

Spontaneous Bone Regeneration After Enucleation of Large Jaw Cysts: A Digital Radiographic Analysis of 44 Consecutive Cases

RABIN CHACKO¹, SAURABH KUMAR², ARUN PAUL³, ARVIND⁴

ABSTRACT

Purpose: This study evaluated the healing in cystic defect of the jaw to substantiate our understanding of spontaneous bone healing after enucleation of jaw cysts subjectively and with analysis of digital postoperative panoramic radiographs.

Materials and Methods: Fourty four consecutive patients reporting to the Department of Dental and Oral Surgery, during the period between 2008-2012 having maxillary and mandibular cysts treated by either surgical enucleation or by marsupialization followed by enucleation were evaluated for subsequent bone formation at the site of cystectomy defect by subjective clinical examination along with digital radiographic examination. Postoperative clinical and radiographic examinations were performed at 6,9,12, and 24 months. Bone regeneration was evaluated by reduction of the size of residual cavities at the cystectomy defect using digital orthopantomogram.

Results: Out of 44 patients 15 patients completed two years of follow-up with all the patients having 6 months follow-up.

The maximum size of the cystic pathology was 150.40mm and minimum of 14.73mm at the time of presentation (average size of 58.16mm). Twenty patients were diagnosed with odontogenic keratocyst, with one patient having multiple OKC associated with Gorlin Goltz Syndrome, 17 patients had dentigerous cyst, 5 had Radicular cyst; solitary bone cyst and globulomaxillary cyst formed one each. Uneventful healing and spontaneous filling of the residual cavities were obtained in all cases. The digital analysis of the postoperative radiographs showed mean values of reduction in size of the residual cavity of 25.85% after 6 months, 57.13% after 9 months, 81.03% after one year and 100% after two year.

Conclusion: Spontaneous bone regeneration can occur after surgical removal of jaw cysts without the aid of any graft materials even in large cystic cavity sufficiently surrounded by enough bony walls. This simplifies the surgical procedure, decreases the overall cost of surgery, and reduces the risk of postoperative complications associated with grafting.

Keywords: Bone grafting, Cyst recurrence, Odontogenic cyst

INTRODUCTION

Eradication of the jaw cyst remains the goal of any treatment; this goal must be achieved ensuring prevention of recurrence along with minimum morbidity by preserving mandibular continuity and nerve function, wherever possible [1]. Enucleation has traditionally been the standard method of management of odontogenic jaw cysts. Following enucleation the large cystic defects always creates a huge dilemma whether to fill the defect with bone substitutes. This study evaluated retrospectively cystic defects treated by a defined protocol at tertiary care center and assessed radiographically the reduction in the size of the cystic defect following the cyst removal to substantiate our understanding that spontaneous bone regeneration can well avoid bone grafting and thus simplify the treatment for the jaw cysts.

MATERIALS AND METHODS

This retrospective radiographic study included 44 patients, 10 females and 34 males, aged between 10 and 58 years, treated over a 4-year period (2008 to 2012) at the Department of Oral Surgery, Christian Medical College and Hospital, Vellore, India. The patients were retrospectively evaluated based on the patient's record and the digital X-ray archiving system of the hospital. The dimensions of the cysts were evaluated on panoramic radiographs taken just before surgical treatment and on subsequent follow-up at interval of 6m, 9m, 12m and at 24 months as reported in [Table/Fig-1]. The measurements were performed in millimeters on the digital OPG available through archiving system.

MANAGEMENT PROTOCOL

The protocol followed was based on the size, histopathology, clinical character and the site of the lesion [Table/Fig-2]. Unilocular Cysts less than 4 cm in size were treated by enucleation (excision biopsy) and primary closure. Larger lesions (more than 4 cm), multilocular cysts and cysts with cortical perforation (confirmed by CT imaging) were planned for incision biopsy along with marsupialisation and were followed up for 3 months. If the OPG showed reduction in the size of the lesion, enucleation with open packing was carried out. Open packing (BIPPS PACK) constituted of; sterile gauze (ribbon) impregnated with 'Bismuth Iodine Paraffine Paste' (1. one part bismuth subnitrate; 2. Two parts iodoform; 3. One part sterile liquid paraffin by weight). The pack would need to be replaced every 2-3 weeks. Follow-up was based on clinical and radiographic examinations at 6, 12, and 24 months after surgical treatment to evaluate the reduction in size of the residual cavity. The estimations were based on measuring the longest dimension of the cystic cavity on the digital OPG. Out of 44 patients all the patients had 6 months of follow-up with 15 patients having 9 months and 14 patients having 1 year and 2 years of follow-up each. The residual cystic cavity at each follow-up was measured and percentage reduction in the size of the defect was tabulated, as reported in [Table/Fig-3].

RESULTS

Out of 44 consecutive cases of jaw cysts reported between 2008-2012, 20 cases were reported to be as OKC, 17 as Dentigerous cyst, 5 as Radicular cyst and 1 case each of Solitary bone cyst and

Case No.	0 m (mm) At presentation	6 month (mm)	change 1	9 month (mm)	change 2	1year (mm)	change 3	2 y (mm)
1	89.16	77.1	12.06	-	-	-	-	0
2	37.23	33.06	4.17	-	-	-	-	0
3	32.51	20.23	12.28	-	-	-	-	-
4	29.79	18.48	11.31	9.18	20.61	-	-	-
5	53.92	32.24	21.68	-	-	-	-	-
6	61.85	61.19	0.66	0	61.85	-	-	-
7	63.4	32.89	30.51	-	-	0	63.4	-
8	49.65	-	-	24.66	24.99	-	-	-
9	57.51	39.71	17.8	26.13	31.38	-	-	-
10	32	-	-	-	-	15.71	16.29	-
11	25.49	-	-	-	-	-	-	0
12	46.58	35.01	11.57	-	-	-	-	-
13	41.47	27.59	13.88	-	-	-	-	-
14	126.52	82.8	43.72	41.47	85.05	-	-	-
15	51.49	37.91	13.58	12.51	38.98	9.93	41.56	-
16	45.01	34	11.01	-	-	0	45.01	-
17	40.15	31.73	8.42	-	-	-	-	-
18	51.42	-	-	-	-	35.1	16.32	0
19	114.89	112.5	2.38	-	-	79.51	35.38	0
20	35.03	18.57	16.46	-	-	-	-	0
21	45.4	31.32	14.08	-	-	0	45.4	-
22	75.34	72.55	2.79	41.56	33.78	-	-	-
23	47.37	-	-	-	-	0	47.37	-
24	92.34	-	-	48.63	43.71	-	-	-
25	14.73	7	7.73	-	-	-	-	-
26	34.57	15.08	19.49	-	-	-	-	-
27	70.38	-	-	54.98	15.4	-	-	-
28	75	70.26	4.74	-	-	0	75	-
29	39.08	27.83	11.25	-	-	-	-	0
30	38.61	-	-	0	38.61	-	-	-
31	67.35	66.49	0.86	31.42	35.93	0	67.35	0
32	75.15	56.2	18.95	29.44	45.71	15.1	60.05	-
33	35.34	17.06	18.28	-	-	-	-	-
34	44.49	-	-	-	-	0	44.49	0
35	26.85	-	-	11.54	15.31	-	26.85	-
36	76.21	61.85	14.36	-	-	-	-	-
37	150.4	93.43	56.97	-	-	-	-	-
38	34.85	32.1	2.75	0	34.85	-	-	-
39	91.98	91.29	0.69	-	-	-	-	0
40	32.56	24.42	8.14	-	-	12.88	19.68	0
41	126.63	100.6	26.07	42.97	83.66	-	-	-
42	92.11	74.09	18.02	36.7	55.41	-	-	-
43	56.86	42.38	14.48	-	-	-	-	0
44	30.52	24.64	5.88	-	-	-	-	0
Average	58.16	47.16	14.03	25.70	41.58	12.94	43.15	0

[Table/Fig-1]: (Measurement in millimeters of the longest diameter of the cystic cavity)

0 m (mm) - measurement in millimeters of the longest diameter of the cystic cavity at the time of presentation

6 m (mm) - measurement in millimeters of the longest diameter of the cystic cavity at first follow-up between 3 to 6 months

Change 1 - decrease in the size in mm of the cystic cavity at first follow-up

9m (mm) - measurement in millimeters of the longest diameter of the cystic cavity at second follow-up between 7 to 9 months

Change 2 - decrease in the size in mm of the cystic cavity at second follow-up

1y(mm) - measurement in millimeters of the longest diameter of the cystic cavity at third follow-up between 10 months to 1year

Change 3 - decrease in the size in mm of the cystic cavity at third follow-up

2y(mm) - measurement in millimeters of the longest diameter of the cystic cavity at third follow-up at 2years

'-' - Data not available as patient not reported

Globulomaxillary cyst. One case of multiple OKC'S was reported to be associated with GorlinGoltz Syndrome.

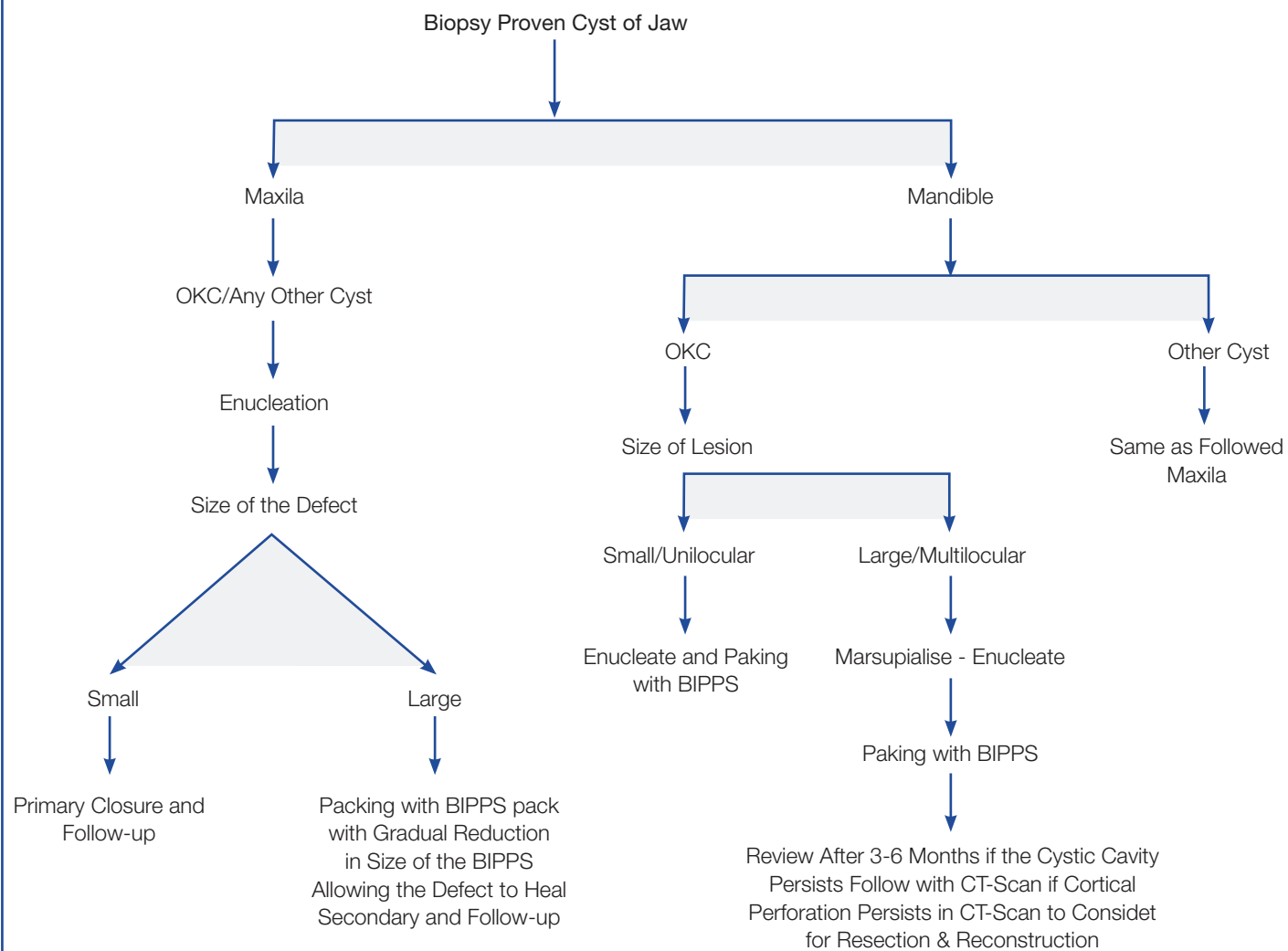
The jaw cysts were found to be more in males than females (34 male, 10 female). In males the mean age of presentation was 31.90 years, whereas in females it was 24.33 years. The 30 of the jaw cysts were in the mandible having maximum size of 150.40mm and minimum size of 26.85mm at presentation. The 14 maxillary cysts had maximum size of 67.35mm and minimum of 14.73mm. The average size of the cysts at the time of presentation was 58.16mm.

In mandible the most common site of presentation was the Body region (11 cases), followed by Ramus (9 cases), Angle-Ramus (4 cases) and 6 cases were reported as crossing the midline. 15

patients were treated with enucleation alone and the remaining 29 were treated with marsupialisation followed by enucleation.

All the jaw cysts showed progressive bone healing. 14 patients returned for review at 2 years, with complete healing in all cases [Table/Fig-4-19]. In one case (not included in the study), even 9 months after marsupialisation bone regeneration was not adequate. CT scan confirmed that perforation of lingual cortex had not closed. Resection of the vertical ramus with reconstruction was done instead of enucleation [Table/Fig-20-23]. One case returned at 4 years follow up with a recurrence in the posterior vertical ramus. The digital analysis of the postoperative radiographs showed mean values of reduction in size of the residual cavity of 25.85% after 6 months, 57.13% after 9 months, 81.03% after 12 months and 100% after 24 months.

CMC PROTOCOL FOR MANAGEMENT OF JAW CYSTS



[Table/Fig-2]: Flowchart

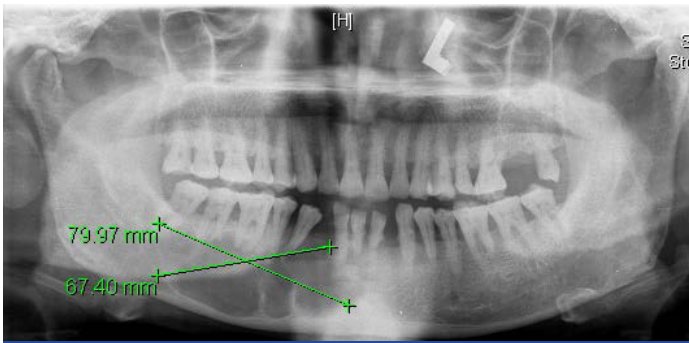
BIPPS Pack – sterile gauze (ribbon) impregnated with 'Bismuth Iodine Paraffine Paste' [1. One part bismuth subnitrate 2. Two parts iodoform 3. One part sterile liquid paraffin by weight]

Case. No	Change 1 (%)	Change 2 (%)	Change 3 (%)	Change 4 (%)
1	13.53	-	-	100.00
2	11.20	-	-	100.00
3	37.77	-	-	-
4	37.97	69.18	-	-
5	40.21	-	-	-
6	1.07	100.00	-	-
7	48.12	-	100.00	-
8	-	50.33	-	-
9	30.95	54.56	-	-
10	-	-	50.91	-
11	-	-	-	100.00
12	24.84	-	-	-
13	33.47	-	-	-
14	34.56	67.22	-	-
15	26.37	75.70	80.71	-
16	24.46	-	100.00	-
17	20.97	-	-	-
18	-	-	31.74	100.00
19	2.07	-	30.79	100.00
20	46.99	-	-	100.00
21	31.01	-	100.00	-
22	3.70	44.84	-	-
23	-	-	100.00	-
24	-	47.34	-	-
25	52.48	-	-	-

Case. No	Change 1 (%)	Change 2 (%)	Change 3 (%)	Change 4 (%)
26	56.38	-	-	-
27	-	21.88	-	-
28	6.32	0.00	100.00	-
29	28.79	0.00	-	100.00
30	-	100.00	-	-
31	1.28	53.35	100.00	100.00
32	25.22	60.83	79.91	-
33	51.73	-	-	-
34	-	-	100.00	100.00
35	-	57.02	100.00	-
36	18.84	-	-	-
37	37.88	-	-	-
38	7.89	100.00	-	-
39	0.75	-	-	100.00
40	25.00	-	60.44	100.00
41	20.59	66.07	-	-
42	19.56	60.16	-	-
43	25.47	-	-	100.00
44	19.27	-	-	100.00
Average	25.85	57.14	81.04	100.00

[Table/Fig-3]: (%reduction in the size of cyst)
 Change 1(%)- % reduction in size of cyst at 1stfollowup, 6 months
 Change 2(%)-% reduction in size of cyst at 2ndfollowup, 9 months
 Change 3(%)-% reduction in size of cyst at 3rdfollowup, 12 months
 Change4(%)-% reduction in size of cyst at 4thfollowup, 2 year

Case 1



[Table/Fig-4]: Cyst in right side body of the mandible

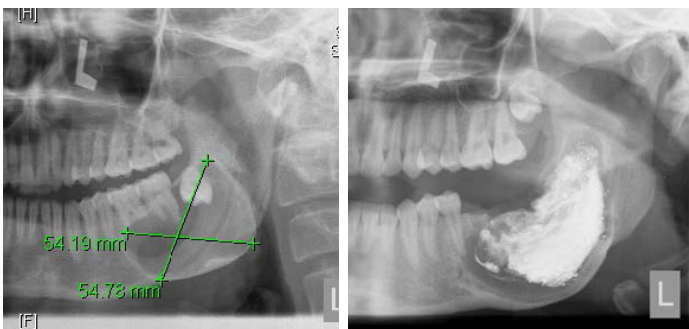


[Table/Fig-5]: Six months follow-up



[Table/Fig-6]: One year follow-up

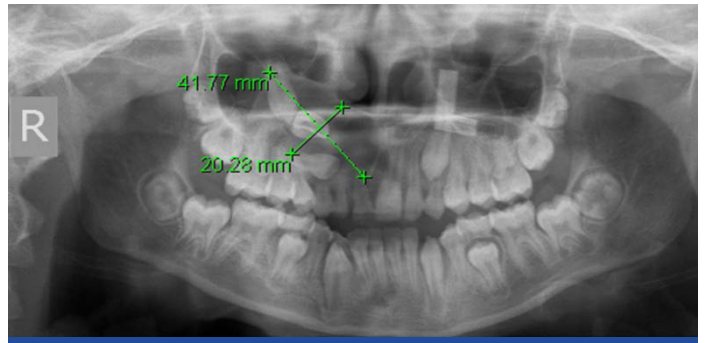
Case 2



[Table/Fig-7]: Cyst in the left side angle-ramus of the mandible [Table/Fig-8]: Immediate bipps packing after enucleation [Table/Fig-9]: Nine months follow-up.



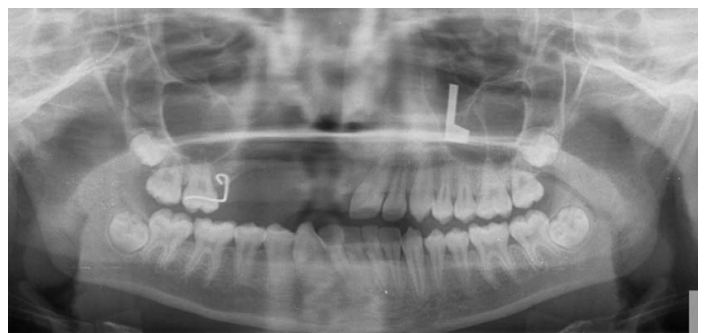
Case 3



[Table/Fig-10]: Right side upper maxillary cyst

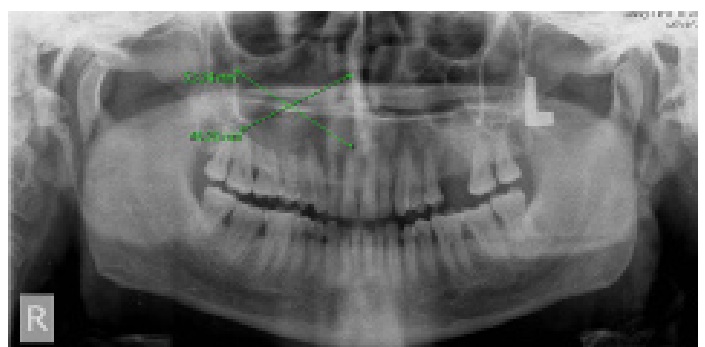


[Table/Fig-11]: One year follow-up



[Table/Fig-12]: Two years follow-up

Case 4



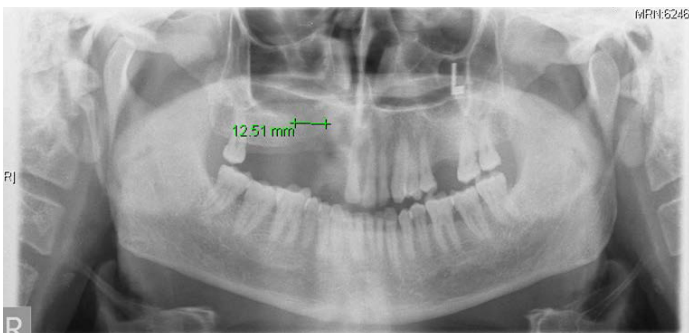
[Table/Fig-13]: Right side upper maxillary cyst



[Table/Fig-14]: Six months follow-up

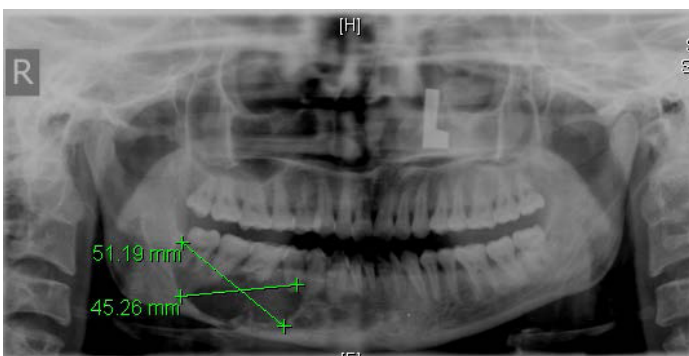


[Table/Fig-15]: Nine months follow-up



[Table/Fig-16]: One year follow-up

Case 5



[Table/Fig-17]: Cyst in right side body of the mandible



[Table/Fig-18]: Nine months follow-up

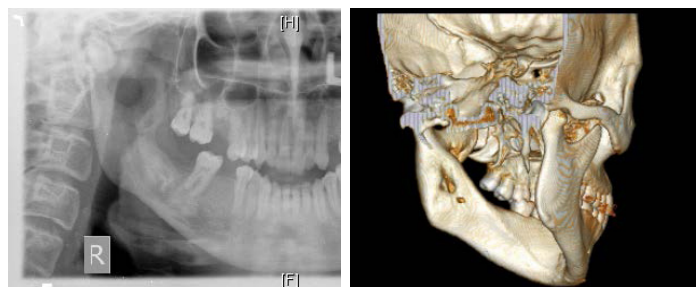


[Table/Fig-19]: One year follow-up

Case 6



[Table/Fig-20]: Cyst in the angle ramus region, immediate post bone biopsy, OPG shows biphasic pack in place [Table/Fig-21]: OPG immediate marsupialisation and biphasic pack placement



[Table/Fig-22]: Patient at 9 months of follow-up showing residual cyst at the ramus [Table/Fig-23]: 3D CT showing persistent lingual cortical perforation

DISCUSSION

The principle of early marsupialisation followed by enucleation after initial bone healing was first proposed by Parsch and backed by Killey and Kay in their pioneering monograph on jaw cysts [2,3]. Recurrence of cysts following enucleation alone has been noted in studies ranging from 11% [4] to 18% [5]. In our protocol if the bone healing at early review (usually 3 months) was inadequate following marsupialisation the patient was continued to be kept under follow-up for a further 3 months. A CT scan was usually done at this review and if the bone deposition was found to be still poor, more aggressive treatment was suggested, usually by resection and reconstruction. This may be required even in odontogenic cysts, especially in the vertical ramus region since such cysts seem to be resistant to decompression and are more likely to recur following enucleation [6]. The use of the digital picture archiving system (PACS) and the same OPG machine enabled the radiographs to be sequenced and compared using digitized measuring tools. The average reduction in size of a cyst at 6 months, 9 months, 12 months and 2 years was 25.85%, 57.13%, 81.03% and 100% respectively. This corresponds with the findings of Chiapasco et al., who treated a series of 27 cases and found 48% healing after 12 months and 91% healing at 24 months by measuring bone density. Comparatively, present study showed a quicker rate of healing in the first year which tapered through the second year but was almost complete by the end of 24 months [7].

Many researchers have attempted grafting with autogenous bone or bone substitutes. However, the present study proves that healing of the cystic defect occurs with spontaneous regeneration. In our series, there were no pathological fractures of the mandible using the treatment protocol, even for very large cysts, revealing that strengthening the bone with replacement materials is not required [7]. Most of our patients were also able to undergo prosthetic rehabilitation. In this series, cyst recurrence occurred in a patient who presented with a large cystic lesion of the vertical ramus of the mandible extending to the condyle. It can be presumed the recurrence may have been due to inadequate removal of the cyst from the condylar region which is an area of poor accessibility. We

agree with Stoelinga's recommendation of close and long term follow up of operated odontogenic cysts because of the risk of recurrence [4].

CONCLUSION

The above findings suggests that normal bone formation along with clinical and radiographic accepted results after surgical removal of jaw cyst without the aid of any graft material, henceforth simplifying the surgical procedure and reducing the post-operative complications associated with grafting the defect. Role of CT scan is inadvertently important in case of cysts that are non-responsive to surgical removal and have persistent cortical perforation. Follow-up is necessary along with patient's compliance for the success of treatment.

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PARTICULARS OF CONTRIBUTORS:

1. Professor and Head, Department of Dental and Oral Surgery, Christian Medical College, Vellore, Tamil Nadu, India.
2. Assistant Professor, Department of Dental and Oral Surgery, Christian Medical College, Vellore, Tamil Nadu, India.
3. Assistant Professor, Department of Dental and Oral Surgery, Christian Medical College, Vellore, Tamil Nadu, India.
4. Fellowship Registrar, Department of Dental and Oral Surgery, Christian Medical College, Vellore, Tamil Nadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Saurabh Kumar,
Assistant Professor, Department of Dental and Oral surgery Unit 1, OPD Block,
Christian Medical College and Hospital, Vellore, Tamil Nadu-632004, India.
E-mail: dr.s.kumar.bds@gmail.com

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