement of a decompression drain was 6 to 10 months in this study.

Keywords

Benign Osteolytic Odontogenic Lesions, Decompression, Three-Dimensional Study, Segmentation, 3D Slicer

1. Introduction

Benign odontogenic lesions constitute a group of heterogeneous, polymorphic conditions arising from remnants of odontogenesis [1] [2]. They can grow to a considerable size, leading to bone deformities, bone lysis, tooth displacement and compression of vital anatomical structures, resulting in aesthetic and/or functional impairment [3] [4].

Treatment often involves enucleation or surgical excision [1] [3]. However, where there is significant bone lysis, there is a risk of damage to vital anatomical structures during excision surgery. To prevent this risk, a more conservative approach involving decompression is sometimes considered prior to excision [5]-[7]. This procedure involves draining the lesion cavity by creating a small fenestration, which is kept open using a specialised device. Decompression allows the elimination of intra-lesional hydrostatic pressure. This is a conservative surgical technique that promotes bone re-ossification whilst restoring the patient's aesthetic and functional impairments [6] [8]. This technique has a success rate as high as that of more aggressive radical surgical treatments [9] [10]. The need to quantify bone gain using this conservative technique prompted this study, the aim of which was to perform a three-dimensional analysis of the bone gain achieved following decompression of benign osteolytic odontogenic lesions.

2. Materials and Methods

This was a descriptive analytical cross-sectional study of a series of 10 patients presenting with benign osteolytic odontogenic lesions, who were treated using the decompression technique.

The study was conducted in the Department of Oral and Maxillofacial Surgery at the Idrissa Pouye General Hospital (HOGIP) in Dakar, Senegal.

The study included all patients who presented with a benign osteolytic odontogenic lesion, treated using the decompression technique, and for whom cone-beam CT scans were available both before and after the placement of a decompression drain.

The variables studied were sociodemographic (age and sex), clinical (duration of decompression in months) and radiographic (gain in bone volume corresponding to the difference between the bone volume measured before and after placement of the decompression drain).

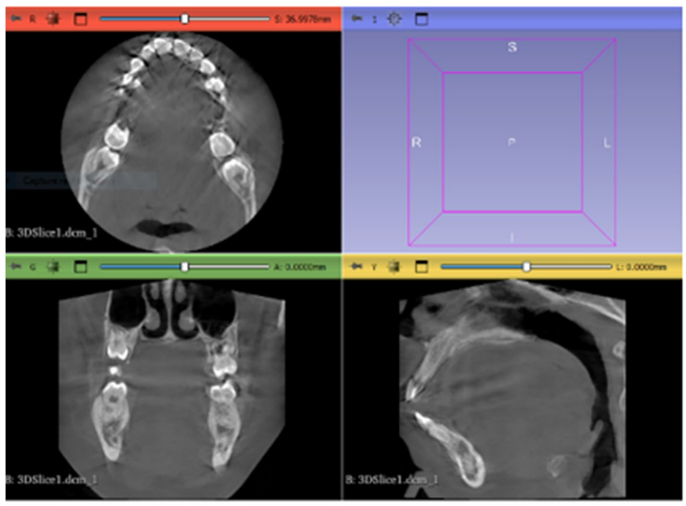
Segmentation was carried out in six (06) stages using "3D Slicer", a free, open-source software programme (BSD licence) that enables image acquisition, diffusion tractography processing, the use of interfaces with external devices for imageguided procedures, and GPU rendering of volumes.

3D Slicer offers a range of features, including the handling of DICOM images and the reading and writing of other formats, automatic image segmentation, interactive visualisation of volumetric images comprising voxels and polygonal meshes, as well as volumetric rendering; it also enables the analysis and visualisation of images using diffusion tensors.

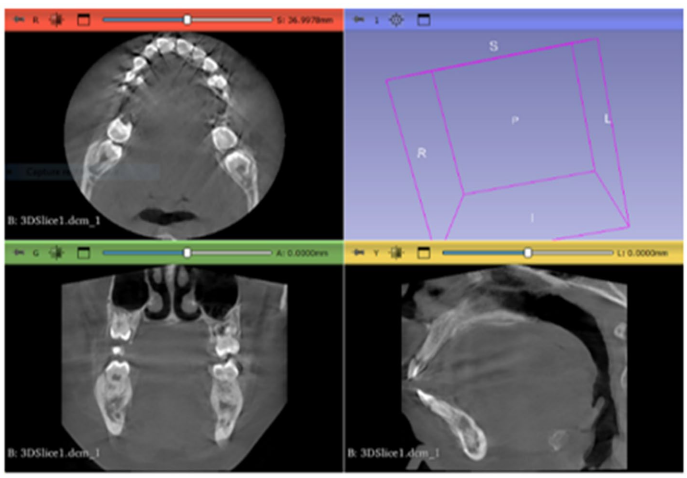
2.1. Importing the DICOM File

To import the DICOM file, first open the 3D Slicer software, then import the imaging data (DICOM) via "Add Data" or "Add DICOM Data", and click on "Choose directory to add" or "Choose file to add".

Once the data has loaded, check that the axial, coronal and sagittal slices are clearly visible on the interface (**Figure 1(a)**).



(a)



(b)

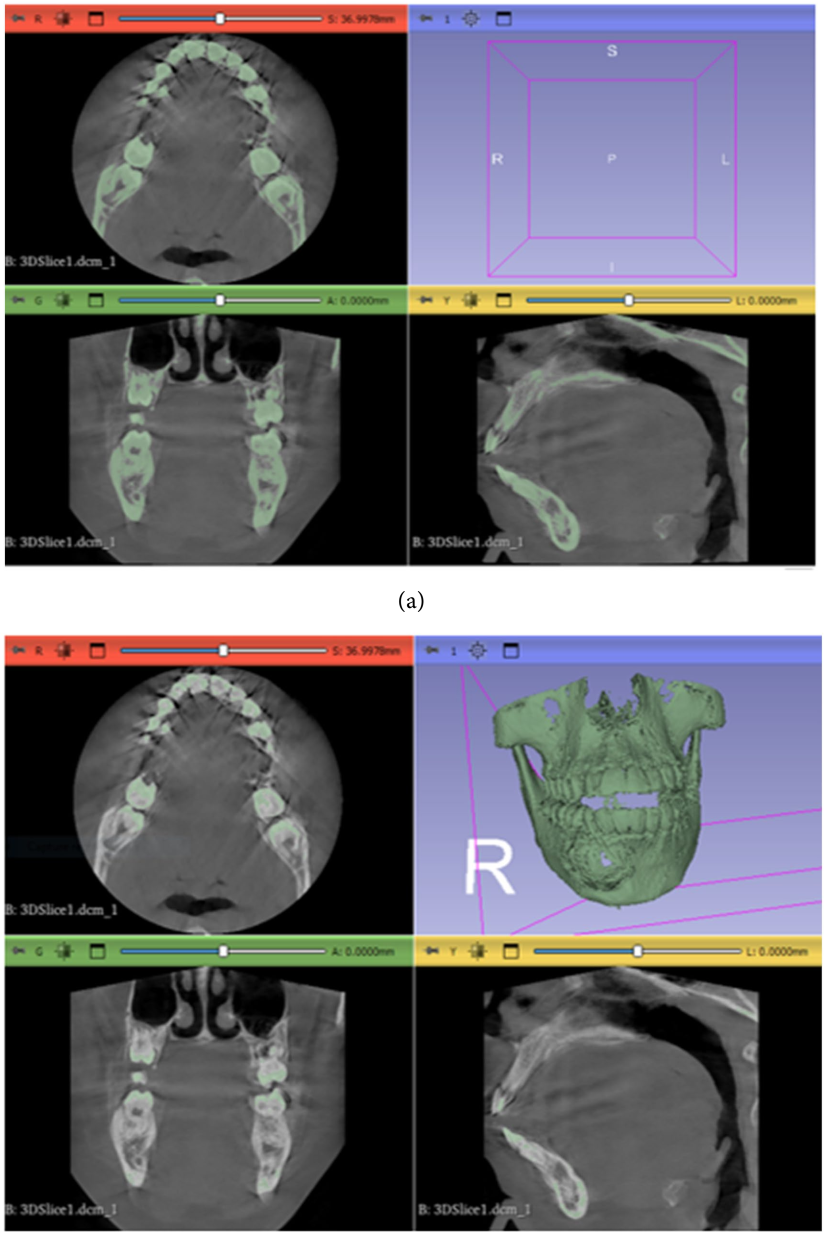
Figure 1. Images of the DICOM image data import (a) and the segmentation using the "Segment Editor" module (b).

2.2. Moving to the Segmentation Module

Once the files have been fully loaded into the 3D Slicer software's graphical interface, navigate to the "Segment Editor" module, create a new segmentation (by clicking "Add"), and then rename the newly created segment (**Figure 1(b)**).

2.3. Thresholding Settings

This adjustment is made using the "Threshold" tool, which allows you to determine the appropriate threshold before validation. This process is repeated as many times as necessary until a satisfactory threshold is achieved (**Figure 2(a)**).



(a)

(b)

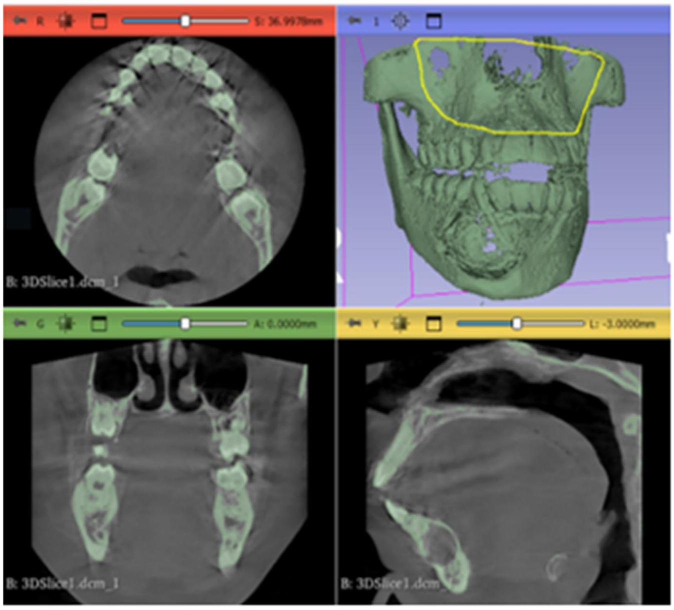
Figure 2. Images showing the "Threshold" effect (a) and viewing the 3D model (b).

2.4. Viewing the 3D Model

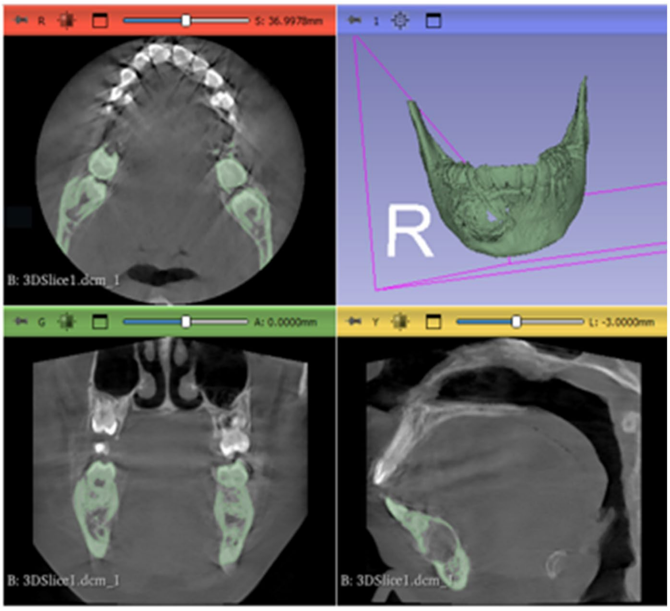
The 3D model can be viewed by clicking on the "Show 3D" (Figure 2(b)).

2.5. Removing Unwanted Parts

This is done using the "scissors" tool, which allows you to remove one or more parts of a segment by drawing an outline or a line directly in the 3D view (Figure 3(a) and Figure 3(b)).



(a)



(b)

Figure 3. Images showing the start of the removal of unwanted parts (a) and the mandible after removal of unwanted parts (b).

The mandible is then checked from all angles (**Figure 4**).

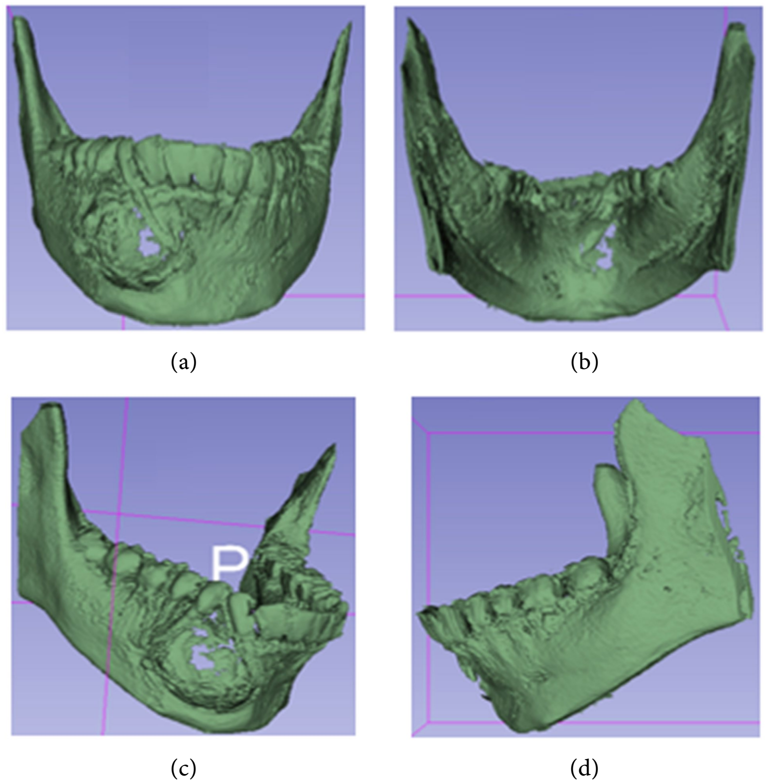


Figure 4. Images showing the steps involved in verifying the mandible following segmentation, viewed from the anterior (a), posterior (b), right lateral (c) and left lateral (d) angles.

2.6. Volume Calculation

Once segmentation is complete, go to the "segment statistics" module to select the segmented element and the reference volume (scalar volume) before clicking "apply".

The data collected were entered into an Excel spreadsheet and analysed using JASP software, version 0.19. A descriptive analysis was carried out, with quantitative variables expressed as mean ± standard deviation. The comparison of bone volumes before and after decompression was performed using the non-parametric Mann-Whitney test, given the distribution of the data.

For the analytical statistics, a significance threshold of less than 0.05 was set.

3. Results

3.1. Sociodemographic Characteristics

The mean age of the sample was 19.62 ± 8.07 years, with a maximum of 38 years and a minimum of 5 years. The study involved 10 subjects, comprising 2 men with a mean age of 18 ± 1.41 years, ranging from a maximum of 19 years to a minimum of 17 years, and 8 women with a mean age of 19.62 ± 9.10 years, ranging from a maximum of 38 years to a minimum of 5 years (**Figure 5**).

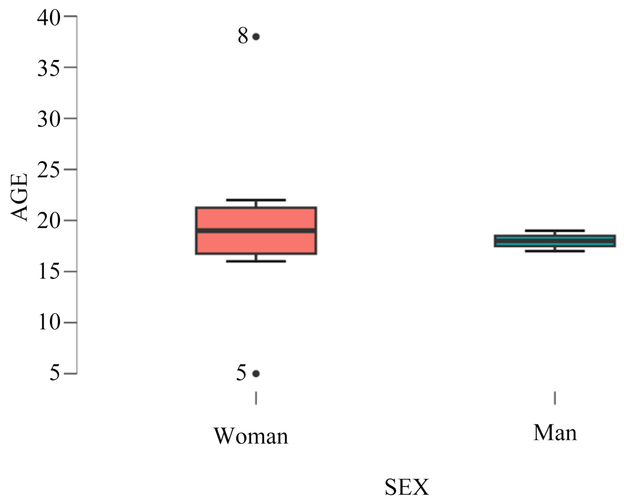
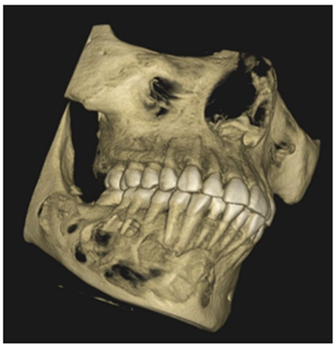


Figure 5. Box-and-whisker plot showing age by sex.

3.2. Clinical and Radiographic Findings

Pre- and post-operative bone volumes (Figure 6)

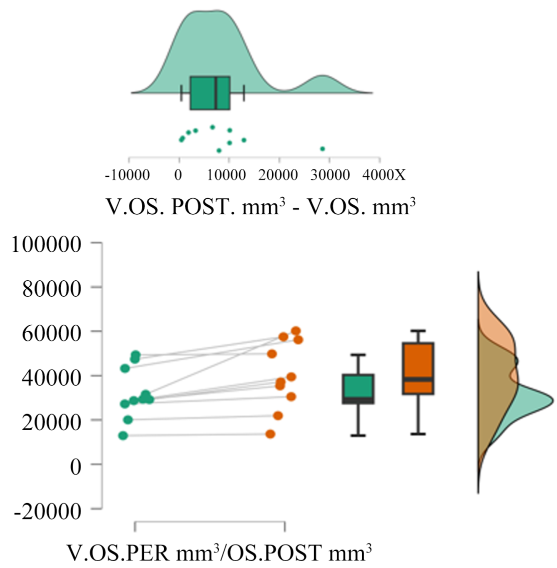
The figure below shows the mean pre- and post-operative bone volumes. The mean bone volume prior to decompression was 31907.23 ± 11642.59 mm^3 and the mean bone volume after decompression was 40177.66 ± 1680.33 mm^3. Student's t-test revealed a statistically significant difference between the mean pre- and post-operative bone volumes ($p = 0.002$) (Figure 7).



(a)

(b)

Figure 6. 3D reconstructions of a cone beam image showing a very extensive osteolytic lesion of the right mandible prior to decompression (a) and bone regrowth with filling of the cystic cavities in the right mandible 10 months after decompression (b).



Volume * mm³	N	Mean	SD	SE	P
V.OS. POST.	10	40177.660	15680.331	4958.556	

Figure 7. Bone volumes before and after decompression (in mm³).

Bone gain following decompression by gender

The figure below shows the bone gain achieved following decompression, broken down by the subjects' gender.

The mean bone gain in men was 4214.40 ± 5312.78 mm³, with a maximum of 7971.10 mm³ and a minimum of 457.70 mm³. In women, the mean bone gain was 9284.42 ± 8943.16 mm³, with a maximum of 28623.50 mm³ and a minimum of 709.20 mm³ (**Figure 8**). These results showed that the bone gain achieved after decompression was greater in women than in men.

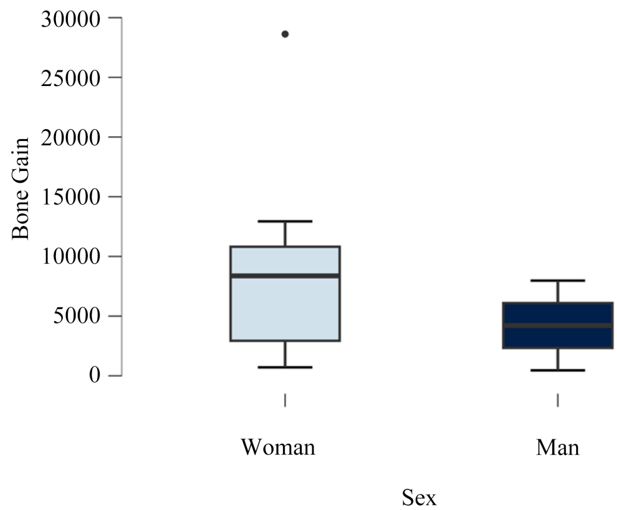


Figure 8. Box-and-whisker plot showing bone gain (mm³) by gender.

Depending on the duration of decompression

The figure below illustrates the bone gain observed following decompression, depending on the duration of decompression.

- For a decompression duration of 11 to 15 months, the mean bone gain was 5809.25 ± 3870.62 mm³ with a maximum of 10103.60 mm³ and a minimum of 1878.00 mm³.
- For a decompression duration of 2 to 5 months, the mean bone gain was 6822.80 ± 8645.93 mm³, with a maximum of 12936.40 mm³ and a minimum of 709.20 mm³.
- For a decompression period of 6 to 10 months, the mean bone gain was 11455.40 ± 12117.76 mm³, with a maximum of 28623.50 mm³ and a minimum of 457.70 mm³.

These results showed that a decompression period of 6 to 10 months appears to be optimal for achieving greater bone gain (**Figure 9**).

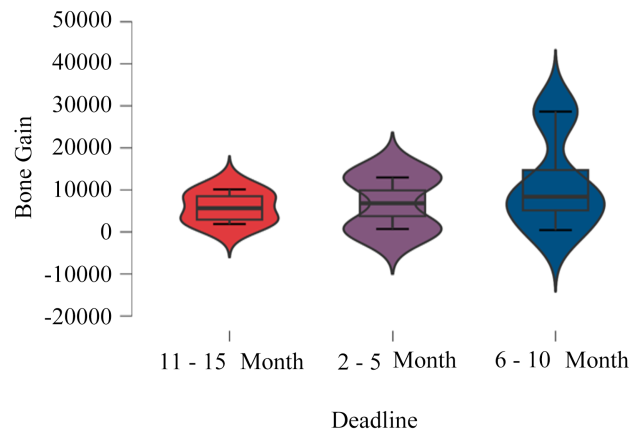


Figure 9. Box-and-whisker plot showing bone gain (mm³) as a function of the duration of decompression (months).

4. Discussion

The main limitation of this study is the small sample size (10 subjects). This limited number may be partly explained by the lack of resources available to the majority of patients, thereby restricting the possibility of performing cone-beam CT (CBCT) scans before and during follow-up after the insertion of a decompression drain. However, the number of patients in this study is higher than that reported by Kim *et al.* [11] in 2024, where, out of 26 patients who underwent decompression drainage, 6 had undergone follow-up cone beam scans.

Furthermore, according to Bao *et al.* [12], by 2024, the retrospective nature of studies may also be a source of selection bias, which is sometimes unavoidable.

This study utilised the 3D Slicer software, which offers several advantages, including a free licence, support for DICOM files, segmentation, registration, image visualisation and multi-platform compatibility running on Windows and Mac OS X. The software enables the construction of virtual 3D models of maxillomandibular intraosseous lesions, the isolation of the maxilla or mandible, the extraction of regions of interest, the determination of the actual shape of a cystic lesion, and the measurement of bone volume following decompression [12] [13].

Despite its many advantages, the 3D Slicer software has certain limitations, including its inability to process very large images, an interface that is complex for first-time users, and the need for a good understanding of thresholding and slicing parameters to ensure effective 3D image visualisation [12] [13].

4.1. Sociodemographic Data

Of the 10 patients in our sample, women were more common (n = 8). This same trend was noted by Lee *et al.* [14] in 2017, who found that of a total of 17 patients who underwent decompression, all 10 were women. However, other studies have reported a higher proportion of men in their samples, with over 52% of patients treated with decompression being male [13] [15]. This difference could be explained by variations in sample size across the studies.

Furthermore, in the present study, the mean age of patients was 19.62 ± 8.07 years, with a range of 5 to 38 years. Similar trends have been reported in the literature, with lesions particularly affecting young individuals under the age of 35 [13] [15]. However, the study by Oliveros-Lopez *et al.* [15] reported a higher mean age of 39.39. This difference could be explained by the fact that the study involved adult patients who were able to perform rinsing sessions themselves as part of home-based treatment follow-up.

In addition to sociodemographic factors, radiographic aspects for assessing the progression of lesions were examined.

4.2. Clinical and Radiographic Data

Benign osteolytic odontogenic lesions can occur at any age, and decompression may sometimes be required if indicated [13] [15].

In the present study, the mean bone volume prior to decompression was 31907.23 ± 11642.59 mm^3. This increased to 40177.66 ± 1680.33 mm^3 after decompression, thus demonstrating bone gain. This finding of bone gain following decompression has been reported in the literature [13]. This could be explained by the fact that decompression leads to the continuous removal of fluid from the cystic cavity, thereby eliminating intracystic hydrostatic pressure and resulting in neo-ossification [13] [15]. Indeed, according to Kwon *et al.* [13] in 2020, decompression results in a reduction of more than 54% in the volume of the cystic lesion. The mean reduction rate for benign odontogenic osteolytic lesions with an initial volume ≤ 10,000 mm^3 was 10.18 ± 5.91 mm^3, and for those with an initial volume > 10,000 mm^3, it was 35.36 ± 28.45 mm^3. This indicates a more marked reduction in larger lesions. Thus, regardless of the size of the osteolytic lesion, decompression promotes regression of osteolytic lesions. According to the literature, decompression results in a considerable reduction in the volume of benign osteolytic odontogenic lesions [13] [15].

The mean bone gain in men (4214.40 mm^3) was lower than that in women

(9284.42 mm^3). Similar results have been reported by various authors, showing greater bone gain in women than in men following decompression [12] [15]. This could be explained by hormonal variations, particularly involving oestrogens, which inhibit bone resorption and stimulate osteogenesis. However, Kwon *et al* [13], in their study, found a greater reduction in tumour volume in men. This difference in results could be linked, on the one hand, to variations in the size of benign osteolytic lesions and, on the other hand, to the higher number of patients in their sample.

Furthermore, a decompression period of 6 to 10 months appeared to be optimal for achieving greater bone gain (11455.40 ± 12117.76 mm^3). Beyond this, bone gain stagnates and bone resorption resumes. These observations have been reported in the literature, with an average decompression period not exceeding 10 months [12] [13] [15].

5. Conclusion

The 3D segmentation used in this study enabled an assessment of bone gain following decompression of benign osteolytic odontogenic lesions. In this study, the follow-up period required for optimal bone gain following the placement of a decompression drain was 6 to 10 months. A study involving a much larger number of patients should be conducted to better assess bone gain following the placement of a decompression drain. In light of these results, conservative treatment via decompression should be preferred over radical surgery in cases of large benign osteolytic odontogenic lesions, in order to perform less mutilating surgery.

Ethical Approval

Patient consent was obtained, as the patients selected for this study were part of a study approved by the Ethics Committee of Cheikh Anta Diop University in Dakar (Ref.: CER/UCAD/AD/MSN/046/2020).

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Author Contributions

Conceptualization, Diatta Mamadou and Y.Y.; methodology, Kane Mouhammad; software, Soumboundou Sankoung; validation, Diatta Mamadou, Sogue Assane, and Soumboundou Sankoung; formal analysis, Soumboundou Sankoung; investigation, Ndeye Fatou Alle Fall; resources, Gassama Bintou Catherine; data curation, Sogue Assane; writing—original draft preparation, Khadim Seck; writing—review and editing, Diatta Mamadou and Ba Abdou; visualization, Kounta Alpha; supervision, Tamba Babacar; project administration, Diatta Mamadou. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare that they have no competing interests.

References

[1] Robinson, R.A. and Vincent, S.D. (2012) Tumors and Cysts of the Jaws. American Registry of Pathology, 288 p. https://doi.org/10.55418/9781933477237

[2] Soluk-tekkesin, M. and Wright, J.M. (2022) The World Health Organization Classification of Odontogenic Lesions: A Summary of the Changes of the 2022 (5th) Edition. *Turkish Journal of Pathology*, **38**, 168-184. https://doi.org/10.5146/tjpath.2022.01573

[3] Menditti, D., Laino, L., Di Domenico, M., Troiano, G., Guglielmotti, M., Sava, S., *et al.* (2018) Cysts and Pseudocysts of the Oral Cavity: Revision of the Literature and a New Proposed Classification. *In Vivo*, **32**, 999-1007. https://doi.org/10.21873/invivo.11340

[4] Berretta, L.M., Melo, G., Mello, F.W., Lizio, G. and Rivero, E.R.C. (2021) Effectiveness of Marsupialisation and Decompression on the Reduction of Cystic Jaw Lesions: A Systematic Review. *British Journal of Oral and Maxillofacial Surgery*, **59**, E17-E42. https://doi.org/10.1016/j.bjoms.2021.03.004

[5] Gao, L., Wang, X.L., Li, S.M., Liu, C.Y., Chen, C., Li, J.W., *et al.* (2014) Decompression as a Treatment for Odontogenic Cystic Lesions of the Jaw. *Journal of Oral and Maxillofacial Surgery*, **72**, 327-333. https://doi.org/10.1016/j.joms.2013.07.035

[6] Anavi, Y., Gal, G., Miron, H., Calderon, S. and Allon, D.M. (2011) Decompression of Odontogenic Cystic Lesions: Clinical Long-Term Study of 73 Cases. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, **112**, 164-169. https://doi.org/10.1016/j.tripleo.2010.09.069

[7] Park, H.S., Song, I.S., Seo, B.M., Lee, J.H. and Kim, M.J. (2014) The Effectiveness of Decompression for Patients with Dentigerous Cysts, Keratocystic Odontogenic Tumors, and Unicystic Ameloblastoma. *Journal of the Korean Association of Oral and Maxillofacial Surgeons*, **40**, 260-265. https://doi.org/10.5125/jkaoms.2014.40.6.260

[8] Colnot, N., Savoldelli, C., Afota, F., Latreche, S., Lupi, L., Lerhe, B., *et al.* (2024) Treatment of Benign Maxillomandibular Osteolytic Lesions Larger than 4 cm: A Systematic Review. *Journal of Stomatology, Oral and Maxillofacial Surgery*, **125**, Article ID: 101933. https://doi.org/10.1016/j.jormas.2024.101933

[9] Joshi, M., Samuel, S., Abraham, A. and Deepak, D.M. (2021) Management of Dentigerous Cysts—A Review. *Journal of Evolution of Medical and Dental Sciences*, **10**, 1948-1953. https://doi.org/10.14260/jemds/2021/400

[10] Inturi, N.M.R., Natra, P.S. and Tummalapalli, S. (2022) Use of Disposable Needle Hub for Decompression of Large Dentigerous Cyst: A Case Report. *Journal of Family Medicine and Primary Care*, **11**, 6549-6552. https://doi.org/10.4103/jfmpc.jfmpc_180_22

[11] Kim, H.Y., Lee, S.M., Park, J.H. and Kim, S.J. (2024) Three-Dimensional Analysis of Decompression Efficacy and Influencing Factors in the Maxillofacial Cystic Lesions: A Retrospective Study. *Journal of the Korean Association of Oral and Maxillofacial Surgeons*, **50**, 197-205. https://doi.org/10.5125/jkaoms.2024.50.4.197

[12] Bao, T., Yu, D., Zheng, J., Zhu, W., Wei, D. and Wang, H. (2024) A Three-Dimensional Quantitative Assessment on Bony Growth and Symmetrical Recovery of Mandible after Decompression for Unicystic Ameloblastoma. *Scientific Reports*, **14**, Article No. 15492. https://doi.org/10.1038/s41598-024-66411-4

[13] Kwon, Y.J., Ko, K.S., So, B.K., Kim, D.H., Jang, H.S., Kim, S.H., *et al.* (2020) Effect of Decompression on Jaw Cystic Lesions Based on Three-Dimensional Volumetric

Analysis. *Medicina*, **56**, Article 602. https://doi.org/10.3390/medicina56110602

[14] Lee, S.T., Kim, S.G., Moon, S.Y., Oh, J.S., You, J.S. and Kim, J.S. (2017) The Effect of Decompression as Treatment of the Cysts in the Jaws: Retrospective Analysis. *Journal of the Korean Association of Oral and Maxillofacial Surgeons*, **43**, 83-87. https://doi.org/10.5125/jkaoms.2017.43.2.83

[15] Oliveros-Lopez, L., Fernandez-Olavarria, A., Torres-Lagares, D., Serrera-Figallo, M., Castillo-Oyague, R., Segura-Egea, J., *et al*. (2017) Reduction Rate by Decompression as a Treatment of Odontogenic Cysts. *Medicina Oral Patología Oral y Cirugia Bucal*, **22**, e635-e642. https://doi.org/10.4317/medoral.21916