Analysis of sedation and general anesthesia in patients with special needs in dentistry using the Korean healthcare big data

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Background: People with special needs tend to require diverse behavioral management in dentistry. They may feel anxious or uncomfortable or may not respond to any communication with the dentists. Patients with medical, physical, or psychological disorders may not cooperate and therefore require sedation (SED) or general anesthesia (GA) to receive dental treatment. Using the healthcare big data in Korea, this study aimed to analyze the trends of SED and GA in special needs patients undergoing dental treatment. It is believed that these data can be used as reference material for hospitals and for preparation of guidelines and related policy decisions of associations or governments for special needs patients in dentistry.

Methods: The study used selected health information data provided by the Korean National Health Insurance Service. Patients with a record of use of one of the eight selected drugs used in dental SED between January 2007 and September 2019, those with International Classification of Diseases-10 codes for attention deficit hyperactivity disorder (ADHD), phobia, brain disease, cerebral palsy, epilepsy, genetic disease, autism, mental disorder, mental retardation, and dementia were selected. The insurance claims data were analyzed for age, sex, sedative use, GA, year, and institution.

Results: The number of special needs patients who received dental treatment under SED or GA from January 2007 to September 2019 was 116,623. Number of SED cases was 136,018, performed on 69,265 patients, and the number of GA cases was 56,308, implemented on 47,257 patients. In 2007, 3100 special needs patients received dental treatment under SED while in 2018 the number of cases increased 6 times to 18,528 SED cases. In dentistry, ADHD was the most common disability for SED cases while phobia was the most common cause of disability for GA. The male-to-female ratio with respect to SED cases was higher for males (M : F = 64.36% : 35.64%).

Conclusion: The application of the SED method and GA for patients with special needs in dentistry is increasing rapidly; thus, preparing guidelines and reinforcing the education and system are necessary.

Keywords: Big Data; Dental Sedation; General Anesthesia; Healthcare; People with Disability.

INTRODUCTION

Dental care for people with special needs is the treatment of patients who are medically, physically, or mentally abnormal [1]. Patients with physical and mental problems may have several difficulties and limitations in receiving dental care [2]. People with special needs who exhibit anxiety and fear during dental treatment or who are not able to cooperate because of cognitive impairment, may need dental treatment under sedation (SED) or general anesthesia (GA) [3]. There is a method of
controlling behavior in dental treatment for special needs patients, but there is also a method of dental treatment under GA, especially if the treatment takes a long time and or the treatment is invasive and complex [4]. Recently, a thorough investigation of the healthcare big data identified the practice of SED or GA according to the type of disability in dental treatment [5]. Therefore, this study used the big data from the Korean National Health Insurance Service (KNHIS) to analyze and assess the SED and GA practices in dental treatment of patients with special needs in Korea.

The current state of dental SED and GA can be observed through the years using this data applied to the Health Insurance Review and Assessment Service (HIRA) [6]. Specifically, the number and characteristics of patients per year and the number of medical institutions and changes in characteristics can be confirmed. In addition, whether SED or GA was used and the type of disability were analyzed. Medical records of patients who had undergone dental treatments were used to understand the actual condition of the patient. The data analyzed through this can be used as reference data in establishing the dental policy of dental associations and also for the demand of dental hospitals for people with special needs. This can contribute to the direction of education related to medical and dental treatments and institutions for people with special needs.

METHODS

1. Study design and source of data

The healthcare big data hub, operated by the Korean Health Insurance Review and Assessment Service (HIRA) includes information on the use of medical service, usage of medications, and diagnosed diseases [6]. The data are stored and public can remotely access the information for secondary use upon request and payment [7]. HIRA approved the use of customized health information (M201910144119) of the healthcare big data hub (https://opendata.hira.or.kr/). The requested data from January 2007 to September 2019 were used as the data source for the subjects. The study was conducted with the approval of the Institutional Review Board of Seoul National University School of Dentistry (IRB No. S-020200006).

Firstly, a request was made to the healthcare big data hub for the payment data of patients at dental hospitals and dental clinics who made insurance claims for one of the following eight sedatives: chloral hydrate, hydroxyzine, propofol, sevoflurane, midazolam, triazolam, N2O, or dexmedetomidine, which can be used in dental SED. To analyze the medical history of each patient, the general summary information (200 table), treatments (300 table), and diagnosis (400 table) were extracted from the data warehouse containing information on medical treatments carried out between January 2007 and September 2019 [8].

The International Classification of Diseases (ICD)-10

| ICD-10 Disease Classification Code | Disease | Disability |
|-----------------------------------|---------|------------|
| F90~91 | ADHD | 1 ADHD |
| F43 | PTSD | 2 Phobia |
| F41~42, F43 | Anxiety disorder | 2 Phobia |
| F40 | Phobia | |
| F84 | Autism | 3 Autism |
| F80 | Speech disorder | 4 Mental retardation |
| F70~73,78,79 | Mental retardation | |
| F30~34,38~40 | Depression | 5 Mental disorder |
| F06, F07 | Diseases of the CNS | |
| I60~69 | Cerebrovascular disease | 6 Genetic disease |
| F05 | Delirium | |
| F10 | Mental disorder due to alcohol | |
| G40~41 | Epilepsy | 7 Epilepsy |
| G10~13, G70~73, G60, G80~83 | Diseases of myoneural junction and muscle | 8 Hereditary neuropathy |
| G80~83 | Cerebral palsy | 9 Cerebral palsy |
| F00~03, G30~31, G20~23 | Dementia | 10 Parkinson disease |

ADHD, attention deficit hyperactivity disorder; CNS, central nervous system; ICD, International Classification of Diseases; PTSD, post-traumatic stress disorder
Table 2. Number of cases and total number of patients by disability (from January 1, 2007, to September 30, 2019)

| Disability          | Number of cases (%) | Total Patients |
|---------------------|---------------------|----------------|
|                     | No GA or SED | SED | GA | Total |
| ADHD                | 217885 (88%) | 28276 (11.4%) | 1451 (0.6%) | 247612 (100%) | 13685 |
| Phobia              | 638975 (95.6%) | 15721 (2.4%) | 3860 (0.6%) | 668459 (100%) | 22089 |
| Brain disease       | 650217 (94.4%) | 26585 (3.9%) | 12169 (1.8%) | 688971 (100%) | 24842 |
| Cerebral palsy      | 67828 (88.7%) | 6252 (8.2%) | 2384 (3.1%) | 76464 (100%) | 4541 |
| Epilepsy            | 147408 (89.6%) | 12545 (7.6%) | 775 (2.8%) | 16495 (100%) | 9134 |
| Genetic disease     | 32338 (90.6%) | 2570 (7.2%) | 775 (2.2%) | 35883 (100%) | 1865 |
| Autism              | 71726 (85.1%) | 10263 (12.2%) | 2325 (2.8%) | 84314 (100%) | 6597 |
| Mental disorder     | 483659 (95.7%) | 9806 (1.9%) | 12067 (2.4%) | 50532 (100%) | 16945 |
| Mental retardation  | 164932 (86.4%) | 22232 (11.6%) | 3814 (2%) | 190978 (100%) | 12900 |
| Dementia            | 133982 (96.6%) | 1768 (1.3%) | 3018 (2.2%) | 138768 (100%) | 4025 |
| Total               | 2608950 (93.1%) | 136018 (4.9%) | 56308 (2%) | 2801276 (100%) | 116623 |

ADHD, attention deficit hyperactivity disorder; GA, general anesthesia; SED, sedation.

codes of the 400 table were searched in the remote statistical analysis system, and patients with the ICD-10 codes for dementia (F00–03), delirium (F05), mental disorder to brain damage (F06), brain disease, damage, dysfunction (F07), unspecified organic or symptomatic mental disorders (F09), mental disorder due to use of alcohol (F10), schizophrenia (F20–25,28,29), mood disorders (F30–34,38,39), phobic anxiety disorders (F40), other anxiety disorders (F41–42), reaction to severe stress (F43), mental retardation (F70–73,78,79), developmental disorder of speech and language (F80), autism (F84), attention deficit hyperactivity disorder (ADHD) (F90–91), inflammatory diseases of the CNS (G00–09), systemic atrophies affecting the CNS (G10–13), extrapyramidal and movement disorders (G20–23), degenerative diseases of the nervous system (G30–31), demyelinating diseases of the CNS (G35–37), hereditary and idiopathic neuropathy (G60), polynuropathy (G61–63), diseases of myoneural junction and muscle (G70–73), cerebral palsy (G80–83), other disorders of the nervous system (G90–99), and cerebrovascular diseases (I60–69) were selected (Table 1).

In order to exclude misdiagnosis, the patient was classified as having a disability only if there were more than two prescriptions for diagnosis of this disability (Table 1).

2. Grouping of GA or SED

The GA code (L121) for GA and N2O behavioral management code (U237) for SED were searched in the medical service item code (DIV_CD; treatment, medical materials, and drugs) of the treatment table (300 table) for each of the 2,801,276 cases. Cases with the GA code were classified as cases of GA. Cases with the N2O behavioral management code rather than the GA code, or with one or more of the eight sedatives listed above as a named generic drug code (GNL_CD) in the treatment table (300 table), were classified as SED cases. All other cases were classified as no anesthesia cases, where neither SED nor GA had been implemented [9].

3. Yearly trend of special needs patients by GA or SED cases

For analysis, information on the pseudonym personal identification number (JID), pseudonym hospital identification number (YID), sex, age, and claim date were collected from the general summary information table.
Table 3. Change in the number of annual sedation cases by disability (from January 1, 2007, to September 30, 2019)

| Disability       | 2007  | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | Total   |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
| ADHD             | 402   | 503   | 489   | 658   | 912   | 1093  | 1403  | 2942  | 4279  | 4520  | 4144  | 3580  | 3351  | 28276   |
| Phobia           | 661   | 720   | 731   | 777   | 771   | 750   | 891   | 1323  | 1847  | 1917  | 1873  | 1743  | 1717  | 15721   |
| Brain Disease    | 590   | 630   | 686   | 806   | 880   | 899   | 1147  | 2307  | 3210  | 3801  | 4006  | 3827  | 3706  | 26585   |
| Cerebral Palsy   | 95    | 128   | 151   | 167   | 208   | 234   | 270   | 537   | 739   | 910   | 942   | 903   | 903   | 6252    |
| Epilepsy         | 224   | 279   | 315   | 382   | 446   | 446   | 588   | 1225  | 1505  | 1843  | 1823  | 1663  | 1806  | 12545   |
| Genetic Disease  | 41    | 60    | 65    | 55    | 82    | 94    | 103   | 224   | 284   | 356   | 357   | 407   | 442   | 2570    |
| Autism           | 175   | 148   | 160   | 212   | 263   | 348   | 446   | 979   | 1082  | 1415  | 1648  | 1775  | 1795  | 10263   |
| Mental Disorder  | 558   | 603   | 576   | 658   | 629   | 516   | 617   | 920   | 1070  | 1002  | 991   | 905   | 761   | 15721   |
| Mental Retardation| 264  | 282   | 309   | 429   | 524   | 644   | 940   | 1870  | 2681  | 3064  | 3669  | 3939  | 2232   | 136018  |
| Dementia         | 90    | 103   | 121   | 131   | 148   | 134   | 134   | 224   | 284   | 356   | 357   | 407   | 442   | 2570    |
| Total            | 3100  | 3456  | 3603  | 4275  | 4863  | 5248  | 6554  | 12300 | 16885 | 19020 | 19617 | 18528 | 18569 | 136018  |

ADHD, attention deficit hyperactivity disorder.

Table 4. Change in the number of annual general anesthesia cases by disability (from January 1, 2007, to September 30, 2019)

| Disability       | 2007  | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | Total   |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
| ADHD             | 47    | 42    | 50    | 55    | 69    | 79    | 108   | 122   | 136   | 183   | 191   | 198   | 171   | 1451    |
| Phobia           | 779   | 755   | 794   | 824   | 850   | 933   | 1081  | 1227  | 1284  | 1336  | 1344  | 1412  | 1084  | 13763   |
| Brain Disease    | 633   | 649   | 753   | 743   | 795   | 913   | 967   | 1103  | 1159  | 1127  | 1156  | 1214  | 957   | 12169   |
| Cerebral Palsy   | 77    | 90    | 102   | 106   | 122   | 159   | 176   | 210   | 216   | 238   | 295   | 329   | 264   | 2384    |
| Epilepsy         | 187   | 175   | 181   | 231   | 259   | 299   | 304   | 426   | 439   | 477   | 549   | 521   | 494   | 4542    |
| Genetic Disease  | 25    | 31    | 38    | 29    | 33    | 61    | 54    | 75    | 66    | 85    | 105   | 96    | 76    | 775     |
| Autism           | 45    | 67    | 61    | 75    | 85    | 94    | 138   | 171   | 192   | 262   | 353   | 414   | 368   | 2325    |
| Mental Disorder  | 640   | 624   | 744   | 717   | 806   | 820   | 991   | 1070  | 1074  | 1168  | 1177  | 1288  | 948   | 12067   |
| Mental Retardation| 135  | 131   | 135   | 175   | 165   | 209   | 255   | 311   | 351   | 450   | 508   | 504   | 485   | 3814    |
| Dementia         | 142   | 154   | 182   | 183   | 186   | 230   | 276   | 290   | 290   | 286   | 271   | 283   | 245   | 3018    |
| Total            | 2710  | 2718  | 3040  | 3138  | 3370  | 3857  | 4350  | 5005  | 5207  | 5613  | 5949  | 6259  | 5092  | 56308   |

ADHD, attention deficit hyperactivity disorder.

The number of SED cases and GA cases performed and sorted them by disability. The number of medical institutions that performed SED and GA was also analyzed using YID. The age and sex of each disability undergoing SED or GA were analyzed.

5. Analysis of SED and GA according to medical institutions and province

The number of medical institutions that performed SED and GA was also analyzed using YID. Medical institutions performing SED and GA can be classified as dental clinic, dental hospital, general hospital, and tertiary general hospital. According to the location of the hospital, the city and province could be narrowed down; therefore, SED and GA cases for city and province could be analyzed.
RESULTS

1. Analysis of the number of SED and GA cases according to disability

According to the data from January 1, 2007, to September 30, 2019, a total of 2,801,276 dental cases and 116,623 patients were identified in the HIRA big data for patients with the disabilities (Table 2).

A total of 136,018 cases of SED were performed and 56,308 cases of GA were carried out during the time. In 2007, sedation cases were 3,100. In 2018, the total number of sedation cases was 18,528, an increase of six times (Table 3). In the case of GA in 2007, the total number of cases was 2,710, and in 2018 the number of GA cases increased three-fold to 6,259. The most common disability in dental SED was ADHD, while in GA it was phobia. In SED cases, apart from dementia, all disabilities had an increase over the years. In GA there was an increase in cases in all the disabilities (Table 4, Fig. 1). However, since the total number of treatments also increased, the ratio of the number of GAs among the total number of dental treatments did not increase much in the 2-3% range. However, the ratio of the number of SED cases showed an increasing trend with increase in the total number of sedation cases. The degree of increase differed according to the type of disability (Fig. 2).

2. Analysis of sex ratio and average age of patients by disability

In patients receiving SED, the male-to-female ratio was very high for males with ADHD and autism. In all the disabilities analyzed, the male ratio was higher, except...
in the case of mental disorder and dementia, where the female ratio was higher (Table 5). In patients receiving GA, the male ratio was very high again in those with ADHD and autism. However, in dementia, the female ratio was significantly higher (Table 6).

There was a large difference between the age at which SED was performed and the age at which GA was performed by type of disability. The age at which SED was performed was often more than 10 years younger than the age at which GA was performed (Table 5, 6).

3. Analysis of the number of SED and GA cases according to medical institutions and province

In our study, a total of 105,289 SED cases were performed in dental clinics and the majority of SED cases in dentistry were carried out in dental clinics. However, in the case of GA, a total of 27,213 cases were performed in tertiary general hospitals. In tertiary general hospitals and general hospitals, GA method was performed more than SED in treating patients with special needs (Fig. 3). In 2019, there were 406 dental clinics that provided dental SED (Table 7).

The number of GA and SED cases by the city and province in Korea was investigated by year (Table 8, 9), and the ratio of GA and SED was also plotted as a graph (Fig. 4, 5).

DISCUSSION

As of 2006, the registered population of persons with special needs in South Korea was 1,134,177, but increased to 2,618,918 in 2019, accounting for 5.1% of the total population [10]. In 2019, the number of persons
Sedation and general anesthesia in patients with special needs

Fig. 3. Number of sedation and general anesthesia (GA) cases according to medical institutions. GA, general anesthesia; MDZ, midazolam; N+M, nitrous oxide and midazolam; N+P+H, nitrous oxide and chloral hydrate and/or hydroxyzine; Oral, oral sedatives (chloral hydrate, hydroxyzine); PPF, propofol; SED, sedation; SEVO, sevoflurane.

with special needs aged 65 or older was 1,263,952 accounting for 48.3% of the registered population for special needs. The male-to-female ratio was 57.8%: 44.2%, which accounted for 15.6% higher males [10]. When analyzing the dental treatment of persons with special needs with a history of dental treatment using the above eight sedative drugs, a total of 116,623 patients received 2,801,276 treatments (Table 2). Among them, 136,018 cases of SED were performed, and 56,308 cases were administered under GA.
Table 7. Change in the number of SED and GA cases according to medical institutions and number of institutions (from January 1, 2007, to September 30, 2019)

| Year | Tertiary General Hospital | General Hospital | Dental Hospital | Dental Clinic |
|------|----------------------------|------------------|-----------------|---------------|
|      | SED | GA  | SED | GA  | SED | GA  | SED | GA  |
| 2007 | 794 | 1529 | 269 | 672 | 874 | 509 | 1163 |
| 2008 | 899 | 1551 | 308 | 574 | 776 | 593 | 1473 |
| 2009 | 934 | 1873 | 285 | 537 | 887 | 630 | 1478 |
| 2010 | 814 | 1822 | 336 | 608 | 1076 | 707 | 2049 |
| 2011 | 743 | 1844 | 317 | 647 | 1154 | 877 | 2649 |
| 2012 | 626 | 1828 | 310 | 740 | 960 | 1289 | 3351 |
| 2013 | 671 | 2088 | 367 | 929 | 1018 | 1333 | 4494 |
| 2014 | 763 | 2284 | 278 | 898 | 1438 | 1823 | 9820 |
| 2015 | 652 | 2531 | 183 | 783 | 1772 | 1885 | 14276 |
| 2016 | 736 | 2583 | 125 | 1048 | 2159 | 2248 | 16124 |
| 2017 | 641 | 2531 | 144 | 970 | 2144 | 2475 | 15643 |
| 2018 | 523 | 2038 | 217 | 1211 | 1841 | 2074 | 16097 |
| 2019 | 671 | 2088 | 367 | 929 | 1018 | 1333 | 4494 |
| Total | 9205 | 27213 | 3356 | 10458 | 18128 | 18503 | 105289 |

GA, general anesthesia; SED, sedation.

Table 8. Change in the number of annual sedation cases by city and province in Korea (from January 1, 2007, to September 30, 2019)

| City                  | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|-----------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|--------|
| Seoul                 | 1084 | 1100 | 1125 | 1180 | 1313 | 1285 | 1639 | 3117 | 4241 | 4259 | 4114 | 4114 | 4183  | 32754  |
| Busan                 | 210  | 336  | 270  | 325  | 284  | 450  | 598  | 1206 | 1909 | 2389 | 2462 | 2348 | 2506 | 15293  |
| Inchon                | 260  | 258  | 260  | 285  | 368  | 349  | 375  | 555  | 638  | 754  | 743  | 701  | 757   | 6303   |
| Daegu                 | 210  | 278  | 296  | 312  | 366  | 366  | 352  | 643  | 815  | 987  | 1184 | 1041 | 1070  | 7920   |
| Gwangju               | 148  | 173  | 218  | 279  | 249  | 247  | 404  | 586  | 669  | 850  | 774  | 584  | 556   | 5737   |
| Daejeon               | 58   | 80   | 51   | 59   | 117  | 153  | 212  | 479  | 681  | 648  | 693  | 655  | 588   | 4474   |
| Ulsan                 | 41   | 68   | 53   | 50   | 73   | 85   | 116  | 218  | 437  | 456  | 450  | 392  | 435   | 2874   |
| Gyeonggi-do           | 503  | 600  | 674  | 962  | 1175 | 1436 | 1849 | 3705 | 4899 | 5592 | 5842 | 5478 | 5466  | 38181  |
| Gangwon-do            | 258  | 215  | 244  | 241  | 230  | 210  | 200  | 271  | 354  | 364  | 386  | 393  | 272   | 3638   |
| Chungcheongbuk-do     | 35   | 32   | 44   | 52   | 60   | 70   | 121  | 277  | 311  | 401  | 308  | 370  | 313   | 2394   |
| Chungcheongnam-do     | 83   | 81   | 48   | 55   | 82   | 80   | 110  | 157  | 228  | 234  | 249  | 335  | 385   | 2127   |
| Jeollabuk-do          | 80   | 76   | 108  | 114  | 124  | 143  | 234  | 478  | 683  | 840  | 1023 | 906  | 718   | 5527   |
| Jeollanam-do          | 24   | 32   | 21   | 21   | 34   | 35   | 46   | 93   | 195  | 173  | 170  | 109  | 117   | 1070   |
| Gyeongsangbuk-do      | 11   | 13   | 34   | 34   | 33   | 47   | 84   | 148  | 237  | 262  | 354  | 369  | 352   | 1998   |
| Gyeongsangnam-do      | 80   | 73   | 145  | 291  | 332  | 239  | 165  | 297  | 419  | 456  | 522  | 464  | 552   | 4035   |
| Jeju-do               | 15   | 41   | 12   | 15   | 23   | 53   | 49   | 70   | 94   | 148  | 104  | 110  | 103   | 837    |
| Total                 | 3100 | 3456 | 3603 | 4275 | 4863 | 5248 | 6554 | 12300| 16885| 19020| 19617| 18528 | 18569  | 136018  |
Table 9. Change in the number of annual general anesthesia cases by city and province in Korea (from January 1, 2007, to September 30, 2019)

| Disability            | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019   | Total  |
|-----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Seoul                 | 1035   | 1011   | 1127   | 1128   | 1182   | 1336   | 1383   | 1829   | 1839   | 1983   | 2049   | 2332   | 1805   | 19949  |
| Busan                 | 238    | 268    | 258    | 203    | 205    | 211    | 253    | 252    | 265    | 307    | 365    | 325    | 326    | 3476   |
| Inchon                | 68     | 61     | 73     | 96     | 71     | 85     | 80     | 94     | 99     | 151    | 136    | 164    | 129    | 1327   |
| Daegu                 | 242    | 211    | 268    | 295    | 309    | 310    | 334    | 321    | 357    | 364    | 361    | 402    | 346    | 4120   |
| Gwangju               | 165    | 173    | 163    | 136    | 172    | 195    | 254    | 342    | 384    | 316    | 324    | 342    | 276    | 3242   |
| Daejeon               | 100    | 86     | 97     | 114    | 106    | 132    | 166    | 179    | 130    | 138    | 122    | 123    | 86     | 1579   |
| Ulsan                 | 71     | 36     | 49     | 58     | 48     | 61     | 117    | 107    | 169    | 139    | 123    | 145    | 31     | 1154   |
| Gyeonggi-do           | 307    | 317    | 352    | 380    | 460    | 479    | 636    | 692    | 715    | 939    | 857    | 860    | 789    | 7783   |
| Gangwon-do            | 76     | 61     | 86     | 66     | 113    | 128    | 124    | 121    | 119    | 112    | 158    | 150    | 97     | 1411   |
| Chungcheongbuk-do     | 62     | 77     | 79     | 66     | 59     | 62     | 66     | 76     | 71     | 73     | 66     | 28     | 859    |        |
| Chungcheongnam-do     | 151    | 184    | 165    | 190    | 194    | 229    | 270    | 304    | 313    | 403    | 525    | 424    | 397    | 3749   |
| Jeollabuk-do          | 111    | 138    | 240    | 235    | 218    | 280    | 358    | 364    | 367    | 395    | 396    | 370    | 329    | 3801   |
| Jeollanam-do          | 4      | 4      | 8      | 5      | 4      | 7      | 6      | 1      | 1      | 3      | 2      | 4      | 45     |        |
| Gyeongsangbuk-do      | 3      | 4      | 4      | 3      | 4      | 7      | 7      | 2      | 4      | 4      | 13     | 5      | 60     |        |
| Gyeongsangnam-do      | 69     | 59     | 61     | 150    | 200    | 329    | 286    | 316    | 361    | 363    | 439    | 479    | 367    | 3479   |
| Jeju-do               | 8      | 8      | 10     | 13     | 10     | 9      | 14     | 16     | 12     | 17     | 14     | 62     | 81     | 274    |
| Total                 | 3100   | 3456   | 3603   | 4275   | 4863   | 5248   | 6554   | 12300  | 16885  | 19020  | 19617  | 18528  | 18569  | 136018 |

Fig. 4. Ratio of the number of GA (A) and SED (B) among the total number of dental treatments divided by city and province. Data are expressed province or city name, ratio (%), total cases from January 1, 2007, to September 30, 2019. GA, general anesthesia; SED, sedation.

In this study, patients with ADHD represented the greatest number of cases of dental SED while patients with brain disease had the most number receiving dental treatment among the disabilities (Table 3). However, the
most common disability that received GA was phobia, and this disability had the most patients and most cases in receiving GA (Table 4).

Dental phobia patients unable to respond to and cooperate well with psychotherapeutic interventions, and not willing to undergo these types of treatment, should seek pharmacological therapies such as SED or GA [11]. Prevalence of extreme or very high dental anxiety has been estimated to be between 5 and 22% in representative adult samples [12]. As prevalence of dental anxiety is quite high and results in avoidance of dental treatment, irregular dental attendance, and poor cooperation, measures to attend to the dental phobia population must be taken into consideration. These data are meaningful in understanding the importance and severity of dental phobia.

According to the study, ADHD, brain disease and mental retardation were the three disabilities with the most cases of SED (Table 3), while in GA, phobia, mental disorder, and brain disease were the most common cause for undergoing GA in dental treatment (Table 4).

From 2007 to 2019, an increase in both SED and GA cases were observed, but a much more rapid increase was found in the number of SED cases. In 2007, there were 3,100 SED cases, but in 2019, it was 18,569 cases, a six-fold increase (Fig. 1). From 2014, SED cases increased rapidly possibly because of the N2O code being claimed at the insurance [9].

Fig. 5. Ratio of the number of GA and SED among the total number of dental treatments divided by year and province from January 1, 2007, to September 30, 2019. GA, general anesthesia; SED, sedation.
The increase in yearly SED cases over the years from 2007 to 2018 which included ADHD, cerebral palsy, genetic disease, autism, and mental retardation, showed a near ten-fold increase in the course of 12 years. The increase in number of GA cases was much less than that of SED; nevertheless, in autism, the number of GA cases increased ten times from 2007 to 2013. This could be owing to an increase in the prevalence of autism spectrum disorders that has increased in recent decades, which could be because of changes in diagnosis reporting practices [13].

There were ample differences in the male-to-female ratio and age in receiving SED or GA according to types of disability. The majority of the disabilities showed a higher ratio in male population, except in dementia where the female ratio was higher [5]. Pediatric patients were of the mean age in receiving SED or GA for ADHD and autism. Overall, the mean age for all disabilities was in younger patients receiving SED than GA (Table 5, 6).

In the case of dementia among disabilities, 1344 patients with dementia received 1515 procedures with SED and 3015 patients underwent 3396 procedures with GA. Consequently, it can be understood that dementia patients received SED and GA at least once. This predicts that the demand for SED and GA for patients will increase in the aging population as the dementia population is also rising.

In the case of tertiary hospitals and general hospitals, the number of cases of SED is decreasing year by year, while the number of cases of GA is increasing.

In terms of SED, most cases were carried out in the Gyeonggi province and Seoul came in second. However, in terms of GA, the majority of cases were carried out in Seoul. In 2007, the number of medical institutions in Seoul that were capable of performing dental SED or GA was 70 while in 2019 the number increased to 125.

In conclusion, a total of 116,623 patients with disabilities received 2,801,276 dental care with insurance during the survey period. Among these, 69,265 patients underwent 136,018 dental procedures with SED method and 47,257 patients underwent 56,308 procedures with GA.

The improvement of welfare and newly opened dental hospitals for people with special needs, an increase in insurance coverage and easier accessibility has led to a steep rise in the practice of SED and GA in patients with special needs.

Recently, the number of patients with dental phobias has shown an increase and the number of SED and GA has also increased accordingly. This is a subject that should be taken into consideration, such that dental phobia may be included as a type of disorder in dentistry and the need for implementation of SED and GA during dental treatment may be considered.

Overall, from the results of analyzing dental SED and GA for patients with special needs, data show that the number of dental SED and GA cases and the number of patients with disabilities is increasing compared to that in the past. It is suggested that guidelines for SED and GA for patients with special needs need to be prepared, and reinforcement of related policies and management needs to be implemented.

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