Received: 7 June 2023 | Revised: 13 June 2023 | Accepted: 22 June 2023

DOI: 10.1002/lio2.1107

ORIGINAL RESEARCH

Laryngoscope Investigative Otolaryngology

Facial plating industry payments: An analysis of the open payments database

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Abstract

Objective: To compare industry payments from facial plating companies to plastic surgery, oral and maxillofacial surgery (OMFS), and otolaryngology (OHNS).

Methods: The Open Payments Database was queried from 2016 to 2021 to identify all industry disbursements related to facial plating products from Stryker, Zimmer Biomet, Depuy Synthes Products, Acumed, and KLS Martin. Total dollars, number of payments, and specialists paid were compared between plastic surgery, OMFS, and OHNS. Funding was correlated to estimated case volume and number of licensed surgeons determined by literature review.

Results: From 2016 through 2021, OMFS received an average of $786,497 annually, followed by plastic surgery ($765,482), and OHNS ($184,484). On average, facial plating companies distributed 2256, 963, and 917 yearly payments to 699 oral and maxillofacial surgeons, 378 plastic surgeons, and 354 otolaryngologists, respectively. Total dollars, number of payments, and specialists paid were significantly different between specialties ($p < .05$). Facial trauma coverage is 39.6% by plastic surgery, 36.6% by OMFS, and 23.3% by OHNS. There are 7560 licensed oral and maxillofacial surgeons, 4948 plastic surgeons, and 11,778 otolaryngologists in the United States. Decreased payment to OHNS was more than could be accounted for by case volume alone.

Conclusions: The facial plating industry allocates more funding dollars to OMFS and plastic surgery compared to OHNS. OMFS receives the greatest number of payments to the most specialists compared to plastic surgery and OHNS. Engagement between OHNS and the facial plating industry is a potential area of growth in the future.

Level of evidence: Level 4.

KEYWORDS
facial plating, facial trauma, industry payments, open payments

1 | INTRODUCTION

There are three million cases of facial trauma per year in the United States,[1] with assault and motor vehicle accidents as the most common mechanisms of injury.[2,3] Facial plating systems are integral in the fixation of facial and mandibular fractures after craniomaxillofacial trauma to restore function and appearance.[4] The leading specialties in the surgical management of these injuries are plastic surgery, oral and

maxillofacial surgery (OMFS), and otolaryngology–head and neck surgery (OHNS).[5–7]

The facial trauma field is also dependent on relationships with device manufacturers, which carries financial implications. While collaboration between the medical device industry and physicians is important for innovation and the advancement of the field, concerns regarding conflicts of interest as a result of nonpatient service-related payments are well-documented.[8] Per the Physician Payments Sunshine Act, it is mandated that financial transactions between the industry and physicians be openly accessible.[9] The purpose is to increase transparency and limit the potential undue influence on medical decision-making.[10] The Open Payments Database has been utilized to analyze industry payments to a number of different specialties.[11–13]

Although the volume of facial trauma coverage among different specialties has been studied, the connectedness of each of these surgical specialties with the facial plating industry is unclear. The management of these injuries by multiple surgical entities presents a unique opportunity to compare relationships with facial plating companies. The objective of this study was to analyze industry payments related to facial plating to plastic surgery, OMFS, and OHNS. To the authors' knowledge, there are no existing studies of this nature.

2 | MATERIALS AND METHODS

2.1 | Data source

The study data were obtained from the Open Payments Database, which is a freely accessed archive of industry payments made by drug and medical device companies to healthcare providers. The database is openly accessible, therefore Institutional Review Board review was not required.

2.2 | Study cohort

The database was queried during 2016 through 2021 to identify general industry payments made by facial plating companies (Stryker, Zimmer Biomet, Depuy Synthes Products, Acumed, and KLS Martin) directly to plastic surgeons, oral and maxillofacial surgeons, and otolaryngologists. Each payment in the database had an associated medical device documented, therefore only those related to facial plating were included in the analysis. The list of included products is present in the Appendix. Industry payments are nonpatient care-related payments, and include consulting fees, food and beverage, grants, honoraria, royalties or license, travel and lodging, education, and compensation for services other than consulting. Research payments, payments to nonphysician practitioners, and indirect or third-party payments were excluded from analysis.

2.3 | Study outcomes

Outcome measures included annual total dollars paid, number of payments, and number of physicians paid from each specialty. The reason for each payment and academic/private affiliations of physicians were also collected. The aggregate number of licensed physicians practicing plastic surgery and OHNS was obtained from the Centers for Medicare and Medicaid Services (CMS) National Plan and Provider Enumeration System,[14] and OMFS was acquired from the American Dental Association.[12] The literature was also searched to determine the volume and breakdown of facial trauma coverage between plastic surgery, OMFS, and OHNS on a national level.

2.4 | Statistical analysis

One-way ANOVA tests were conducted to compare the mean gross payment amounts, number of payments, and number of unique physicians paid between plastic surgery, OMFS, and OHNS. Post hoc Tukey tests were also performed to analyze all potential comparisons of means. Statistical significance was defined as $p < .05$. All data organization and statistical tests were conducted via Tableau and Python software.

3 | RESULTS

From 2016 through 2021, manufacturers distributed 24,809 payments related to facial plating, amounting to $10,418,782. OMFS, plastic surgery, and OHNS specialists received average annual payments from facial plating companies of $786,497 ± 397,655, $765,482 ± 251,839, and $184,484 ± 87,238, respectively. Additionally, OMFS received an average of 2256 ± 689 annual payments, compared to 963 ± 227 for plastic surgery and 917 ± 245 for OHNS. Finally, an average of 699 ± 119 oral and maxillofacial surgeons, 378 ± 50 plastic surgeons, and 354 ± 56 otolaryngologists received at least one payment annually (Table 1). One-way ANOVA tests indicated significant differences in average annual payment amount ($p = .003$), number of payments ($p < .001$), and number of physicians paid ($p < .001$) between specialties. Post hoc Tukey tests indicated that the overall significant difference in payment dollars was driven by the comparison of OMFS and plastic surgery with OHNS ($p = .005$ and $p = .006$, respectively). The significant differences in the number of payments and unique specialists paid were driven by the comparisons of OMFS with plastic surgery ($p < .001$ and $p < .001$, respectively) and OHNS ($p < .001$ and $p = .001$, respectively).

One-way ANOVA tests revealed statistical differences between companies' payment patterns for each of the specialties. Annual dollar amounts and number of payments allocated by each company are displayed in Figure 1 and Tables 2 and 3. On average, DepPuy Synthes and KLS Martin allocated significantly more funds to OMFS ($p = .04$ and $p = .001$, respectively) compared to the other specialties. Zimmer Biomet also paid more dollars to OMFS annually, however, it did not achieve statistical significance ($p = .44$). Stryker paid the most annual dollars to plastic surgery, however, it was not statistically significant ($p = .10$; Table 2). In terms of the number of payments, KLS Martin and Zimmer Biomet made significantly more payments to OMFS ($p < .001$ and $p = .002$, respectively) compared to plastic surgery and OHNS.

TABLE 1 Total dollars paid, number of payments made, and individuals paid by specialty.

	Year	Plastic surgery	Oral and maxillofacial surgery	Otolaryngology
Number of US Dollars Paid ($)	2016	345,069	675,494	176,920
	2017	670,535	578,138	175,083
	2018	841,091	633,827	163,178
	2019	1,113,603	1,583,293	352,478
	2020	800,132	733,623	139,838
	2021	822,464	514,607	99,409
	Average ± SD	765,482 ± 251,839	786,497 ± 397,655	184,484 ± 87,238
Number of Payments Made	2016	1012	2672	891
	2017	974	2446	1050
	2018	1157	2357	1041
	2019	1239	3170	1244
	2020	705	1405	670
	2021	688	1485	603
	Average ± SD	963 ± 227	2256 ± 689	917 ± 245
Number of Specialists Paid	2016	375	778	376
	2017	367	786	386
	2018	441	696	363
	2019	432	818	426
	2020	320	520	282
	2021	334	596	292
	Average ± SD	378 ± 50	699 ± 119	354 ± 56

Abbreviations: SD, standard deviation; US, United States.

DePuy Synthes also made more disbursements to OMFS, however, it was not statistically significant ($p = .051$). Stryker made more payments to OHNS, however, it was not statistically significant ($p = .25$; Table 3). All specialties saw an increase in dollars and number of payments in 2019, and Stryker led all companies in each category (Figure 1). This was proceeded by abrupt decreases in all payment metrics during 2020 and 2021. Compared to 2019, dollars paid in 2021 were reduced by 26% for plastic surgery, 68% for OMFS, and 72% for OHNS.

According to a study of 57 level-one trauma centers, 39.6% of facial traumas are covered by plastic surgery, 36.6% by OMFS, 23.3% by OHNS, and 0.5% by other specialties (general surgery and oculoplastics).[5] Based on case volume, it would be expected that OHNS would receive 59 and 63 cents for every dollar paid by the industry to plastic surgery or OMFS, respectively. However, OHNS as a specialty received 24 and 23 cents on the dollar over the study period.

Per the CMS National Plan and Provider Enumeration System, there are 4948 plastic surgeons and 11,778 otolaryngologists licensed to practice in the United States.[14] Per estimates from the American Dental Association, there are 7560 oral and maxillofacial surgeons in the country.[12] When compared to the total number of surgeons in each specialty, an average of 7.6% of plastic surgeons, 9.2% of oral and maxillofacial surgeons, and 3.0% of otolaryngologists received at least one payment related to facial plating annually. Taking into consideration the total number of licensed surgeons in each specialty, the average plastic surgeon received $154.71, oral and maxillofacial surgeons received $104.00, and otolaryngologists received $15.66 annually. Therefore, on a per surgeon basis, individual otolaryngologists actually received 10 and 15 cents for every dollar disbursed to plastic surgeons and oral and maxillofacial surgeons, respectively.

Figure 2 includes box plots of the dollar amount of individual payments made to physicians belonging to each specialty over the study period. The median individual payment amount was $62 (interquartile range: $24–$116, Min: $0.50, Max: $246,914) for plastic surgery, $61 (interquartile range: $24–$117, Min: $0.30, Max: $56,527) for OMFS, and $63 (interquartile range: $26–$122, Min: $0.30, Max: $13,125) for OHNS. From 2016 to 2021, the top 10% of plastic surgeons, oral and maxillofacial surgeons, and otolaryngologists accounted for an average of 97%, 95%, and 87% of the total dollars paid to each specialty, respectively (Table 4). After removing outlier payments exceeding the 99th percentile per specialty ($11,493 for plastic surgery, $9275 for OMFS, and $3019 for OHNS) from the analysis, the mean annual dollars paid to OMFS was $404,018 ± 217,675, plastic surgery was 227,410 ± 62,096, and OHNS was 106,087 ± 35,477, which remained statistically significant differences ($p = .005$).

The total dollars paid, number of payments made, and specialists paid among the top 10% of annual earners from each specialty stratified according to academic or private affiliation are presented in Table 5. Among the top 10% of earners by specialty, 46% of oral and maxillofacial surgeons, 61% of plastic surgeons, and 77% of otolaryngologists had an academic affiliation. Additionally, 50%, 65%, and 80%

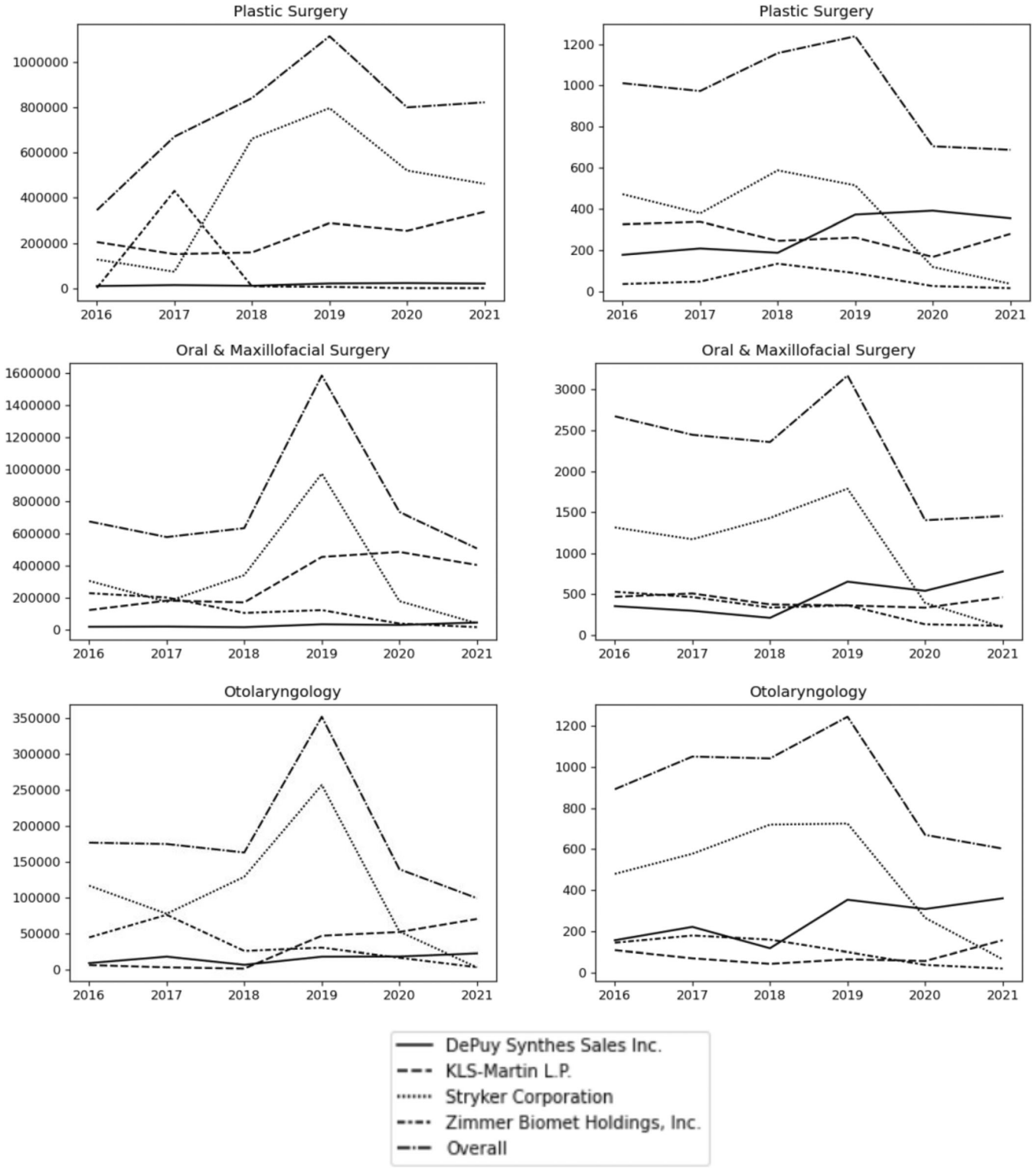

FIGURE 1 Total dollars paid (left) and number of payments (right) to each specialty by facial plating companies. Of note, Acumed accounted for 30 total payments during the study period. All were made in 2021 and were to OMFS, therefore these were not represented in this figure.

of payments were to academic physicians belonging to each specialty, respectively. Academic plastic surgeons and otolaryngologists received 86% and 90% of funding for their specialties, respectively, while academic oral and maxillofacial surgeons received just 41% of funds.

Analysis of the nature of industry expenditures revealed that food and beverage were responsible for the greatest number of disbursements to plastic surgery (85%), OMFS (82%), and OHNS (80%). Royalty or license accounted for the highest percentage of dollars paid to plastic surgery (77%) and OMFS (33%), while

TABLE 2 Comparison of dollars paid to each specialty by company.

	Year	US dollars paid to plastic surgery ($)	US dollars paid to oral and maxillofacial surgery ($)	US dollars paid to otolaryngology ($)
DePuy Synthes	2016	10,317	18,822	9093
	2017	14,697	20,029	18,093
	2018	11,560	16,479	6694
	2019	21,913	34,379	18,029
	2020	23,441	30,165	18,289
	2021	21,437	45,508	22,603
	Average ± SD	17,228 ± 5737	27,563 ± 11,236	15,467 ± 6164
KLS-Martin	2016	205,088	123,248	6353
	2017	151,755	181,882	3128
	2018	159,151	171,036	1407
	2019	288,229	454,171	46,967
	2020	254,861	485,475	52,183
	2021	338,132	404,177	70,383
	Average ± SD	232,869 ± 74,046	303,332 ± 161,729	30,070 ± 30,032
Stryker	2016	127,913	305,165	116,867
	2017	73,717	174,515	77,646
	2018	661,277	341,069	129,289
	2019	796,820	971,892	257,119
	2020	520,536	178,948	52,820
	2021	461,812	40,800	3131
	Average ± SD	440,346 ± 288,030	335,398 ± 329,612	106,145 ± 86,846
Zimmer Biomet	2016	1751	228,260	44,607
	2017	430,366	201,712	76,215
	2018	9103	105,244	25,787
	2019	6641	122,851	30,362
	2020	1294	39,035	16,546
	2021	1083	16,695	3291
	Average ± SD	75,040 ± 174,105	118,966 ± 84,668	32,801 ± 25,355
Acumed[a]	2021	–	7428	–

Abbreviations: SD, standard deviation; US, United States.
[a]Of note, Acumed accounted for 30 total payments during the study period. All were made in 2021 and were to OMFS.

the greatest percentage of dollars paid to OHNS (34%) was in the form of consulting fees. The complete itemization of the number of payments and dollars paid to each specialty is displayed in Figure 3.

4 | DISCUSSION

The surgical management of facial trauma is a shared entity by plastic surgery, OMFS, and OHNS. Our analysis of industry payments found that OMFS may be the most connected with the facial plating industry in terms of total dollars, number of payments, and number of specialists paid. OHNS trailed both OMFS and plastic surgery in dollars paid, and was behind OMFS in terms of number of payments and specialists paid. OMFS received four times the industry dollars in twice the number of payments made to two times as many specialists compared to OHNS.

The differences in dollars, number of payments, and specialists paid are notable when the total number of physicians licensed to practice each specialty is considered. Although there are over 1.5 times the number of practicing otolaryngologists compared to oral and maxillofacial surgeons, there was a 50% decrease in the number of OHNS surgeons who received a payment compared to OMFS surgeons. Additionally, OHNS surgeons represent double the workforce compared to plastic surgeons, yet there were a similar number of physicians in each specialty who received a payment. Overall, the increased number of otolaryngologists eligible to receive industry payments did not translate to additional transactions.

Part of the explanation for the disparity in facial plating industry payments to OHNS physicians could be because they handle fewer

TABLE 3 Comparison of number of payments to each specialty by company.

	Year	Number of payments made to plastic surgery	Number of payments made to oral and maxillofacial surgery	Number of payments made to otolaryngology
DePuy Synthes	2016	178	355	157
	2017	209	298	222
	2018	188	212	118
	2019	373	654	354
	2020	392	542	309
	2021	355	778	361
	Average ± SD	283 ± 101	473 ± 221	254 ± 103
KLS-Martin	2016	326	469	109
	2017	338	510	70
	2018	246	376	43
	2019	262	364	65
	2020	168	336	57
	2021	280	464	157
	Average ± SD	270 ± 61	420 ± 70	84 ± 42
Stryker	2016	472	1317	480
	2017	379	1172	578
	2018	588	1432	720
	2019	515	1787	725
	2020	119	394	266
	2021	37	98	65
	Average ± SD	352 ± 224	220 ± 261	472 ± 263
Zimmer Biomet	2016	36	531	145
	2017	48	466	180
	2018	135	337	160
	2019	89	365	100
	2020	26	133	38
	2021	16	115	20
	Average ± SD	58 ± 45	325 ± 170	107 ± 66
Acumed[a]	2021	–	30	–

Abbreviation: SD, standard deviation.

[a]Of note, Acumed accounted for 30 total payments during the study period. All were made in 2021 and were to OMFS.

cases and presumably utilize less facial plating products. As could be expected, industry likely supports those that utilize their resources the most. As previously noted, OHNS does cover the least amount of facial trauma of the three specialties.[5] Another study noted no significant differences in referrals for panfacial and midface fractures between the three surgical subspecialties, however plastic surgery and OHNS received decreased referrals for mandibular fractures compared to OMFS.[6] This could represent a lack of comfort or desire for otolaryngologists to perform facial plating procedures. However, the decreased amount paid to OHNS cannot be explained by case volume alone, as payment amounts were still less than would be expected when accounting for case volume and the number of licensed surgeons per specialty. It is unlikely that a general lack of interaction with industry as a whole for one specialty compared to another accounted for differences in payments. Prior analyses of the Open Payments Database found that 69% of plastic and oral and maxillofacial surgeons, and 61% of otolaryngologists received at least one payment in a given year.[12,14] Additionally, there is no reason to believe industry is less likely to associate any of these specialties with maxillofacial trauma given the fact that craniofacial surgery is a core component of all of these specialties and has been for decades.[7]

It is interesting that among the top 10% of earners for each specialty, OHNS had the greatest proportion of academic physicians (77%) and funds paid academic physicians (90%). Conversely, OMFS had the greatest proportion of physicians who worked in private practice (54%) and funding to private practice physicians (59%). The increased proportions of OHNS physicians in academics and OMFS physicians in private practice could explain the overall differences in funding and payments to these specialties. Perhaps the reason there were so few dollars allotted to OHNS was that the surgeons

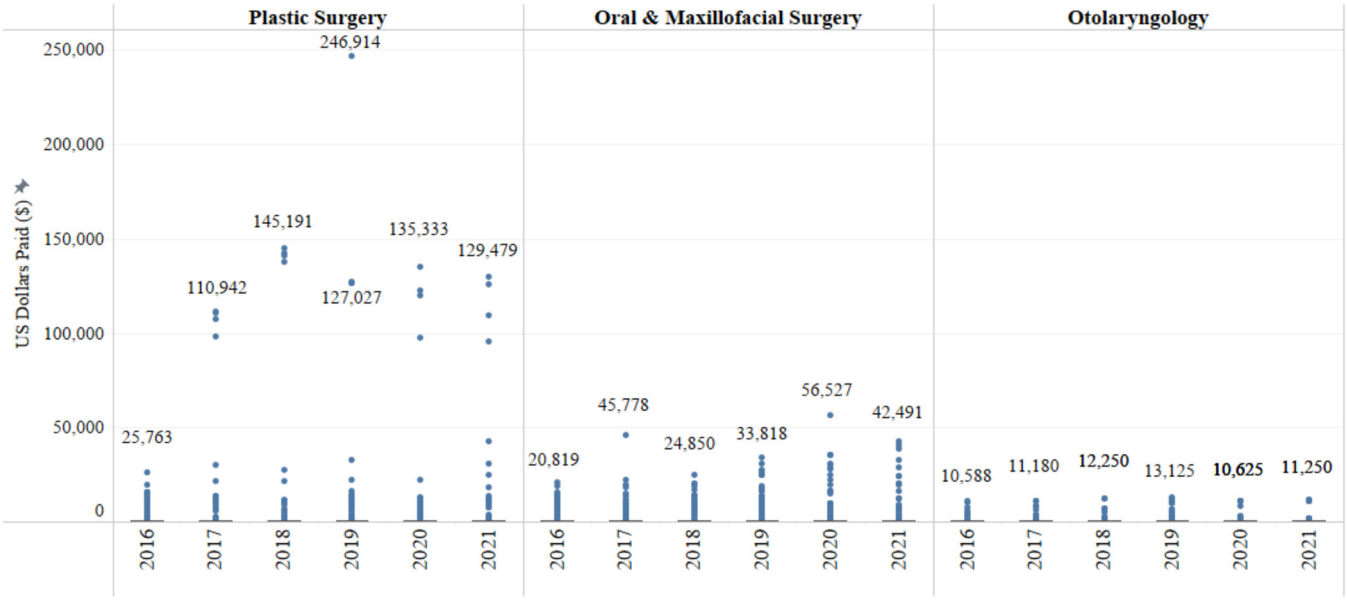

FIGURE 2 Range of payments to plastic surgery, OMFS, and OHNS. The top numbers represent the maximum payment amount for a given year.

TABLE 4 Percentage of dollars paid to top 10% of earners annually.

Specialty	2016	2017	2018	2019	2020	2021	Average ± SD
Plastic Surgery	93%	98%	97%	98%	97%	98%	97% ± 1%
OMFS	95%	94%	94%	95%	97%	96%	95% ± 1%
OHNS	84%	84%	88%	91%	88%	89%	87% ± 3%

Abbreviations: OHNS, otolaryngology; OMFS, oral and maxillofacial surgery; SD, standard deviation.

performing complex facial reconstructions that require plating are employed by academic institutions that restrict industry contact and dollars paid.

It is unclear why there was such variability in industry payments on a year-to-year basis. It is notable that this was the case for all three specialties, and fluctuations followed a similar trend. For example, all specialties received the greatest number of industry dollars in 2019. This could be an indication that companies, specifically Stryker, dedicated increased funding to facial plating in that year, which translated to proportionately increased dollars received by all affiliated specialties. This was followed by declines in dollars, payments, and specialists paid in 2020 and 2021, which could be explained by the onset of the COVID-19 pandemic. Other analyses of the Open Payments Database have also reported sudden decreases in payments during this time frame for a number of specialties.[15–17] As more data becomes available in the coming years and we move past pandemic restrictions, future research should assess whether industry payments have recovered.

In our study, consulting fees accounted for the greatest amount of dollars paid to OHNS, while royalties accounted for the most paid to plastic surgery and OMFS. According to the CMS, consulting fees are defined as payments for advice/expertise about a medical product, and royalties refer to payments for sales of a product based on the intellectual property of a physician.[18] While payments for these purposes are valuable for exposing new technologies and may be indicative of innovation and advancement of the field, it is the responsibility of all involved to promote a culture of transparency and disclosure to avoid unjustified influence on clinical decision making.

If OHNS bolsters relationships with industry, it has the potential to foster the promotion of new technologies. Additionally, although education accounted for a small portion of payments in our study, there is opportunity for payments to provide educational and research opportunities. For example, plating courses and lectures in coordination with industry staff allows for greater exposure and confidence in technical skills among residents so they can take initiative in the operating room. Comfort with performing these operations may increase the likelihood of performing them throughout their careers. Involvement with industry also has potential for utilization of newer technologies available for facial trauma cases that may otherwise be less accessible for providers. These technologies are great avenues for research that can positively impact patient care, including factors such as case length, complications, and patient satisfaction.

Innovation in the medical field is dependent on the dynamic relationship between physicians and industry.[19] However, physicians must be aware of the potential undue influence and bias that financial relationships may have on their decision making and ultimately patient care. A systematic review of 36 studies found a consistent positive association between industry contact/

TABLE 5 Total dollars paid, number of payments made, and specialists paid to the top 10% of earners by specialty according to academic or private affiliation.

	Plastic surgery		Oral and maxillofacial surgery		Otolaryngology	
	Academic	Private	Academic	Private	Academic	Private
Number of US dollars paid ($)	3,842,709 (86%)	615,503 (14%)	1,822,328 (41%)	2,657,693 (59%)	861,425 (90%)	98,995 (10%)
Number of payments made	423 (65%)	230 (35%)	666 (50%)	666 (50%)	417 (80%)	105 (20%)
Number of specialists paid	253 (61%)	162 (39%)	361 (46%)	421 (54%)	312 (77%)	93 (23%)

Note: From 2016 to 2021, the top 10% of plastic surgeons, oral and maxillofacial surgeons, and otolaryngologists accounted for an average of 97%, 95%, and 87% of the total dollars paid to each specialty, respectively. Therefore, this table analyzed the top 10% of annual earners.

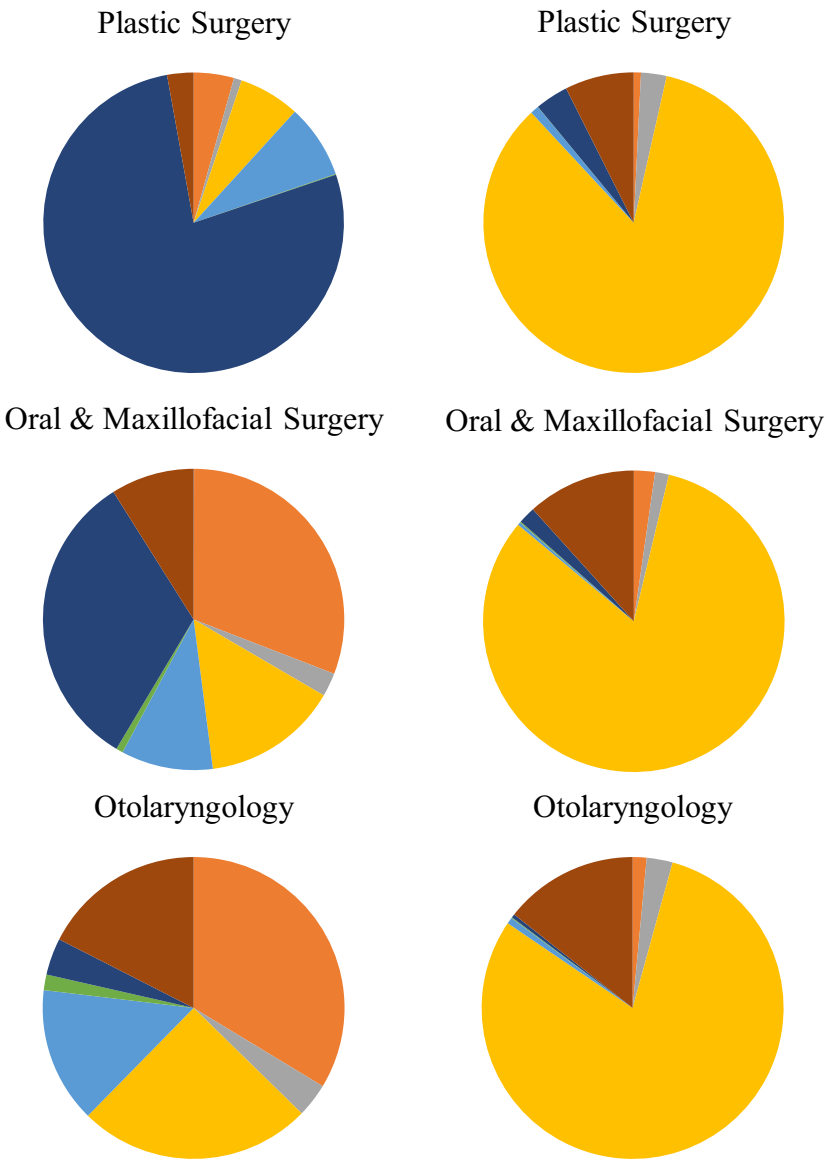

FIGURE 3 Nature of payment to each specialty by payment amount (left) and number of payments (right). ■ Compensation for services other than consulting, including serving as faculty or as a speaker at a venue other than a continuing education program; ■ Consulting Fee; ■ Education; ■ Food and Beverage; ■ Grant; ■ Honoraria; ■ Royalty or License; ■ Travel and Lodging.

payments and physician prescribing of the paying company's product, cost of prescriptions, and prescriptions of brand-name products.[20] Plastic surgeons, oral and maxillofacial surgeons, and otolaryngologists should keep this in mind when collaborating with industry to prevent compromised care delivery. This is most applicable to the top 10% of physicians who received the majority of dollars, especially those who received outlier payments.

This study adds to the existing literature regarding the relationship between industry and physicians, and close examination of payment patterns may provide some guidance in terms of future engagement with industry for the specialty of OHNS and minimize bias and conflict of interest. This is an important topic of ongoing research as we assess the influence that industry has on the medical profession. This is the first study to review industry payments

related to facial plating, however, it is not without limitations. First, it is limited by the quality and accuracy of data entry into the Open Payments Database, which may have impacted the data and subsequent interpretations.[21] Specifically, payments included in our study depended on the accuracy of documentation of associated facial plating products. Furthermore, it was not possible to account for payments from branch companies such as AO North America (funded through Johnson and Johnson, parent to Synthes), thus we may be under-accounting for their contributions. Additionally, while we were able to estimate case volume for each specialty based on the literature, it was not possible to determine the practices of physicians who received industry payments, including types of cases performed (orthognathic surgeries, craniofacial cases, etc.).

5 | CONCLUSION

Over the years 2016–2021, facial plating industry payments fluctuated by year. OHNS trailed OMFS and plastic surgery in overall industry dollars received, and OMFS in number of payments and specialists who received payments. These differences exceeded that which could be accounted for by case load, and may be addressed by pursuing additional opportunities to collaborate with the facial plating industry in the future. If such relationships with industry are desired, it is important to minimize bias and conflict of interest.

FUNDING INFORMATION

No funding was received for this research.

CONFLICT OF INTEREST STATEMENT

All authors report no conflicts of interest.

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How to cite this article: Lorenz FJ, LaBarge B, Lighthall JG, Walen SG. Facial plating industry payments: An analysis of the open payments database. *Laryngoscope Investigative Otolaryngology*. 2023;8(4):847-856. doi:10.1002/lio2.1107

APPENDIX E: Device Names Associated with Payments (as Listed in the Open Payments Database)

Stryker

advance mf distractor
customized mandible recon
delta
delta system 1.7 and 2.2
delta system 1.7/2.2
delta system 1.72.2
hybrid mmf
intermaxillary fixation
luhr mand. recon
mandibular recon
maxface
mf instruments
mf sets
mini plating system (mps)
mini plating system mps
oculoplastic
orbital
ped mandible distraction
pediatric mandible distraction
smartlock
universal
universal mandible
universal mid face
universal mid-face
universal orthognathic
universal upper face
universal upper-face
vsp orthognathic
vsp reconstruction
medpor titan
varispeed powered scrdvr

Depuy synthes

cmf ceramics & allograft
cmf external fixation
cmf instruments
craniofacial modular fixation system
imf
matrixmandible
matrixmidface
matrixorthognathic
matrixwave
orthognathic
rapidsorb
distraction osteogenesis systems
matrixcombo
trumatch
matrixcombo
alveolar distractor

Zimmer Biomet

cmf instrument
cmf orthognathic
encompass orthognathic
encompass reconstruction
lactosorb
midface titanium system
omni max
recon plate
thinflap
traumaone
virtual surgical planning

Acumed

craniofacial fixation system
maxillomandibular fixation system
orthognathic system

KLS Martin

Distraction and tissue molding.
Distraction.
Osteosynthesis.