



**A Survey Of The Utilization Of Ligation Bracket Systems By Orthodontists In The
United States**
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ORTHODONTISTS IN THE UNITED STATES**

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A SURVEY OF THE UTILIZATION OF LIGATION BRACKET SYSTEMS BY ORTHODONTISTS IN THE UNITED STATES

The notion of straightening teeth to achieve a more beautiful and functional smile is not a new concept. Efforts to achieve these goals can be traced back to at least 1000 B.C.¹ The goal of reaching an ideal functional occlusion was studied in the late 1800s when Edward H. Angle began developing occlusion principles for prosthetic dental treatment.² Angle invented the edgewise bracket system and is known as the “father of modern orthodontics”. Since Angle, the specialty of orthodontics has had many significant advances. In 1972 Andrews forever changed the specialty with his works and the article “The Six Keys To Normal Occlusion”.³ Andrews modified the edgewise bracket system and it became known as the straight wire appliance. Andrews’ invention has led to a change in the manner in which orthodontics is practiced today.⁴

Technological advances continue to be made in orthodontics and the modification of bracket systems is still active to this day. One modification technique is to alter the way the archwire is ligated into the bracket. Conventional ligation (CL) is achieved with elastomeric modules or steel ligature ties, whereas self-ligating brackets (SL) achieve ligation within the bracket itself by either rigid clips, spring clips, or retaining springs.² Historically, the first self-ligating bracket was the Russell attachment, invented in the mid-1930s by Stolzenberg.⁵ The bracket utilized a flat head screw as ligation over the wire threaded onto the face of the bracket. Additionally, there have been advances within types of SL brackets, such as having an active or passive ligation system. The first active SL brackets were introduced to the market in 1980 by SPEED*.⁶ A few years later, in 1996, Dwight Damon introduced an innovative version of a passive SL bracket.⁵ Since Damon’s reintroduction of SL brackets, the Damon** brackets as well as a large selection of other SL brackets have remained popular.

One of the goals in orthodontics today is a reduction of treatment time without causing harm to the patient’s dentition and surrounding periodontium. In attempt to measure complete treatment time, SL brackets have been shown to be more time efficient compared to CL brackets in the initial stages of leveling and alignment.⁷ In review of overall orthodontic treatment time, Papageorgiou et al. reports an average

2.01 month longer treatment time with SL brackets compared to CL brackets.⁸ When the evaluation of initial pain, the number of treatment visits and total treatment time between CL and SL brackets were reviewed systematically by Celar et al., the findings showed no significant differences between bracket systems.⁹ These authors further state that there are a limited number of studies in this area and additional research is needed to validate conclusions.

In 2010 a survey of United Kingdom orthodontists, published in the Journal of Orthodontics, investigated the usage of fixed appliances.¹⁰ The data indicated that newer inventions, such as SL brackets, had a variation of acceptance and there were differences in appliance popularity based on the years of experience of the orthodontists. Distinguishing differences were noted in the prescription of the bracket used as well as the design preference. Additional research, published in 2016, in the UK compared the pain perception of CL and SL brackets, finding there was no clinically significant difference in perceived pain.¹¹ In 2012, a study in the US found practitioners preferred SL brackets in initial stages and CL brackets in finishing and detailing stages.¹²

Many years have passed since the reintroduction of SL brackets and there are still unanswered questions in their regard. Research is essential to evaluate CL and SL bracket systems used by orthodontists today. Further research could provide insight with the evaluation of correlations between the years of experience, the number of treatment visits, the total treatment time, geographic location influences and other practice techniques between orthodontists in the United States and their different bracket ligation utilization preferences. The objective of this study is to statistically assess the correlation between orthodontists' demographics in the United States and their utilization of different bracket ligation systems. The null hypothesis is there will be no significant difference in the utilization of self-ligating systems compared to conventional ligation systems used by orthodontists practicing in the US according to the time since completing orthodontic residency. Further treatment characteristics will be analyzed by provider demographics.

Material and Methods

Approval was obtained from the 59th Medical Wing Institutional Review Board, Joint Base San Antonio, TX prior to initiation of this study. An online questionnaire utilizing SurveyMonkey.com was approved by the American Association of Orthodontists (AAO) Survey Review Committee. The AAO's Partner's in Research Program sent the electronic questionnaire to a random selection of 2,084 orthodontists practicing in the United States. A digital letter was sent via email to invite them to voluntarily participate in the 14-question research study. The survey was sent again 15 days later to those orthodontists who did not complete the initial survey. The survey was active for a total of 25 days. Orthodontists still in orthodontic residency programs were excluded from the study. Data analysis was performed with the responses received from the AAO authorized surveys. Significance levels and correlations were analyzed using Chi-squared tests, Cochran-Armitage trend tests, Fisher's Exact tests, and t-tests for bracket preferences and differences between providers. Statistical significance was maintained at a p-value of 0.05 for each analysis.

Results

The 14-question survey via SurveyMonkey.com had a 6.4% response rate, which was similar to other researchers who used SurveyMonkey.com to gather data.¹³ The range of respondents varied from those who had graduated in 1979 or earlier to those who graduated in 2018. The majority of respondents had graduated more recent than 1979 (Figure 1) and only two reported not actively practicing. The results of the Chi-squared test and the Cochran-Armitage trend test showed there was no significant difference in bracket ligation preference by time since graduating orthodontic residency ($p > 0.05$), therefore, the null hypothesis failed to be rejected (Figure 2).

Of the orthodontists surveyed, most had been in practice for over 16 years. A Fisher's Exact test and Cochran-Armitage trend test were utilized to determine if an association and trend existed between the number of years in practice and a preference in bracket ligation system. There was no significant difference in preference of CL or SL systems ($p > 0.05$) and the number of years in practice (Figure 3).

When the geographic location was analyzed, there was no difference in bracket preferences based on geographic region or time zone of the orthodontic residency

programs. The majority of respondents reported being single owners in private practice, followed by partnerships with multiple owners, group practices with different specialties, Dental Support Organizations, and military practices (Figure 4). The respondents were distributed throughout the US and there was no association between the geographic location of current practice and the orthodontists' bracket ligation preferences ($p>0.05$).

When practice techniques were evaluated, 85% of providers in the US surveyed routinely include second molars in comprehensive orthodontic treatment. The majority of respondents replied the average total treatment time for comprehensive orthodontic care was 20-23 months. When the average treatment times of CL and SL systems were compared using the Cochran-Armitage trend test, there were no differences found in total treatment times and the bracket ligation systems ($p>0.05$; Figure 5). Conversely, when the average time between adjustments in CL and SL bracket systems was evaluated with a t-test, a significant difference was determined ($p<0.05$; Figure 6). The CL system providers had more frequent recall times between adjustment appointments for their patients, which averaged 5.7 weeks for CL system providers compared to a 6.8 week recall average for SL system providers.

The results of the survey indicated 72% of respondents use CL bracket systems, 27% use SL bracket systems, and less than 2% use exclusive aligner therapy (Figure 7). Of the respondents, 91% reported they have used a SL system at some point in their careers. When asked the primary reason they do not use SL bracket systems, the top two responses were difficulty during detailing and finishing, followed closely by cost (Figure 8). Additionally, 10% of the orthodontists reported routinely using both CL and SL systems. Lastly, based on the responses received, the three most highly used brackets in the US are manufactured by American Orthodontics^{***}, 3M Orthodontics[†], and Ormco^{**} (Figure 9).

Discussion

The qualitative data gathered from this survey on overall comprehensive treatment time is consistent with the results of the systematic reviews published by Chen et al. in 2010 and by Celar et al. in 2013.^{9, 14} No difference in overall treatment time is in contrast with Papageorgiou et al., who reported average longer treatment times with SL brackets compared to CL brackets.⁸ Additionally, Chen et al. concluded

there is significantly less chair time with the SL bracket system based on time to open brackets compared to removing ligatures of CL brackets. This current survey also found less chair time with SL bracket systems, however it was based on the total number of appointments for comprehensive treatment. The claims made by manufacturers that total number of visits are less with SL systems is reasonable since the total treatment time is the same for both systems, yet SL systems have longer intervals between recall visits. The information gathered in this survey can be used to further verify the conclusions with the quantitative research data that is historically available.^{10, 14}

Since this survey was electronically distributed, the response rate could have been affected by those who prefer technology. A survey of orthodontists by Park, using SurveyMonkey.com, in the United States reports response rates similar to the rate found in this study.¹³ Caution should be taken when generalizing the results to practices of orthodontist in the US. Further, the response rate potentially could have been increased by allowing the survey to remain open for a longer period of time.

The results of this survey are different from the 2010 UK study by Banks which showed a preference for SL systems in respondents who had recently completed orthodontic residency programs.¹⁰ The UK data indicated that newer inventions, such as self-ligating brackets, had a variation of acceptance and there were differences in appliance popularity based on the years of experience of the orthodontists. The UK results are different from this survey of orthodontists in the US as time since completing residency and total years in practice did not influence the type of bracket ligation system preference. The responses concerning the primary reasons orthodontists do not utilize SL brackets systems are in agreement with the results of the Prettyman et al. survey published in *The Angle Orthodontist* in 2012.¹² In addition to difficulty detailing and finishing as well as cost, other reasons included no real advantages of one system over the other, ligation mechanical failure and difficulty engaging ligation device.

Improvements of this survey could have been made by asking additional questions, however lengthening a survey has to be weighed against the concept that increasing the number of questions can lead to a lower response rate. There have been multiple systematic reviews on SL compared to CL bracket systems and this study supports the finding that there remains a strong preference for CL bracket systems in

the US. Additional research on other areas of treatment characteristics of orthodontists in the US can be explored and analyzed. The results from this survey can contribute to the existing information and may aid orthodontists in making research-based decisions in their practices.

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**Registered trademark of Ormco, Orange, CA, <https://damonbraces.com>

***Registered trademark of American Orthodontics, Sheboygan, WI, <http://www.americanortho.com/>

†Registered trademark of 3M Orthodontics, St. Paul, MN, https://www.3m.com/3M/en_US/orthodontics-us/

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Statistician/ Craniofacial Health & Restorative Medicine

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Figure 1

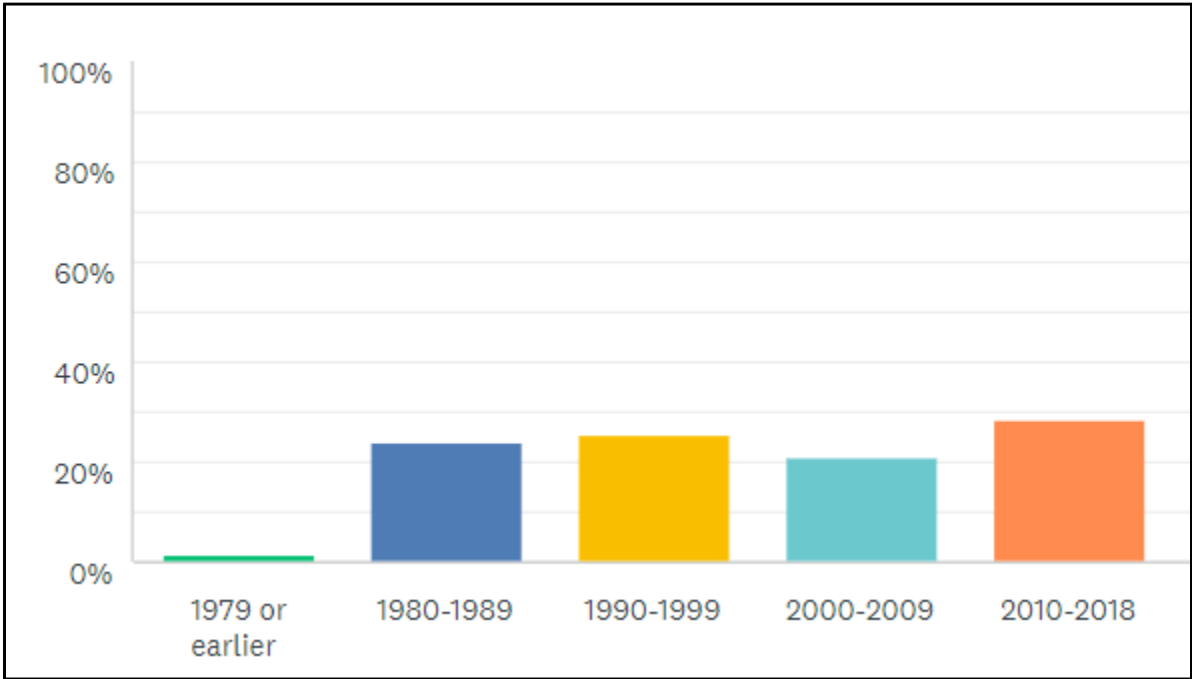


Fig.1 Percentage of Orthodontists by Graduation Year

Figure 2

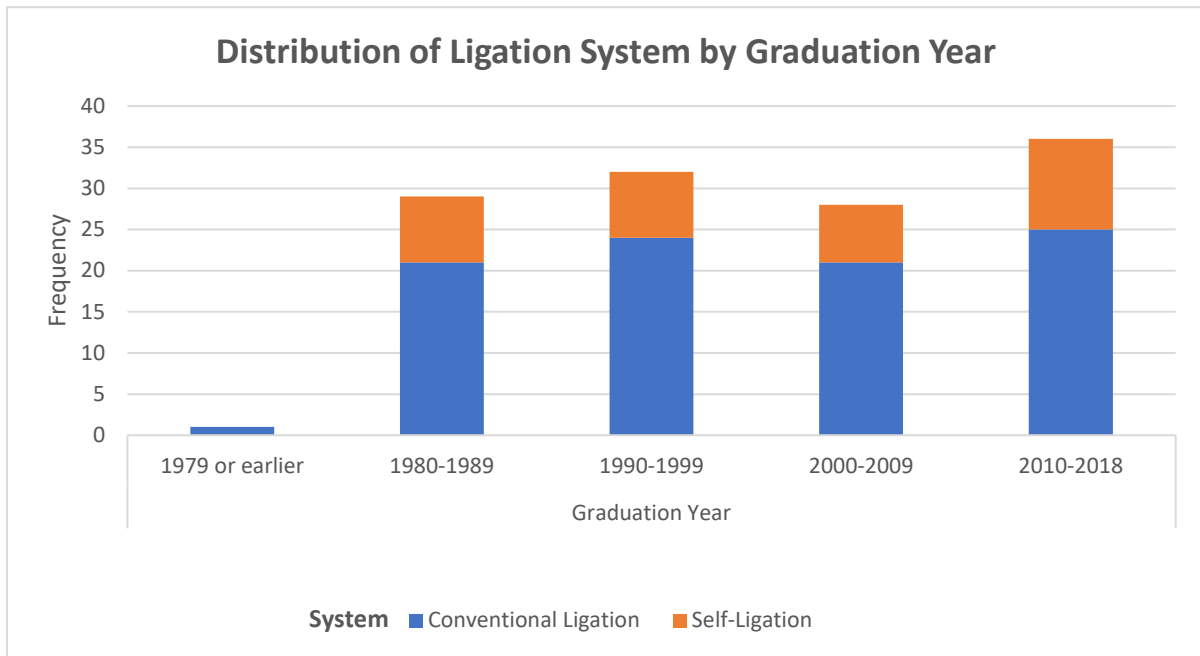


Fig. 2 Distribution of Ligation System by Graduation Year

Figure 3

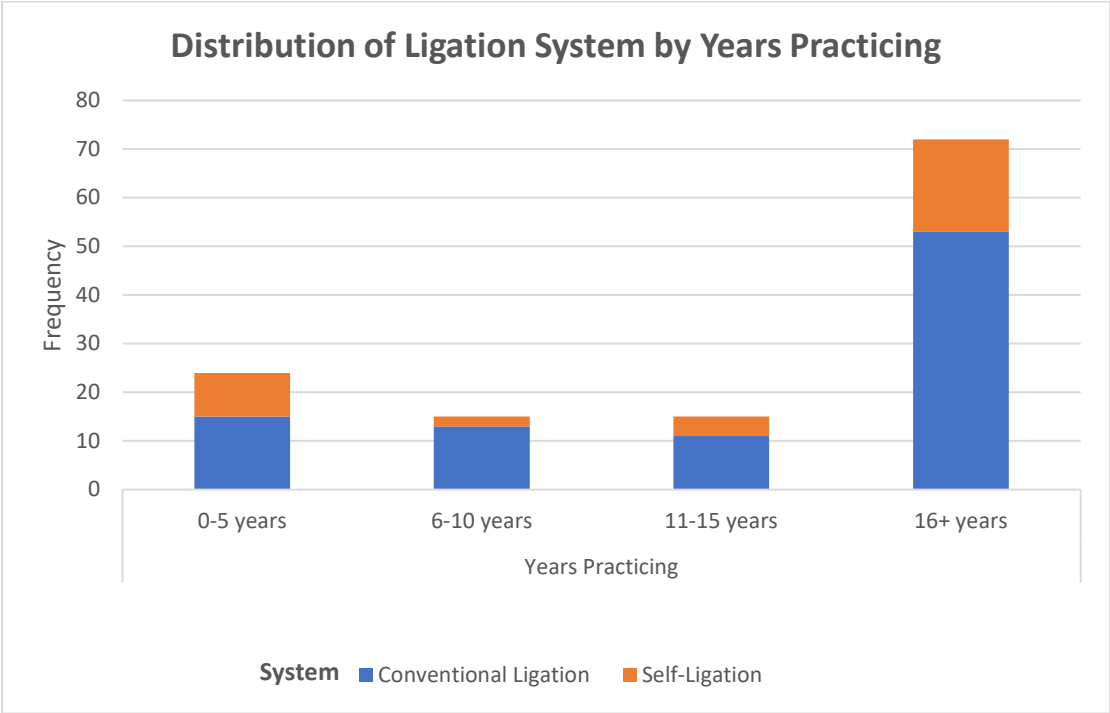


Fig. 3 Distribution of Ligation System by Years Practicing

Figure 4

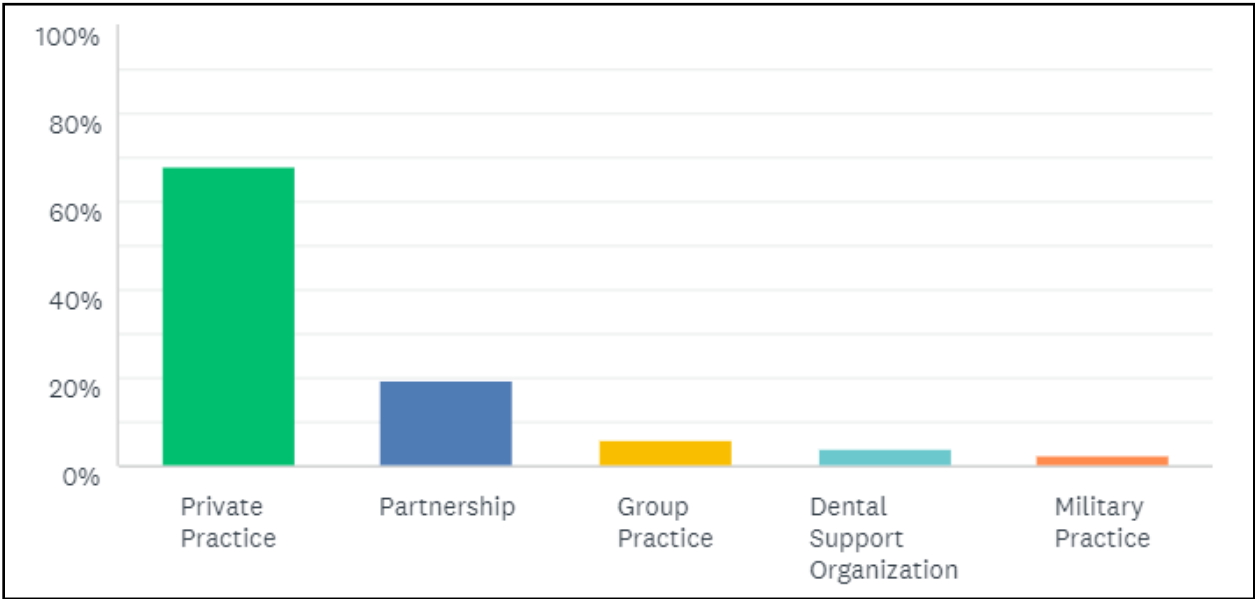


Fig. 4 Percentage of Orthodontists by Practice Type

Figure 5

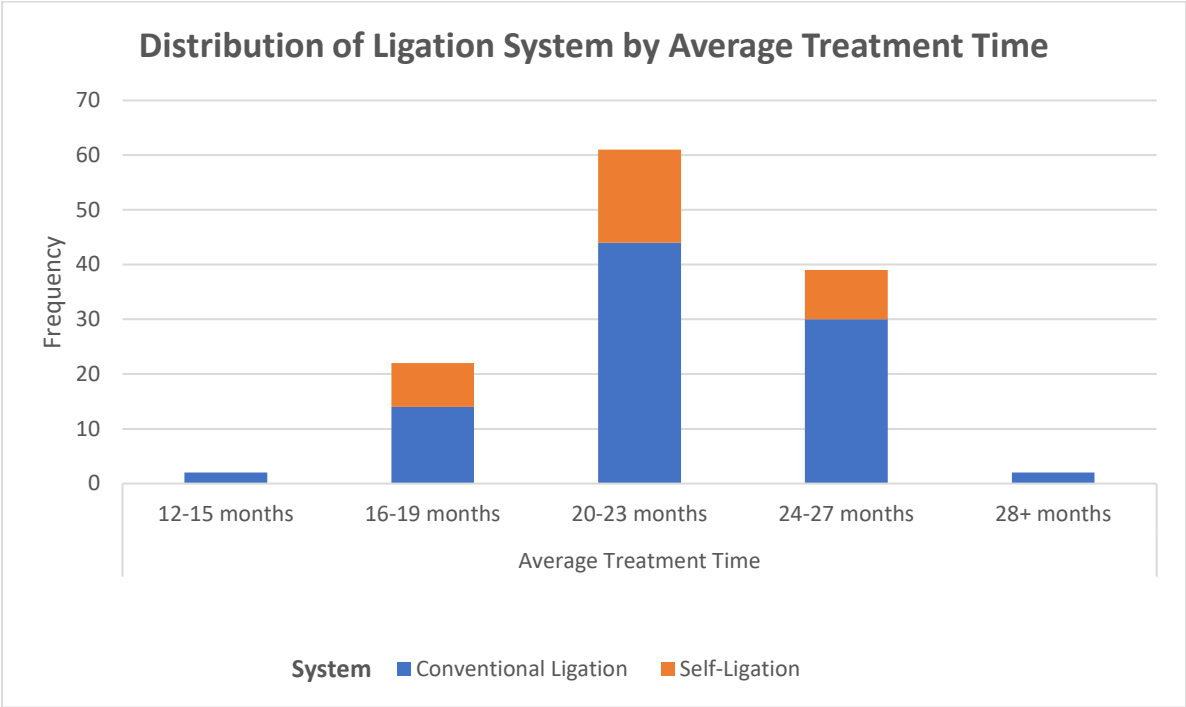


Fig.5 Distribution of Ligation System by Average Treatment Time

Figure 6

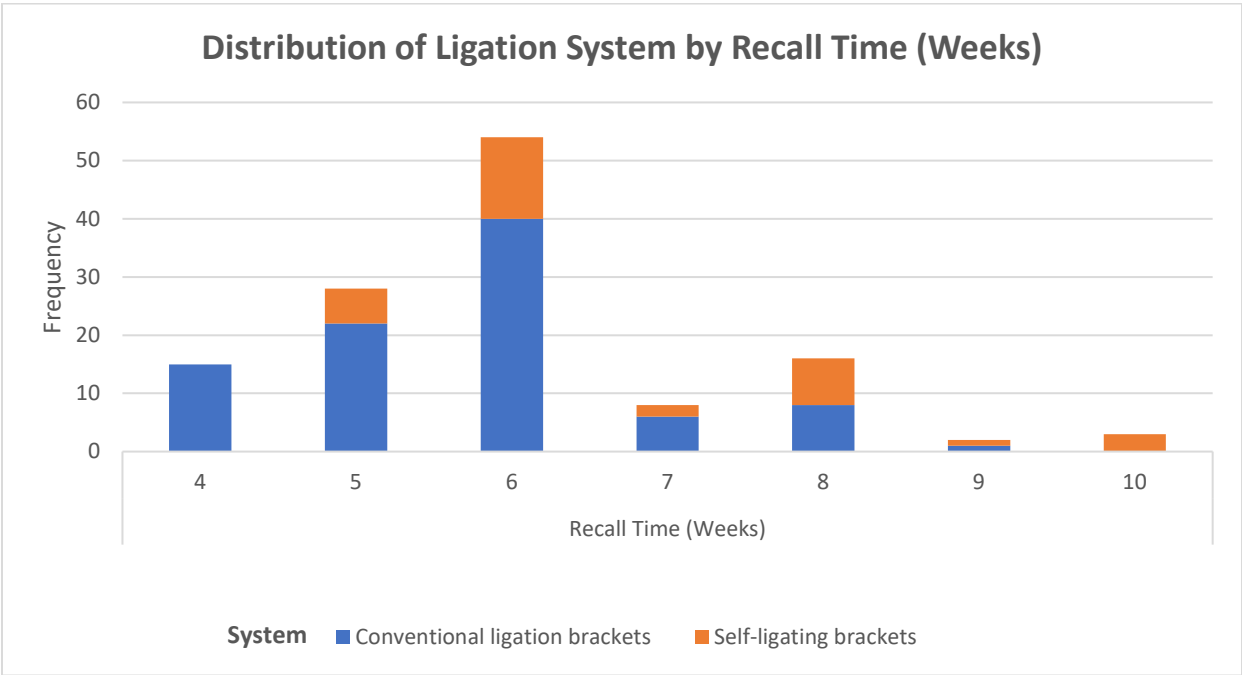


Fig. 6 Distribution of Ligation System by Recall Time

Figure 7

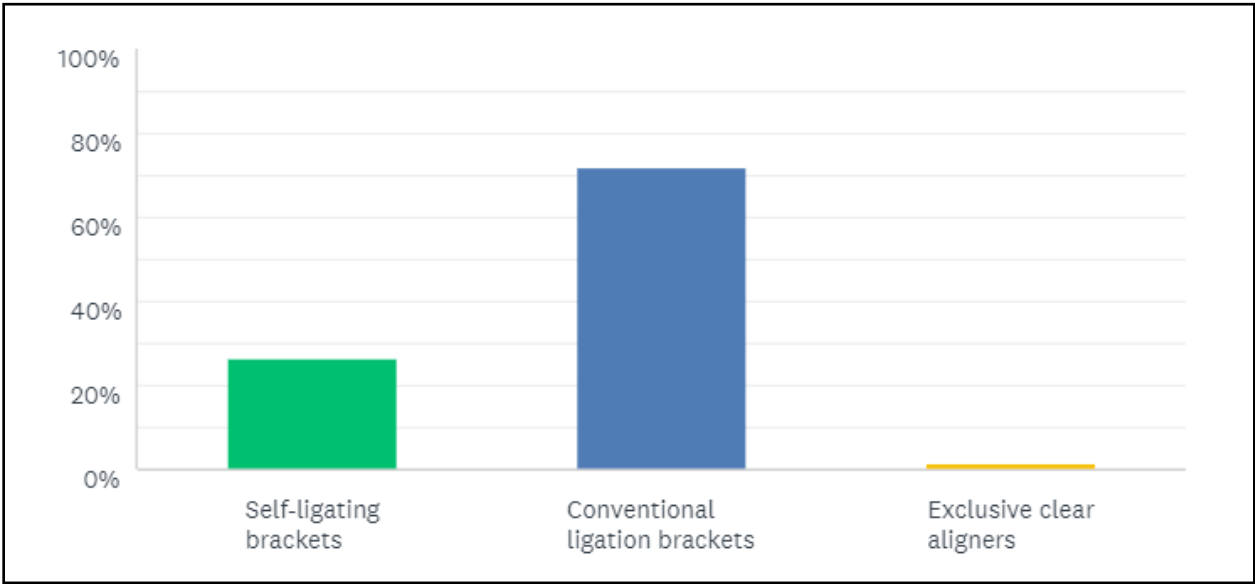


Fig. 7 Percentage of Orthodontists by Bracket Ligation System

Figure 8

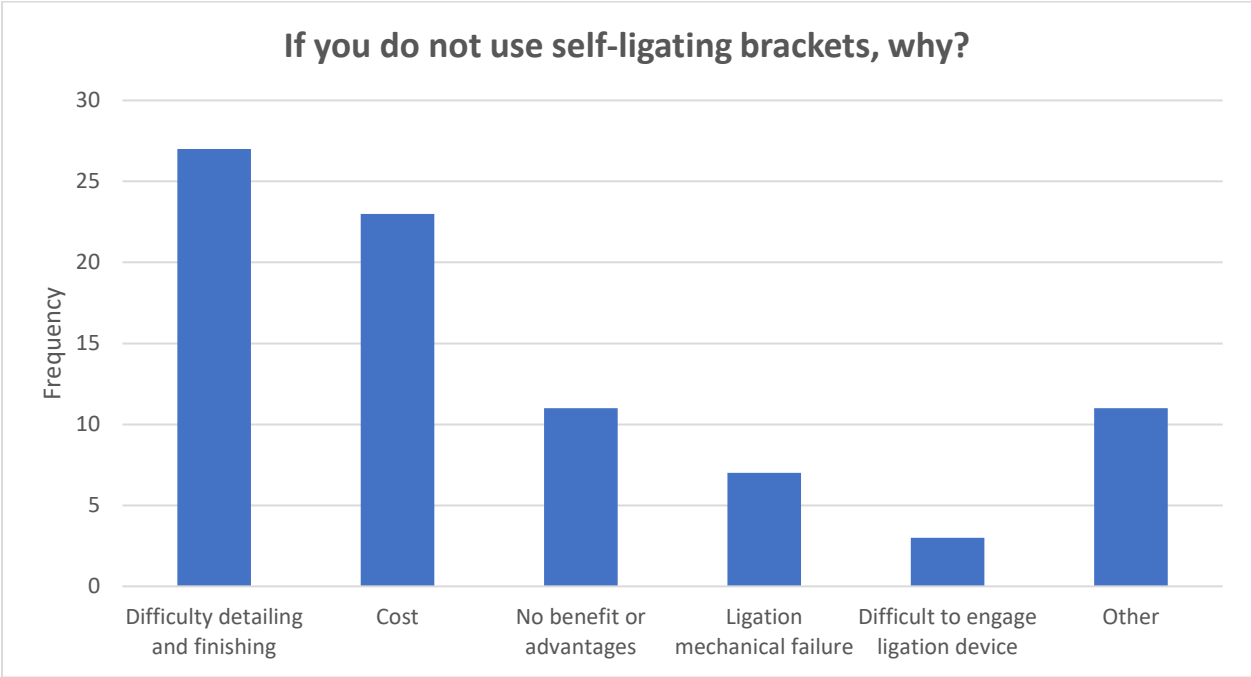


Fig. 8 Distribution of Reasons Orthodontists Do Not Utilize Self-Ligation Brackets

Figure 9

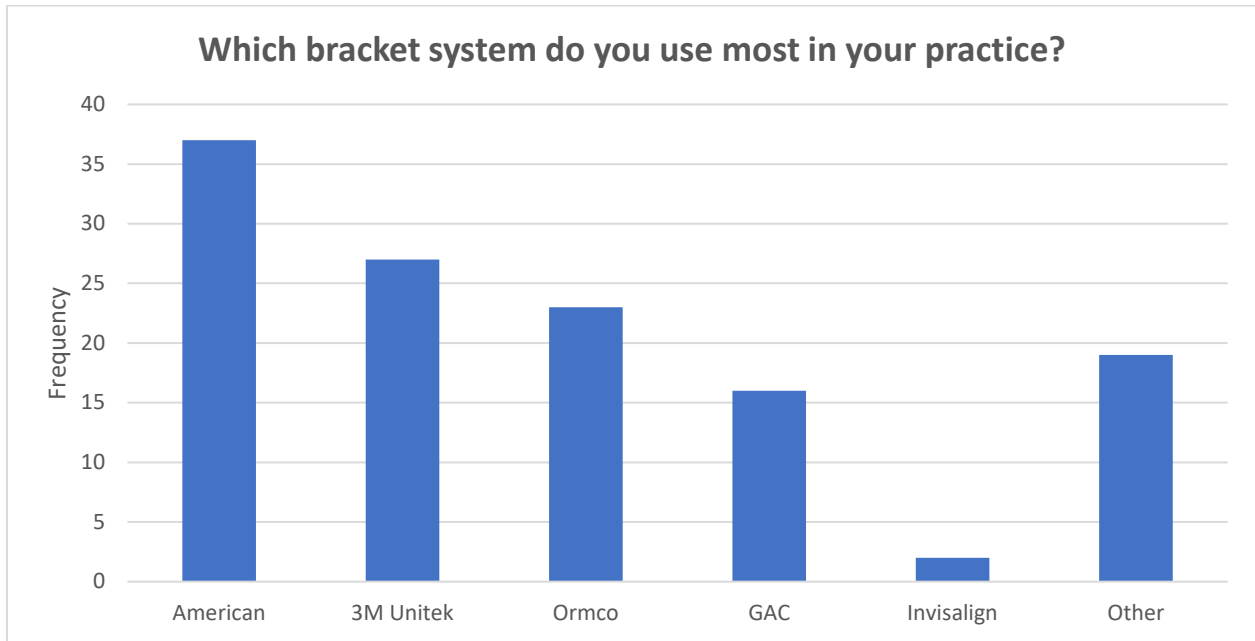


Fig. 9 Distribution of Bracket Systems by US Orthodontists

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