A status report of dental implantology in Switzerland has already been performed in 1994 and 2006. The present study, based on these former surveys, aimed to update these results for the year 2016. To this end, a questionnaire was sent to all dentists in Switzerland who were members of the Swiss Dental Society (SSO) at the time of the survey. The questionnaire asked for personal background data and obtained information about the dentists’ knowledge and concepts when using implants, the extent to which they used implants and about specific implant systems, which were selected based on the previous surveys. Out of 3,168 questionnaires, 1,446 were returned (return rate: 45.6%). Approximately 91% of the responding dentists had a practical involvement in implantology (implant placement only, super-structure insertion only, or both). Just over half of them (53%) placed more than twenty implants per year. Good handling was chosen by all dentists (100%) as a selection criterion for the implant system they used preferably. The current data suggested that the range of indications had widened, yet that the edentulous mandible was still the indication of choice. The percentage of dentists engaged in dental implantology doubled from 1994 to 2006 (1994: 42.2%, 2006: 82.2%). An increase of almost 10% in dentists involved in dental implantology was also apparent from 2006 to 2016 (2006: 82.2%, 2016: 91%). Our data show that, whilst the relative number of implant users had greatly increased among Swiss dentists, their rationale to place implants has remained similar.
Introduction

Surveys on the status of dental implantology in Switzerland were published in 2010 and 1999 (Lambrecht et al. 2010, 1999). The data from the 2010 publication were collected in 2006, while the 1999 publication comprised data collected in 1994. In Switzerland, the number of dentists performing implantology doubled over the period from 1994 to 2006 (1994: 619 [42.2%], 2006: 1289 [82.2%]) (Lambrecht et al. 2010, 1999). Although implant therapy is associated with high costs, a positive correlation between implants and an improvement in dental health was observed. Implants not only serve to replace individual teeth, but they can also be used to improve the support of prostheses. In addition to the improved retention and stability of prostheses, they might improve comfort, speech and chewing (Mishra & Chowdhary 2019). In several studies, high satisfaction rates of 80–92% have already been published for patients receiving implant treatment (Buchs et al. 2002; Pie tursson et al. 2005), thus leading to high acceptance of implant treatment among both patients and dentists. The trend towards an increased number of implant treatments had also been observed in other countries (Narby et al. 2008). In order to observe the status of dental implantology in Switzerland within a period of twenty-two years, the surveys performed in 1994 and 2006 were repeated for the third time in 2016. Comparison of the studies provided an insight into implant development in Switzerland. The main focus of the present survey was to determine patient satisfaction and the general demand for implant therapy and to update the data from the studies from 1994 published in 1999 and 2006 published in 2010 regarding the status of implantology in Switzerland. The present research is an analysis of a cross-sectional survey. Consequently, the results of the current thesis will be compared with results from the two previous studies in the “Discussion” section. The results from 1994 and 2006 of the previous studies from 1999 and 2010 (Lambrecht et al. 2010, 1999) are not mentioned again as they have already been published. Implantology is a widely accepted treatment option. Patients are more and more informed about different treatment options, especially by electronic devices (e.g. internet). At the same time, the market for this industry has become harder because the number of implant brands has increased tremendously in the past twenty-two years. This might have an impact on the amount of implants inserted and possibly create new trends when comparing the status of implantology with data over twenty years. At the beginning of the implant era, implant therapy was mainly performed by specialists. High acceptance and increasing knowledge in the field of implantology might have motivated more and more generalists to perform implant treatment as well. The hypothesis of this study was that the number of dentists practicing implant therapy had increased and that differences concerning the implant brands used and expectations can be observed over a period of twenty-two years.

Materials and methods

At the end of June 2016, the same questionnaire on implantology which was used in 2006 was sent with an accompanying letter and a prepaid addressed envelope to all dentists in Switzerland who were members of the SSO at that time. The questionnaire and accompanying letter were translated into Italian and French in addition to the German version. The questionnaire was only slightly modified compared to the questionnaire used in the study from 2006 (Lambrecht et al. 2010) and included thirty-eight questions with the following range of topics: personal information, degree of recognition of implant brands, use of implant systems, indications for implants, success and failure, recall interval, as well as further training and future prospects.

Participants were only asked for general information, such as their age, year of graduation, gender and the location of their dental education (Swiss canton), thereby ensuring the anonymity of the dentists.

In total, 3,168 questionnaires were sent out to all SSO members in Switzerland, 2,391 being sent to German-speaking dentists, 606 to dentists in the French-speaking regions and 171 to dentists in Italian-speaking areas.

The deadline for returning the questionnaires was fixed as the beginning of January 2017. The data from the questionnaires received were transferred to an Excel table by the end of March 2017. Thereafter the data were descriptively analyzed and charts plus illustrations were created. The software used to calculate the results were Microsoft Excel and IBM SPSS Statistics 22.

Results

Return rate of the questionnaires

In total 1,446 questionnaires were returned out of 3,168, representing a return rate of 45.6%.

Training location

The largest group, comprising 31.1% of dentists who participated in the survey, had studied in Zurich, followed by Bern with 22.8%, Basel with 17.7%, abroad with 14.4%, and the smallest group of 14% of dentists completed their education in Geneva.

Dental training education

Of the 1,446 dentists surveyed, 52.6% indicated that they did not have a specialist title. 680 dentists, equivalent to 47%, reported having a specialist title. 50% of these 680 dentists did not specify the specialization direction. 15% of these dentists stated that they had a specialization in “general dentistry”, followed by “orthodontics” at 14.5%, “oral surgery” at 12.5% and “reconstructive dentistry” at 6.5%. Only 1.5% of the surveyed had a specialization in the field of “oral and maxillofacial surgery”.

Practical involvement in implantology

The question concerning the use of implants and superstructures was answered by 1,370 dentists, 1,246 (91%) of whom had a practical involvement in implantology (implant placement only, superstructure insertion only, or both). 897 (65.1%) out of 1,370 dentists reported that they placed both implants and superstructures (surgery and prosthodontics). Only 37 dentists (2.7%) practiced implant surgery without placing superstructures. 22.8%, which equates to 312 dentists, reported performing only reconstructions on implants without surgical interventions. A group of 111 dentists (8%) transferred their patients to specialized colleagues for the entire implantology treatment. 13 (0.9%) of these dentists, constituting the smallest group in this context, did not recommend any implantology treatment.

Level of recognition of individual implant systems

Which implant system dentists were familiar with was also investigated. This question was answered by 1,379 dentists. Straumann was the best known implant system, recognized
by 98% of dentists. The second place was taken by Nobel Biocare at 92.5%, followed by SPI at 73.5%, Friadent and Camlog at 69.7% each, Astra at 67.6%, Biomet 3i at 63.9% and Ankylos at 62.7%.

Use of individual implant systems
Straumann was also the implant system which was most commonly used (65.2%), followed by Nobel Biocare at 12.8% and SPI at 10.3%. The other implant systems were used by less than 10% of dentists.

Selection criteria for implant systems
In another question the dentists were asked which selection criteria they apply when deciding in favor of a specific implant system. This question was answered by 1,048 (72.5%) dentists. Handling as a selection criterion was chosen first by all dentists (100%) and was regarded as the main criterion in dentists’ choice of implant system. The factor of cost played the smallest role of all the factors, although it was chosen by 97.2% of dentists.

Clinical indications for implants
The indication range for implant therapy was very wide. The edentulous lower jaw was the favorite localization for implantology treatment, given by 94.7%, followed by a free–end gap in the lower jaw which was chosen by 93.1% of the dentists, while free–end gaps in the upper jaw were less chosen for implant therapy (79.1%). A single-tooth gap in the anterior upper jaw was chosen by 90% of dentists as an implant indication.

Surgically inserted endosseous implants per year
Just over half of the dentists (53%), which corresponds to 615 dentists, inserted more than 20 implants per year. In total 116 (10%) dentists inserted 6–10 implants per year. This question about the number of endosseous implants inserted per year was answered by 1,160 (80.2%) dentists.

Discussion
The present survey shows that the number of dentists involved in implantology had increased over the past twenty-two years. In 2016 more than 90% of dentists in Switzerland were involved in implantology, which makes implant therapy a popular treatment option in dentistry. The total number of inserted implants per year had not increased. This means that implant therapy was being increasingly performed by generalists who were not specialized in implantology. This shift from specialists to generalists using implant treatment is one of the biggest differences when comparing the present study to older surveys. In our first survey from 1994 (Lambrecht et al. 1999) the amount of implants inserted was almost the same, but they were inserted by only a small number of dentists.

In the current survey of 2016, there was a slight decrease in the number of participating SSO members and returned questionnaires as compared to 1994 (51.3%) and 2006 (47.3%), respectively. Nevertheless, the return rate of 45.6% can still be regarded as high and allows a direct comparison of the collected data to be made between 1994, 2006 and 1994.

The absolute number of dentists qualified in Bern, Basel, Zurich and abroad increased between 1994 and 2006 (Fig. 1). It is remarkable that the number of dentists who completed their training abroad had doubled in absolute and percentage terms from 1994 to 2016 (1994: 106 = 7.5%, 2006: 146 = 9.3%, 2016: 209 = 14.4%). The immigration of dentists from abroad to Switzerland had thus increased over the last twenty-two years.

Whereas in 1994 only 619 dentists had introduced implantology into their practice, the number of dentists offering implant treatment doubled to 1,289 over twelve years from 1994 to 2006. Comparing the data collected in 1994 and 2006 with the survey of 2016, the percentage of dentists applying implant treatment in general had increased noticeably in the period between 1994 and 2016; it had more than doubled (1994: 42.2%, 2006: 82.2%, 2016: 91%). In addition, the number of dentists who performed both implant surgery and reconstruction on implants had increased in the period from 1994 to 2016 (1994: 54.9%, 2006: 52%, 2016: 65.1%) (Lambrecht et al. 2010, 1999). The increases may be explained by several factors: more treatment possibilities with implants, patient satisfaction or higher efficiency of treatment with implants may be involved as well as the predictability as confirmed in several long-term surveys. The treatment options when using dental implants had greatly increased, which is a positive point, but on the other hand this had made some clinicians more aggressive in relation to extracting teeth (Pjetursson & Heimisdottir 2018). This aspect might also be one reason why dental implant use had more than doubled in the last twenty-two years. Another reason for the rise in implant frequency could be the increase in patient satisfaction with implant-supported overdentures (IODs) especially in the mandible. Patients reported oral-health related quality of life (OHRQoL) and satisfaction with mandibular IODs when compared to complete dentures (CCDs) (Mishra & Chowdhary 2019). The study by Ducommun et al. 2019 revealed that a linear increase in the average age of patients seeking implant treatment can be observed. This might be another reason for the increase in implant treatment, bearing in mind the increase in the average age of the population nowadays.

In all three surveys, the two implant brands Straumann (previously ITI or Bonefit) and Nobel Biocare (previously Bränemark) were the best known and most used implant systems. In 1994, the SPI, Ankylos, Astra and Camlog systems were not present on the Swiss market; instead systems such as Linkow, HaTi, the Tübingen immediate implant, TPS and IMZ were used; these had totally disappeared from the market in 2016. It is remarkable that the absolute number of dentists and percentage recognition level of Biomet 3i had more than quadrupled in these ten years (Biomet 3i 2006: 206 = 13.1%, Biomet 3i 2016: 882 = 63.9%) (Fig. 2) but the use of Biomet 3i was very low and had decreased even further in these ten years (2006: 11.2%, 2016: 5.7%) which is shown in Figure 3. Thus, the recognition level for this system was very high but it was not used as frequently. One reason for this might be that the representatives of Biomet 3i were engaged in heavy advertising, hence the high recognition level of this system, although dentists preferred other systems like Straumann or Nobel Biocare. The formerly less well known implant systems had increased in awareness. Possible reasons might be that dentists increasingly tried out new products, the price-performance ratio was good, or the advertising of these products had increased.

As in 1994, Straumann was still the favored implant system in 2016. The absolute number of dentists using this system had increased from 1994 to 2016 (1994: 278, 2006: 656, 2016: 942). However, a decrease in the percentage of users could be observed over the last twenty-two years (1994: 78.5%, 2006: 77.6%, 2016: 65.2%) (Fig. 3).
Fig. 1  Training location of the SSO members

Location of education in absolute numbers

- BERN: 317, 244, 278, 106
- BASEL: 359, 288, 233, 146
- ZURICH: 310, 256, 202, 209
- GENEVA: 511, 528, 449
- FOREIGN COUNTRY: 511, 528, 449

Year 1994; n = 1,459  Year 2006; n = 1,568  Year 2016; n = 1,446

Fig. 2  Level of recognition of individual implant system by Swiss dentists in percentage. The names of the implant systems were given in the questionnaire (multiple answers were possible).

Level of recognition of individual implant systems in percentage

- STRAUMANN: 98.20% 82.10% 78.50%
- NOBEL BIOCARE: 92.30% 88.50% 50.30%
- FRIALIT: 98.50% 41.80% 15.80%
- SPI: 92.50% 76.10% 65.20%
- ANKYLOS: 90.50% 69.70% 5.10%
- ASTRA: 73.50% 60.80% 12.80%
- CAMLOG: 62.70% 41.10% 15.80%
- BIOMET 3I: 67.60% 40.20% 10.30%
- OTHER: 69.70% 19.30% 22.00%

Year 1994; n = 1,459  Year 2006; n = 1,568  Year 2016; n = 1,379

Fig. 3  Implant systems used by Swiss dentists in percentage (multiple answers were possible).

Use of individual implant systems in percentage

- STRAUMANN: 78.50% 77.60%
- NOBEL BIOCARE: 50.30% 65.20%
- FRIALIT: 15.80% 12.80%
- SPI: 5.50% 5.10%
- BIOMET 3I: 10.00% 10.30%
- OTHER: 18.80% 11.20%

Year 1994; n = 354  Year 2006; n = 845  Year 2016; n = 1,446
For over twenty-two years long-term prognosis and handling had continued to get the most attention in terms of the selection criteria for implant brands. It is worth noting that the selection criterion of cost increased tremendously over the period from 1994 to 2016 (1994: 7%, 2006: 19.3%, 2016: 97.2%). This could be related to general socio-economic trends in the medical and dental field.

As before, the edentulous lower jaw still represented the main indication for implant treatment (1994: 67%, 2006: 95.8%, 2016: 94.7%) (Fig. 4) (Lambrecht et al. 2010, 1999). In a retrospective study from 2004, which was also conducted in Switzerland, the “single-tooth gap upper jaw” was the most reported indication for implant treatment (Sulzer et al. 2004). The different indications in the studies mentioned may be due to the fact that “edentulous lower jaw” was the main indication for implant therapy for dentists but, in reality, implants were most commonly placed in a single-tooth gap in the lower jaw. Overall, the indication spectrum widened very considerably over the period from 1994 to 2016. The different indications from the questionnaire, such as “single-tooth gap lower jaw”, “free-end gap lower jaw”, “single-tooth gap anterior upper jaw”, “free-end gap upper jaw” and “edentulous upper jaw”, were chosen by only about 30% of dentists in 1994 as an indication criterion for implant treatment. This contrasts with 2006 when about 85% of dentists stated that the above-named criteria were an indication for implant therapy (Lambrecht et al. 2010, 1999). There was also an increase in implant indications from 2006 to 2016. The study by Ducommun et al. 2019 examined the most common indication for implant treatment at the University of Bern. The study shows that a single-tooth gap (50.5%) was at that time the most common indication for implant therapy, followed by distal extension situations (22.3%). In the study it could be shown that a total of 60.8% of implants placed needed bone augmentation. This aspect was not subject of the present work and may be examined in future studies.

One reason for the widening of the indication spectrum might be that implant development had expanded and thus the indications for implant use had increased. The range of indications.
for implants had generally increased. One reason might be that nowadays the health issues of high-risk patients, such as smokers, patients with diabetes mellitus or under bisphosphonate therapy and with other general medical problems, are no longer regarded as an absolute contraindication. Thus, further development in the area of implant surface design had enabled a reduction in healing time and a broader indication spectrum for implants in the last twenty years (Al-Nawas et al. 2008). This could be another reason for the increased implant indication spectrum.

In 1994 only 28% of dentists placed over 20 implants per year. There had been a noticeable shift: in 2006 the biggest group, accounting for over 64.6% of dentists, placed over 20 implants a year. In the current survey of 2016 this percentage had decreased (2006: 64.6%, 2016: 53%), but over half of the dentists still placed 21 or more implants a year. Further, it is noteworthy that in 2016 the percentage difference between dentists who only placed up to 10 implants a year (27.9%) did not differ significantly from the percentage of dentists who inserted over 50 implants a year (23.8%) (Fig. 5). This finding may indicate that more general practitioners were also inserting implants, which could be interesting for the industry but questionable with regard to the technical skills of those who did not have a specialization in oral surgery (Lambrecht et al. 2010, 1999).

The present study did not examine whether therapies such as sinus lift, bone augmentation or other such treatments were performed in addition to implantation. It would be interesting to examine this aspect as well in future studies.

Complications associated with implant therapy were not investigated in the present survey. Valuable information is missing, such as the frequency of periimplantitis or prosthetic complications, material failures and other such drawbacks. Implantology brings with it many advantages, but it also has negative implications. Thus, no statement can be made about implant complications in this study. Although this aspect is absent from the present survey, it should be investigated in future studies for a critical examination of dental implantology.

Subdivision of dentists according to different characteristics, which was not done in the present survey, could be an improvement proposal for future studies.

Implant therapy had become an established and accepted treatment option in Switzerland over the last twenty years. Our data are comparable to data from other European countries showing improved acceptance of implants. Implant treatment was performed by a larger number of dentists who had no specialization in implant therapy. This might be a risk factor for success in implant therapy – and acceptance of implant treatment – in the future. Continuous survey of the status of implantology may be interesting for both industry and physicians, showing trends and developments but also focusing on implant success.

Conclusions
Compared to the study from 1994, the number of dentists performing implantology treatment in Switzerland had more than doubled over the course of twenty-two years. In 2016, 91% of dentists who answered the questionnaire were engaged in implantology. It is also remarkable that the spectrum of indications for implant treatment had expanded enormously during this time period. Straumann remained the best known and most used implant system by dentists in Switzerland from 1994 to 2016.

Zusammenfassung
Einleitung

Material und Methode
Ein Fragebogen wurde an alle Zahnärztinnen und Zahnärzte in der Schweiz versandt, die zum Zeitpunkt der Befragung Mitglieder der SSO (Schweizerische Zahnärztesgesellschaft) waren. Dieser war inhaltlich demjenigen von 2006 (Lambrecht et al. 2010) weitgehend angeglichen. Er umfasst 38 Fragen mit verschiedenen Themenbereichen, die sich wie folgt gliedern:
- persönliche Daten
- Bekanntheitsgrad der Implantathersteller
- Erfahrung und Ausbildungsstand
- Erfolgs- und Misserfolgsrate

Die Anonymität wurde gewährleistet, indem nur allgemeine Angaben zur Person, wie Alter, Abschlussjahr, Geschlecht und Ort der Ausbildung, erfragt wurden.

Ergebnisse
Von den Fragebögen, die im Jahr 2016 an 3168 SSO-Mitglieder versandt wurden, kamen 1446 (Rücklaufquote: 45,6%) ausgefüllt zurück. 91% der Befragten gaben an, dass sie zu diesem Zeitpunkt implantologisch tätig waren. Straumann, Nobel Biocare, Friadent und SPI waren die bekanntesten Implantatsysteme. Straumann- und Nobel-Biocare-Systeme wurden am häufigsten verwendet. Ein gutes Handling wurde von allen Antwortenden (100%) als primäres Auswahlkriterium, der Faktor Kosten von 97,2% angegeben.


Schlussfolgerungen

Verbunden damit hat der Einsatz von Implantaten in der Schweiz innerhalb von 22 Jahren also generell stark zugenommen und im zahnmedizinischen Therapiespektrum eine bemerkenswerte Akzeptanz erlangt.

Résumé
Introduction

Matériel et méthode
Un questionnaire a été envoyé à l’ensemble des membres de la Société suisse des médecins-dentistes (SSO) enregistrés au mo-
ment de l’étude. Il s’agit du même questionnaire que celui utilisé en 2006 (Lambrecht et al. 2010) pour étudier cette problématique. Ce questionnaire comprend 38 questions couvrant différents thèmes et se regroupant comme suit :

- données personnelles
- degré de connaissance des fabricants d’implants
- degré d’expérience et état des connaissances
- quota de réussite et d’échec

L’anonymité des réponses fut assurée en ne posant que des questions personnelles générales telles que âge, année d’obtention du diplôme.

Résultat
Parmi les 3168 questionnaires qui furent transmis en 2016 aux membres de la SSO, 1446 ont été remplis et retournés (quota de retour : 45,6 %). Environ 91 % des dentistes indiquent avoir été actifs dans le domaine de l’implantologie. Straumann, Nobel Biocare, Frialit et SPI étaient les systèmes d’implant les plus connus. Parmi eux, les systèmes Straumann et Nobel Biocare ont été les plus utilisés. Parmi les critères de choix, une facilité d’utilisation a été nommée par l’ensemble (100 %) des dentistes. Le facteur coût a été choisi par 97,2 % des dentistes. Le domaine d’application s’est fortement agrandi, bien que la mandibule édentée restât l’indication du choix.

Conclusion

References