치의학석사 학위논문

Investigation of Postoperative Complications of Intrabony Cystic Lesions in Oral and Maxillofacial Region

구강악안면영역의 악골내 낭종의 수술 후

합병증에 관한 연구

2019년 2월

서울대학교 대학원

치의과학과 구강악안면외과학 전공

이한빈

Investigation of Postoperative Complications of Intrabony Cystic Lesions in Oral and Maxillofacial Region

지도교수 서병무

이 논문을 치의학석사 학위논문으로 제출함

2018 년 11월

서울대학교 대학원

치의과학과 구강악안면외과학 전공

이한빈

이한빈의 석사 학위논문을 인준함

2018 년 12월

위 원 장 명 훈 (인)

부 위 원 장 서 병 무 (인)

위 원 박 주 영 (인)

- Abstract -

Investigation of Postoperative Complications of Intrabony Cystic Lesions in Oral and Maxillofacial Region

Han Bin Lee, D.D.S.

Program in Oral and Maxillofacial Surgery, Department of Dental Science, Graduate School, Seoul National University

(Directed by Professor Byoung Moo Seo, D.D.S., M.S.D., Ph.D.)

Background and Purpose

Intrabony jaw cysts are the most common benign oral and maxillofacial findings. The best treatment option is surgical removal, but postoperative complications are common. The purpose of this study was to identify factors influencing complications in surgical removal of intrabony cysts and any significant correlations between them.

Patients and methods

The case records of 249 patients who underwent surgical removal of intrabony cysts were retrospectively reviewed. Cystic lesions were removed by enucleation by one surgeon in the Department of Oral and Maxillofacial Surgery at Seoul National University Dental Hospital from Jan 1st, 2012 to Dec 31st, 2016.

Outcome variables included postoperative complications, infection, and recurrence; the incidence of those complications was calculated. Predictor variables included patient age, sex, comorbidities, anatomic location, pathologic diagnosis, preoperative infection history, previous marsupialization history, and bone graft methods.

Logistic regression analysis was performed to identify risk factors for postoperative infection and recurrence. The Kruskal-Wallis rank sum test and Wilcoxon rank sum test were used to assess differences in cyst size according to bone graft method, pathologic diagnosis, and sex. The Wilcoxon rank sum test with continuity correction and Bonferroni correction of alpha was used to evaluate differences in cyst size according to anatomic location.

Results

A total of 249 patients (178 males and 71 females) comprising 262 cases were included in this study. Mean age at the time of surgery was 37.6 years. Cystic lesion size increased in the order of no bone graft, xenogeneic bone graft, and autogenous bone graft, with few exceptions. Paresthesia after enucleation of the cystic lesion occurred in 38 cases (14.5%). Pathologic fractures were observed in 4 cases (1.5%), and there were 59 (22.5%) postoperative infections. The postoperative infection rate was as high as 63.6% (n=7/11) in those who underwent autogenous bone grafting (n=11), while the infection rate was as low as 26.8% (n=11/41) in cases of xenogeneic bone grafting and 19.5% (n=41/210) those who did not undergo bone grafting.

Location of the cystic lesion in the maxilla and mandible affected infection rate. When cysts were located in the anterior mandible, no postoperative infection occurred, while infection rate was highest for cysts at the mandibular ramus, followed by those in the posterior mandible.

Cystic lesion recurrence was observed in 7 (2.6%) cases. Among them, five cases were diagnosed as odontogenic keratocyst (OKC), one case was a periapical cyst, and the other was a dentigerous cyst suggesting that cyst pathological identity affects recurrence rate. Cyst size was significantly correlated with recurrence rate.

Conclusion

Postoperative infection rate was higher in the autogenous bone graft group than in the no bone graft group. Cystic lesions located in the anterior mandible were not associated with postoperative infection, and cystic lesions located in the anterior and posterior maxilla had a lower infection rate than cystic lesions located in the posterior mandible. Cystic lesions diagnosed as OKC and larger cystic lesions had a higher recurrence rate than other cystic lesions.

Key words: benign, infection, recurrence, bone graft, enucleation

Student Number: 2017-28257

CONTENTS

I. Introduction

Intrabony cysts in the jaw are the most common benign findings in the oral and maxillofacial area. Cystic jaw lesions are best treated with enucleation and the resultant defects frequently require bone grafts or bone substitutes to accelerate bony healing in order to minimize the possibility of collapse of overlying soft tissues. Large cysts encroaching on vital anatomic structures may need decompression procedures such as marsupialization. The best treatment option to manage the intrabony cystic lesions is surgical removal but the sequelae often result in postoperative complications.

Infection, recurrence, paresthesia, and pathologic fractures occur more frequently than other postoperative complications, however it is still challenging for surgeons to predict various preoperative factors affecting complications rates. These complications may be related to the surgical procedure itself and/or graft materials.

There has been controversy over the need for bone grafting after enucleation of cystic lesions. According to some studies, even if the defect is huge, the cavity after enucleation may heal well without additional treatment.[1-3] Other studies suggested that a defect exceeding a certain size or with a particular configuration cannot heal spontaneously therefore bone grafting should be considered.[4-6] They also insist that grafted bone may reduce the chance of infection, accelerate bone regeneration, and prevent soft tissue collapse into the defect.[2, 4] Autogenous bone has been used as an ideal graft material to reconstruct the defect area,[7] with some disadvantages such as donor site morbidity, additional surgical procedures, and limited availability of donor bone.[8] Although autogenous bone grafting was considered the gold standard for a long time, opting against grafting for relatively small surgical defects has actually been associated with a lower infection rate.[1] With increased popularity of the dental implant, various bone graft substitutes including allogeneic, xenogeneic, or alloplastic materials, are now available.[7] Xenogeneic bone is an osteoconductive material that facilitates bone regeneration by providing a supportive scaffold.

Among the troublesome complications, cyst recurrence must be closely monitored over time. Some aggressive pathologic cysts such as odontogenic keratocyst (OKC) or glandular odontogenic cysts have a high recurrence rate.[9-11]

The purpose of this study is to investigate factors related to postoperative infection and risk factors for cystic lesion recurrence. More specifically the infection risk was evaluated with regard to graft materials, and autogenous bone and xenogeneic bone grafts were compared with no graft cases.

II. Patients and Methods

Study design & sample

The case records of 249 patients who underwent surgical removal of intrabony cysts were retrospectively reviewed. Cystic lesions were removed by enucleation by one surgeon at the Department of Oral and Maxillofacial Surgery at Seoul National University Dental Hospital from Jan 1st, 2012 to Dec 31st, 2016. All 249 patients were Korean, had at least one pathologically diagnosed true cystic lesion that was treated surgically, and attended at least one follow-up visit. A cystic lesion without an epithelial lining (pseudocyst) and soft tissue cysts were excluded. The incidence of major complications was evaluated (postoperative infection, paresthesia, recurrence, and pathologic fractures), and risk factors for postoperative infection and recurrence were evaluated.

Study variables

The primary outcome variable was postoperative infections. The presence of infection was determined by record review. Lesions needing incision and drainage (I&D) procedures postoperatively and/or long term antibiotics were considered postoperative infections. The secondary outcome variable was lesion recurrence, which was detected by follow-up radiographs and finally confirmed by pathologic diagnosis following re-excision. Paresthesia and postoperative pathologic fractures were also investigated as additional outcome variables. Predictor variables included demographic data (age, sex), comorbidities (diabetes, osteoporosis), anatomic factors (cyst location and size), pathologic diagnosis, perioperative conditions (preoperative infection history, previous marsupialization, and bone graft methods).

The anatomic locations of the lesions were categorized as anterior mandible, posterior mandible, ramus, anterior maxilla, or posterior maxilla. The canine and 1st premolar were the border and anterior/posterior limit. The lesion's center was used to define location if it was located in more than two regions. Lesion size was determined by measuring the long axis of the cystic lesion on preoperative CT imaging. Bone graft materials were either xenogeneic (Bio-Oss ®, Geistlich, Wolhusen, Switzerland) or autogenous iliac bone.

Surgical protocol

If the cystic lesion was larger than one third of the maxilla or hemimandible (more than 5 cm in length), marsupialization was considered before enucleation. All cyst enucleation procedures were performed under general anesthesia.

Cysts were enucleated with a surgical curette. The biopsy specimen was then sent to the Department of Oral Pathology for pathologic diagnosis. After enucleation of the cyst, the cyst cavity was thoroughly debrided to remove any remnant cystic lining.

After enucleation, bone grafting with xenogeneic bone material or autogenous iliac bone was considered based on the size and configuration of the defect area. If the resultant defects were small or preoperative infection persisted at the time of operation, bone grafting was usually not performed. Autogenous bone was grafted in particle form using a bone crusher (Bone crusher®, Schwert, Seitingen/Oberflacht, Germany) or bone mill (Leibinger TOM Tessier Osseous Microtome Kit®, Leibinger, Stetten/Tuttlingen, Germany)

Statistical analysis

Multiple logistic regression analysis was performed to analyze risk factors for postoperative infection and recurrence. The Kruskal-Wallis rank sum test and Wilcoxon rank sum test were used assess differences in cyst size according to bone graft method, pathologic diagnosis, and sex. The Wilcoxon rank sum test with Bonferroni correction of alpha was used to evaluate differences in cyst size according to anatomic location. P-values less than 0.05 were considered statistically significant.

III. Results

Demographic data

A total of 249 patients (178 males and 71 females) comprising 262 cases were included in this study. Their mean age was 37.6 years at the time of the surgery (Table 1). Cystic lesions were detected in the posterior mandible (132 cases) most frequently, followed by the anterior maxilla (74 cases), posterior maxilla (29 cases), and ramus (16 cases). The most frequent lesion was a dentigerous cyst (135 cases), followed by periapical cyst (57 cases), odontogenic keratocyst (OKC) (37 cases), and nasopalatine duct cyst (26 cases). There were few cases of glandular odontogenic cyst (2 cases), inflamed cyst (1 case), residual cyst (1 case), and lateral radicular cyst (1 case). Marsupialization was performed in 20 cases, the average size of which was a maximum dimension of 43.4 mm. The mean marsupialization period was 4 months 23 days. At the time of definite cyst enucleation, the average marsupialized cyst size had decreased to 33.85 mm in maximum dimension. Autogenous bone grafting was performed in 11 (4.2%) cases, xenogeneic bone grafting was performed in 41 (15.6%) cases, and primary closure without filling material was performed in 210 (80.2%) cases. Eleven patients had diabetes and four had osteoporosis.

Infection

Postoperative infection occurred in 59 (22.5%) cases. Autogenous bone grafting was a meaningful predictor of postoperative infection. Autogenous iliac bone grafting showed a significantly higher postoperative infection rate than no bone grafting (OR=7.56, P=0.008). Although not statistically significant, xenogeneic bone grafting was associated with a higher infection rate compared with no bone grafting (Table 2) (OR=2.13, P=0.094). The postoperative infection rate was 63.6% (n=7/11) when autogenous bone was grafted (n=11), 26.8% (n=11/41) in xenogeneic bone graft cases, and 19.5% (n=41/210) in no bone graft cases.

Location of the cystic lesion in the maxilla and mandible was a meaningful predictor of infection rate. There were no postoperative infections when cysts were located in the anterior mandible, other regions with low post-op infection rates were the anterior maxilla (9.5%, OR=0.17, P<0.001) and posterior maxilla (10.3%, OR=0.26, P=0.0035). On the other hand, the infection rate was highest in those located at the mandibular ramus followed by the posterior mandible (Table 2). In our study, smaller cysts tended to be located

in the anterior mandible and anterior maxilla. Differences in infection rate according to anatomic location are presented in Table 3. Interestingly, the presence of a preoperative infection was not statistically associated with the incidence of postoperative infection (Table 2). Although not statistically significant, the preoperative infection group had a lower postoperative infection rate than those without a preoperative infection (OR=0.49, *P*=0.056). Preoperative infections were identified in 92 cases, among which there were 13 (14.1%) postoperative infections. Among the 170 cases free of preoperative infection, 46 cases (27.1%) developed a postoperative infection.

The average cystic lesion size was 23.0 mm. In xenogeneic bone graft cases, average cystic lesion size was 24.9 mm, whereas it was 38.7 mm in autogenous bone graft cases, and 21.5 mm in no bone graft cases. The Kruskal-Wallis rank sum test showed a statistically significant difference in lesion size between various bone graft groups (P<0.0001). Though there were a few exceptions, cystic lesion size was in the order of autogenous bone, xenogeneic bone, and no bone graft (Figure 1). The dentigerous cyst group and OKC group had similar cyst sizes while nasopalatine duct cysts and periapical cysts were similar in size. The differences in size between other groups was significant (Figure 2). Large cystic lesions were more prevalent in males (P=0.006226) (Figure 3), and small cystic lesions were more prevalent in the anterior maxilla and anterior mandible (Figure 4).

Recurrences

Recurrence was observed in 7 (2.6%) cases. Five of them were diagnosed as OKC, one was a periapical cyst, and one was a dentigerous cyst, suggesting that the pathological identity of the cyst indeed affects recurrence rate (Table 4). Cyst size was significantly correlated with recurrence rate (Table 4). A higher recurrence rate was observed in large cysts (OR=1.11, *P*=0.028) and OKC cases (OR=11.21, *P*=0.046).

Paresthesia and pathologic fractures

Paresthesia after enucleation occurred in 38 (14.5%) cases. Among them, 11 cases were associated with sacrifice or damage of the nasopalatine nerve after enucleation of a cystic lesion located in the anterior maxilla, and 27 cases occurred after enucleation of cystic lesions encroaching into the mandibular canal. There were four (1.5%) pathologic fractures. The mean age of patients with a pathologic fracture was 50.8 years, and all fractures were

at the angle of the mandible. In patients who suffered from pathologic fractures, the mean thickness of the remaining bone on panoramic radiographs was 7.3 mm. Pathologic fractures were identified 33 days, 40 days, 96 days and 102 days after surgery in each case.

IV. Discussion

Autogenous bone graft material has all the desired properties of a bone graft material, including osteogenesis, osteoconduction, and osteoinduction capabilities.[12] For this reason it is still considered the gold standard among bone graft materials.[7] It is generally accepted that autogenous bone graft material results in more favorable postoperative conditions and less frequent adverse immunological response.[8] According to many previous reports, autogenous iliac bone grafting after cyst enucleation is a favorable treatment modality associated with good prognosis. Prade reported that no infections occurred in 11 autogenous bone graft transplants.[13] Carlo et al. reported an infection rate of 15.7% in 56 patients who underwent autogenous grafting for mandibular defects.[14] Contrary to the general belief that autogenous bone graft material has a lower infection risk than xenogeneic bone graft material, our results showed a significantly higher postoperative infection rate in the autogenous iliac bone graft group. In a recently published paper, Lim et al. also reported a similarly higher infection risk in autogenous bone graft cases. [15] The general belief that autogenous bone grafting has a lower infection rate therefore may not be true. In our study, cysts that underwent autogenous bone grafting were on average larger than those that were not grafted and those for which xenogeneic bone grafting was performed (Figure 1). This implies that the higher infection rate in autogenous iliac bone graft cases may be related to central dead space, which is vulnerable to opportunistic infection by oral bacterial flora[1, 16-18] Furthermore, patients might have been prone to infection because of the increased morbidity and surgical time associated with donor site harvesting. [8]

Xenogeneic bone grafting was not associated with a significantly higher infection rate than no bone grafting. The postoperative infection rate in the xenogeneic bone graft cases was 26.8% (n=11/41), which is similar to that reported in previous studies. Weiss reported a 21% infection rate and Horowitz and Bodner reported a 20% infection rate using Kiel bone as a filling material. [18, 19]

In our study, the incidence of postoperative infection was lowest in cases who did not undergo bone grafting (n = 41/210; 19.5%). Similar results were found in the literature with infection rates ranging from 0% to 23.1%. [2] This wide range in reported infection rates may arise from the different criteria used to define postoperative infection. In our study, no complete graft loss occurred, even in cases with postoperative infection. [2]

Another interesting finding is that postoperative infection rate was lower in cases with a preoperative infection. This means that the long term use of antibiotics (usually two to four weeks until resolution of infection) may reduce postoperative infections. We may cautiously suggest that, if a known infection

is well controlled and being actively treated at the time of the surgery, then this should not be a contraindication to a bone graft procedure.

Interestingly, there were no postoperative infections in patients with cysts located in the anterior mandible. Low post-op infection rates were observed in the anterior maxilla and posterior maxilla. The highest infection rate was at the mandibular ramus and the posterior mandible. In our study, smaller cysts tended to be located in the anterior mandible and anterior maxilla. Only two cases in the posterior maxillary region underwent bone grafting (Figure 4, Table 5). The confounding effect of cyst size and location and tendency to opt against bone grafting in the posterior maxillary region may be reasons underlying the lower infection rate in the anterior mandible and maxilla in this study. Lim et al. suggested that cysts in the posterior mandibular or ramus area usually include partially erupted wisdom teeth, which hinder watertight primary closure of lesions after enucleation.[15] The lower infection rates in the maxilla may be due to the rich vascular network in this region.

Approximately 14.5% of patients complained about paresthesia after enucleation, but most symptoms resolved over time. Pathologic fractures after cyst enucleation were rare (1.5%). They occurred mostly in the mandible and usually did not happen right after surgery. We therefore recommend that patients be warned about the possible risk of pathologic fracture during the follow-up period. The incidence of fractures in our study was similar to that reported in the literature (0.5% - 3.1%).[2] The highest risk is for lesions affecting the angle of the mandible.

Recurrence was infrequently observed at a rate of 2.6% (n=7/262), which is lower than in the literature (10 – 15%).[20-22] Among the seven recurrent cases, five were diagnosed as OKC (OKC recurrence rate: 13.5%). The lower recurrence rate in our study may be due to the relatively short follow-up period (average of approximately two years). Some aggressive cystic lesions such as OKC or glandular odontogenic cysts can recur even after seven years;[9, 22-24] therefore the recurrence rate in our study may be an underestimate. There are conflicting opinions about the effect of size on cyst recurrence after surgery. Some studies reported a similar recurrence rate between large and small lesions.[25-28] On the other hand, some studies insist that larger lesions are more prone to recurrence, which is consistent with our findings.[29] Furthermore, OKC has a high reported recurrence rate (0 to 62%) as shown in our study.[30]

Factors affecting major postoperative complications after intrabony cyst resection (infection and recurrence) were bone grafting, bone graft material, lesion location and pathological identity of the cyst. Clinicians can use this information to better predict treatment outcomes and complication rates.

This study is limited by its retrospective design and the confounding effect

of bone grafting method and lesion size (Figure 1). [31] The advantage of this study is that surgeries were performed by one surgeon and the effect of bone graft method on the infection rate was investigated in many cases.

V. Conclusion

Postoperative infection rate was higher in the autogenous bone graft group than in the no bone graft group. Preoperative infection did not have a statistically significant effect on postoperative infection. There were no postoperative infections in patients with cystic lesions of the anterior mandible, and cystic lesions located in the anterior and posterior maxilla had a lower infection rate than those located in the posterior mandible. Cystic lesions diagnosed as OKC and larger lesions had a higher recurrence rate than other cystic lesions.

Tables

Table 1. Descriptive summary of study samples

Study Variables		Descriptive statistics (%)
Sample size		262 (100)
Female gender		76 (29.0)
Age (years)		37.6 ± 17.0
Anatomic location	Anterior mandible	11 (4.2)
	Posterior mandible	132 (50.4)
	Ramus	16 (6.1)
	Anterior maxilla	74 (28.2)
	Posterior maxilla	29 (11.1)
Pathologic diagnosis	Dentigerous cyst	135 (51.3)
	Periapical cyst	57 (21.8)
	Odontogenic keratocyst	37 (14.1)
	Nasopalatine duct cyst	26 (9.9)
	Glandular odontogenic cyst	2 (0.8)
	Inflamed cyst	1 (0.4)
	Residual cyst	1 (0.4)
	Lateral radicular cyst	1 (0.4)
	Paradental cyst	2 (0.8)
Cyst size (mm)		23.0 ± 8.0
Bone graft method	None	210 (80.2)
	Xenogenic bone graft	41 (15.6)
	Autogenic bone graft	11 (4.2)
Previous marsupialization (Yes)		20 (7.6)
Co-morbidities	Diabetes (yes)	13 (5.0)
	Osteoporosis (yes)	6 (2.3)
	Fracture (yes)	4 (1.5)
	Paresthesia (yes)	38 (14.5)
Pre-operative infection (Yes)		92 (35.1)
Post-operative infection (Yes)		59 (22.5)
Post-operative recurrence (Yes)		7 (2.7)

Data presented as n (%) or mean ± standard deviation

Table 2. Results of the logistic regression analysis on the postoperative infection

Study Variables (reference)		Odds ratio	95% Confidence Interval	*P* Value
Gender (Male)	Female	2.08	(0.94 – 4.59)	0.070
Age (1-year increments)		0.99	(0.97 - 1.02)	0.0591
Anatomic location (Posterior mandible)	Ramus	0.70	(0.18 – 2.66)	0.599
	Anterior maxilla	0.17	(0.07 – 0.42)	0.001
	Posterior maxilla	0.26	(0.07 – 0.91)	0.035
Bone graft method (No bone graft)	Xenogeneic bone graft	2.13	(0.88 – 5.16)	0.094
	Autogenic bone graft	7.56	(1.69 – 33.77)	0.008
Pre-operative infection (Yes)	No	0.49	(0.23 – 1.04)	0.056

Table3. Postoperative infection rate based on anatomic location

Anatomic location	No infection (N)	Infection (N)	Infection rate (%)
Anterior mandible	11	0	0
Posterior mandible	89	46	34.1
Ramus	10	6	37.5
Anterior maxilla	67	7	9.5
Posterior maxilla	26	3	10.3

Table4. Results of the logistic regression analysis on the postoperative recurrence

Study Variables (reference)		Odds ratio	95% Confidence Interval	*P* Value
Gender (Male)	Female	0.54	(0.09 – 3.16)	0.496
Age (1-year increments)		0.97	(0.92 - 1.03)	0.289
Pathologic diagnosis (Dentigerous cyst)	Periapical cyst	3.68	(0.19 – 70.32)	0.386
	Odontogenic keratocyst	11.21	(1.05 – 119.73)	0.046
Cyst size (1 mm increment)		1.11	(1.01 – 1.21)	0.028

Table 5. Bone graft methods based on anatomic location

Anatomic location	No graft (N)	Xenogeneic graft (N)	Autogenous graft (N)
Anterior mandible (11)	9	2	0
Posterior mandible (132)	113	16	3
Ramus (16)	8	3	5
Anterior maxilla (74)	53	18	3
Posterior maxilla (29)	27	2	0

Figure Legends

Figure 1. The distribution of cyst size based on graft method. With a few exceptions, the median cystic lesion size decreased in the order of autogenous bone, xenogeneic bone, and no bone graft. The Kruskal-Wallis rank sum test revealed a significant association between cyst size and bone grafting method ($P<0.0001$).

Figure 2. The distribution of cyst size based on pathologic diagnosis. The odontogenic keratocyst and dentigerous cyst were similar in size, and the periapical cyst and nasopalatine duct cyst showed similar size distributions.

Figure 3. Cyst size based on sex. Lesions were significantly larger in males than females.

Figure 4. Cyst size based on anatomic location. Small lesions were more frequently observed in the anterior mandible and anterior maxilla.
The Kruskal-Wallis rank sum test demonstrated that cyst size distribution was significantly associated with anatomic location ($P<0.0000001$).

Figures

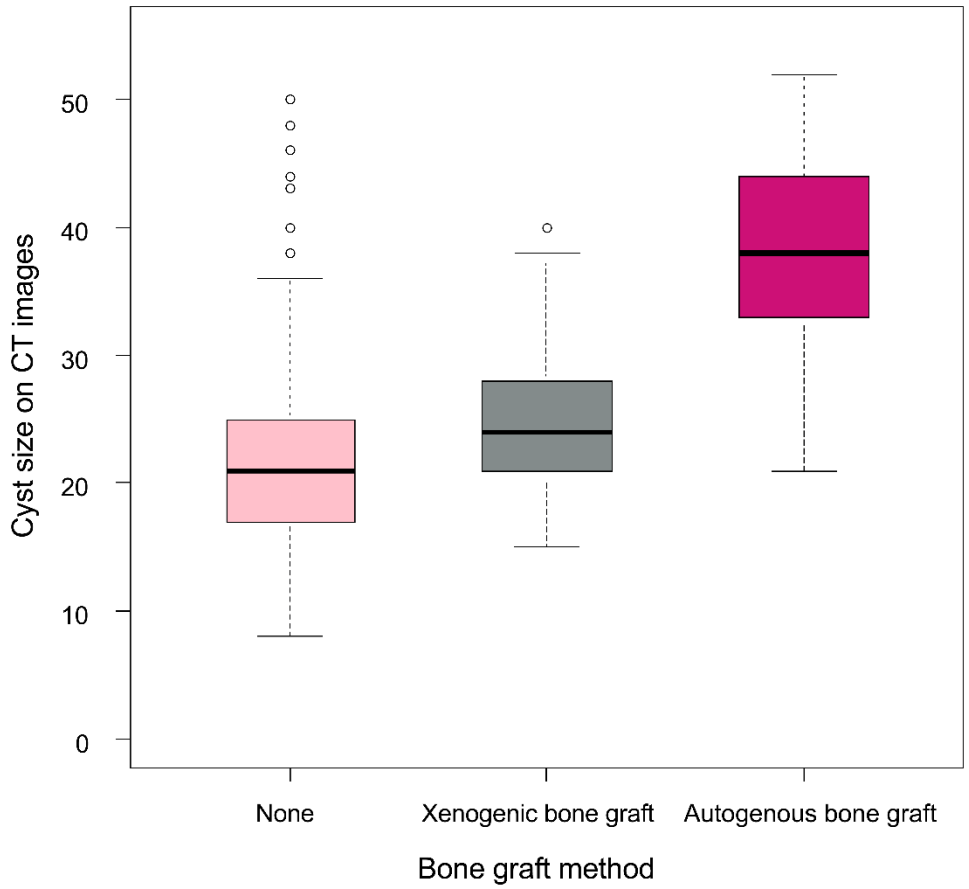

Figure 1. Size of cyst based on graft methods

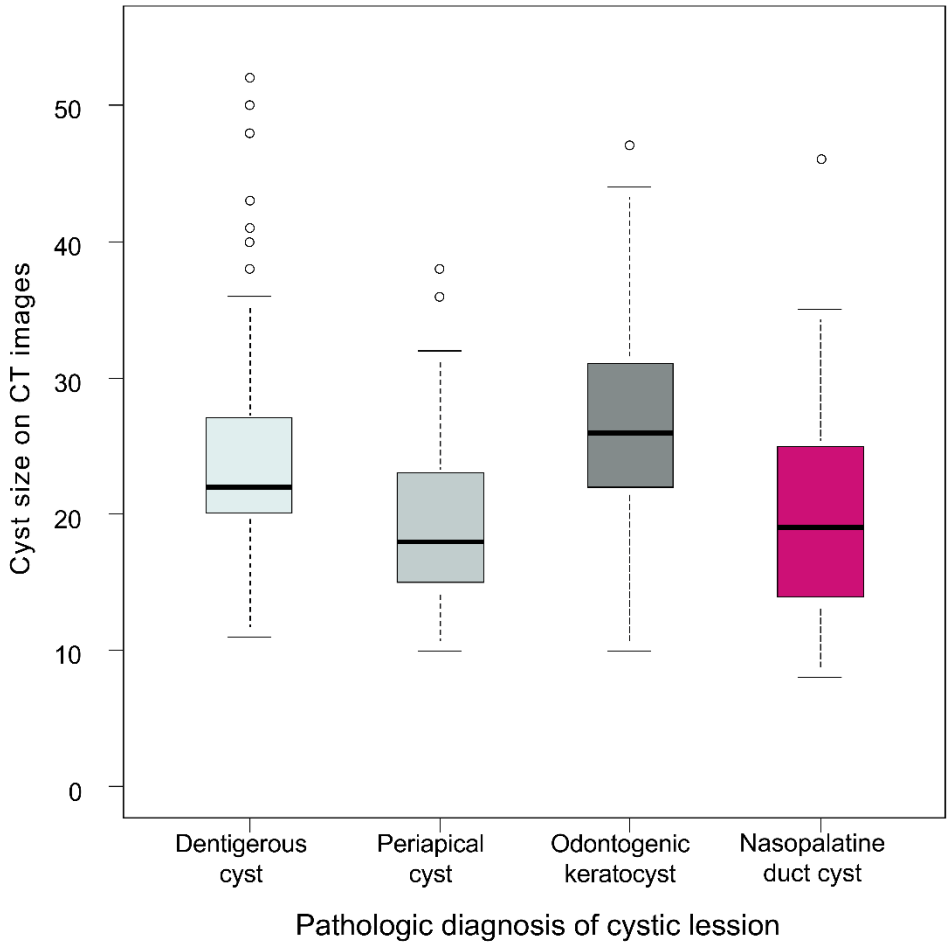

Figure 2. Size of cyst based on pathology type

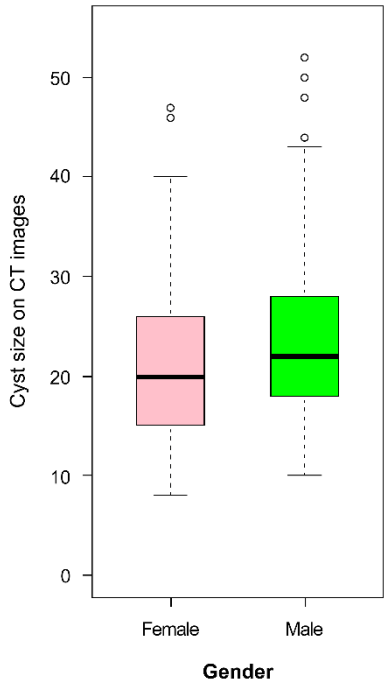

Figure 3. Size of cyst based on sex of patient

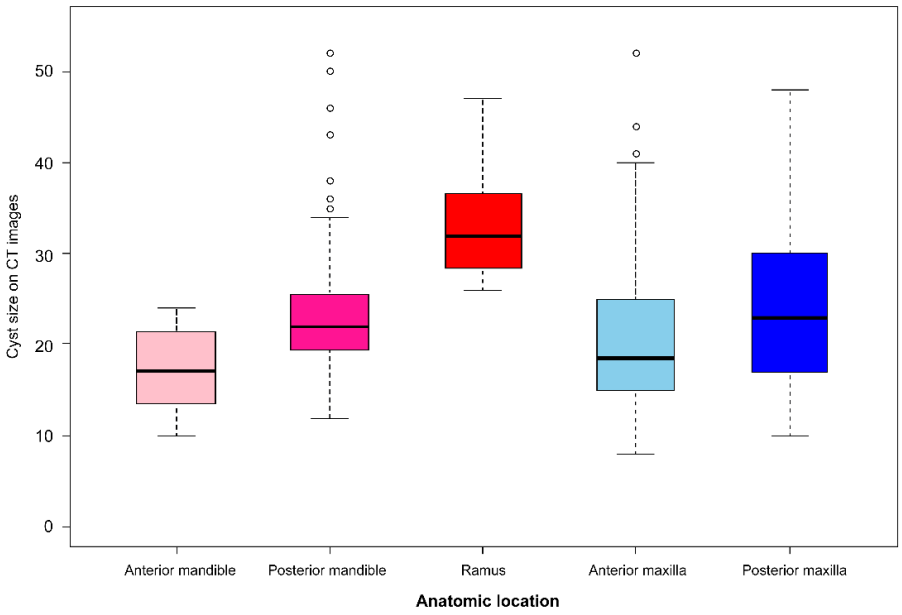

Figure 4. Size of cyst based on anatomic location

References

1. Chiapasco M, Rossi A, Motta JJ, Crescentini M. Spontaneous bone regeneration after enucleation of large mandibular cysts: A radiographic computed analysis of 27 consecutive cases. *J Oral Maxillofac Surg* 2000;58:942-948.

2. Ettl T, Gosau M, Sader R, Reichert TE. Jaw cysts - filling or no filling after enucleation? A review. *J Craniomaxillofac Surg* 2012;40:485-493.

3. Wagdargi SS RK, Arunkumar KV, Katkol B, Arakeri G. Evaluation of Spontaneous Bone Regeneration after Enucleation of Large Cysts of the Jaws using Radiographic Computed Software. *J Contemp Dent Pract* 2016;17:489-495.

4. Schlegel KA, Lang FJ, Donath K, Kulow JT, Wiltfang J. The monocortical critical size bone defect as an alternative experimental model in testing bone substitute materials. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;102:7-13.

5. Hollinger JO, Kleinschmidt JC. The critical size defect as an experimental model to test bone repair materials. *J Craniofac Surg* 1990;1:60-68.

6. Schmitz JP, Hollinger JO. The critical size defect as an experimental model for craniomandibulofacial nonunions. *Clin Orthop Relat Res* 1986:299-308.

7. Kao ST, Scott DD. A Review of Bone Substitutes. *Oral Maxillofac Surg Clin North Am* 2007;19:513-521.

8. Filho HN, Pinto TF, de Freitas CP, Ribeiro-Junior PD, dos Santos PL,

Matsumoto MA. Autogenous Bone Grafts Contamination After Exposure to the Oral Cavity. *J Craniofac Surg* 2014;25:412-414.

9. Kaplan I, Gal G, Anavi Y, Manor R, Calderon S. Glandular odontogenic cyst: Treatment and recurrence. *J Oral Maxillofac Surg* 2005;63:435-441.

10. Regezi JA. Odontogenic Cysts, Odontogenic Tumors, Fibroosseous, and Giant Cell Lesions of the Jaws. *Mod Pathol* 2002;15:331.

11. Lyrio MC, de Assis AF, Germano AR, de Moraes M. Treatment of mandibular glandular odontogenic cyst with immediate reconstruction: case report and 5-year follow-up. *Br J Oral Maxillofac Surg* 2010;48:651-653.

12. Egol KA, Nauth A, Lee M, Pape H-C, Watson JT, Borrelli JJ. Bone Grafting: Sourcing, Timing, Strategies, and Alternatives. *J Orthop Trauma* 2015;29:S10-S14.

13. Pradel W, Eckelt U, Lauer G. Bone regeneration after enucleation of mandibular cysts: comparing autogenous grafts from tissue-engineered bone and iliac bone. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101:285-290.

14. Ferretti C, Muthray E, Rikhotso E, Reyneke J, Ripamonti U. Reconstruction of 56 mandibular defects with autologous compressed particulate corticocancellous bone grafts. *Br J Oral Maxillofac Surg* 2016;54:322-326.

15. Lim H-K, Kim J-W, Lee U-L, Kim J-W, Lee H. Risk Factor Analysis of Graft Failure With Concomitant Cyst Enucleation of the Jaw Bone: A Retrospective Multicenter Study. *J Oral Maxillofac Surg* 2017;75:1668-1678.

16. Thomas MV, Puleo DA. Infection, Inflammation, and Bone Regeneration: a

Paradoxical Relationship. *J Dent Res* 2011;90:1052-1061.

17. van Blitterswijk CA GJ, de Groot K, Daems WT, Kuijpers W. The biological performance of calcium phosphate ceramics in an infected implantation site: I. Biological performance of hydroxyapatite during Staphylococcus aureus infection. *J Biomed Mater Res* 1986;20:989-1002.

18. Horowitz I, Bodner L. Use of xenograft bone with aspirated bone marrow for treatment of cystic defect of the jaws. *Head Neck* 1989;11:516-523.

19. Weiss P. Experiences with the kiel bone graft in the surgical treatment of maxillary cysts. *Langenbecks Arch Klin Chir Ver Dtsch Z Chir* 1964;306:86-91.

20. Iatrou I, Theologie-Lygidakis N, Leventis M. Intraosseous cystic lesions of the jaws in children: A retrospective analysis of 47 consecutive cases. *Oral Surg Oral Med Oral Pathol Radiol Endod* 2009;107:485-492.

21. Shear M. Cysts of the oral regions. *(3rd ed), Wright, Oxford, UK* 1992.

22. Zhao YF, Wei JX, Wang SP. Treatment of odontogenic keratocysts: a follow-up of 255 Chinese patients. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2002;94:151-156.

23. Crowley TE, Kaugars GE, Gunsolley JC. Odontogenic keratocysts: a clinical and histologic comparison of the parakeratin and orthokeratin variants. *J Oral Maxillofac Surg* 1992;50:22-26.

24. Stoelinga PJW. Etiology and pathogenesis of keratocysts. *Oral Maxillofac Surg Clin North Am* 2003;15:317-324.

25. Kuroyanagi N, Sakuma H, Miyabe S, et al. Prognostic factors for keratocystic odontogenic tumor (odontogenic keratocyst): analysis of clinico-pathologic and immunohistochemical findings in cysts treated by enucleation. *J Oral Pathol Med* 2009;38:386-392.

26. Myoung H, Hong S-P, Hong S-D, et al. Odontogenic keratocyst: Review of 256 cases for recurrence and clinicopathologic parameters. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2001;91:328-333.

27. Forssell K, Forssell H, Kahnberg KE. Recurrence of keratocysts. A long-term follow-up study. *Int J Oral Maxillofac Surg* 1988;17:25-28.

28. Enislidis G, Fock N, Sulzbacher I, Ewers R. Conservative treatment of large cystic lesions of the mandible: a prospective study of the effect of decompression. *Br J Oral Maxillofac Surg* 2004;42:546-550.

29. Gosau M, Draenert FG, Muller S, et al. Two modifications in the treatment of keratocystic odontogenic tumors (KCOT) and the use of Carnoy's solution (CS)--a retrospective study lasting between 2 and 10 years. *Clin Oral Investig* 2010;14:27-34.

30. Tolstunov L, Treasure T. Surgical Treatment Algorithm for Odontogenic Keratocyst: Combined Treatment of Odontogenic Keratocyst and Mandibular Defect With Marsupialization, Enucleation, Iliac Crest Bone Graft, and Dental Implants. *J Oral Maxillofac Surg* 2008;66:1025-1036.

31. Ihan Hren N, Miljavec M. Spontaneous bone healing of the large bone defects in the mandible. *Int J Oral Maxillofac Surg* 2008;37:1111-1116.

국문초록

구강악안면영역의 악골내 낭종의 수술 후 합병증에 관한 연구

이한빈

서울대학교 치의학 대학원 치의과학과 구강악안면외과학 전공

(지도교수 서병무)

연구 배경 및 목적

악골내 발생한 낭종은 구강악안면영역에서 가장 흔한 양성병소로 대부분 외과적 제거로 잘 치료되나, 간혹 술 후 합병증이 발생하는 경우가 있다.

본 연구의 목적은 골내 낭종의 외과적 처치 이후 발생한 합병증에 영향을 미치는 요인을 분석해 보고 합병증의 발생과 상기 요인 의 상관관계를 알아보고자 한다.

환자 및 방법

2013년에서 1월부터 2016년 12월까지 서울대학교 치과병원 구강악안면외과에서 한 명의 외과의사에게 낭종적출술을 시행 받아 병리학적 조직

검사 결과 골내낭종으로 진단된 249명의 환자의 의무기록 및 방사선 사진을 후향적으로 분석하였다. 예측 변수는 나이, 성별, 병소의 위치, 병소의 병리학적 진단, 술 전 감염 병력, 술 전 조대술 시행여부, 골이식 방법 등이었고, 결과 변수는 술 후 감염 및 재발이었다. 술 후 감염 및 재발의 위험요소를 분석하기 위하여 로지스틱회귀분석을 사용하였다. 골이식 방법, 병리학적 진단, 및 성별에 따라 낭종 크기의 차이가 존재하는지 알아보기 위하여 Kruskal-Wallis rank sum test와 Wilcox rank sum test를 사용하였다. 병소의 해부학적 위치에 따른 낭종 크기의 차이가 존재하는지 알아보기 위하여 Wilcoxon rank sum test with continuity correction and Bonferroni correction of alpha를 사용하였다.

결과

249명의 환자(남: 178명, 여: 71명) 에서 총 262 증례를 조사하였고 이들의 수술 받을 당시 평균 나이는 37.6세였다. 몇몇의 예외가 존재 하였지만, 병소의 크기는 주로 자가골이식을 시행한 군, 이종골이식을 시행한 군, 골이식을 시행하지 않은 군 순으로 나타났다. 술 후 감각 이상은 38 증례에서 발생하였다(14.5%). 병리학적 골절은 4명(1.5%) 증례에서 발생하였다. 술 후 감염은 59(22.5%) 증례에서 발생하였다. 자가골을 이식을 시행한 경우 총 11 증례 중 7(63.6%) 증례에서 감염이 발생하여 가장 높은 감염률을 보였다. 이종골이식을 시행한 경우 총 41증례 중 11(26.8%) 명의 증례에서 감염이 발생했으며 골이식을 시행하지 않은 총 210 증례 중 41(19.5%) 증례에서 감염이 발생하여 제일 낮은 감염률을 보였다.
하악 전방부에서 술 후 감염이 발생하지 않았으며, 하악지 부위에서 가장 높은 감염률을 보였고 하악후방부가 그 뒤를 이어 높은 감염률을 보였다.
재발은 7(2.6%) 증례에서 발생하였다. 재발이 발생한 7 증례는 치성각화낭종 5증례, 치근단낭종 1증례, 함치성낭종 1증례로 치성각화낭종은 높은

재발률을 보였다. 크기가 큰 병소에서 통계적으로 유의하게 높은 재발률을 보였다.

결론

자가골 이식을 시행한 군이 골 이식을 시행하지 않은 군에 비해 높은 술 후 감염률을 보였다. 하악 전방부에서 술 후 감염이 발생하지 않았으며, 상악 전방부 및 상악 후방부에 위치하는 병소는 하악 후방부에 위치하는 병소에 비해 낮은 술 후 감염률을 보였다.

치성각화낭종으로 진단된 병소와 크기가 큰 병소는 높은 재발률을 보였다.

주요어: 양성(Benign), 감염(Infection), 재발(Recurrence), 골이식(Bone graft), 적출술(Enucleation)

학 번: 2017-28257