European Review for Medical and Pharmacological Sciences 2019; 23: 5548-5557

Intraductal lithotripsy in sialolithiasis with two different Ho:YAG lasers: presetting parameters, effectiveness, success rates

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Abstract. – OBJECTIVE: To compare two different Ho:YAG laser systems in relation to the preset parameters and their effectiveness for intraductal fragmentation of the salivary stones.

PATIENTS AND METHODS: We made a retrospective study in two tertiary referral centers (Department of ENT, Head and Neck Surgery, University of Erlangen-Nuremberg, Germany and the MacKay Memorial Hospital, Taipei, Taiwan). Patients with a diagnosis of sialolithiasis were treated in Erlangen and Taipei. The Erlangen patients were treated using the Calculase II™ Ho:YAG laser (Karl Storz, Tuttlingen, Germany) at 4 Hz, 1.2 J (4.8 W) and the MacKay patients were treated using the VersaPulse® PowerSuite™ Ho:YAG laser (Lumenis Ltd., Yokneam, Israel) at 6 Hz, 0.5 J (3 W).

RESULTS: A total of 12 patients with 12 stones were treated in Erlangen and 54 with 75 stones in Taipei. The submandibular stones were present in 50% and 86.7% of cases, respectively. The complete fragmentation was achieved in all of the treated stones in both groups; 100% and 92.6% of the patients were stone-free, 100% and 94.4% of the patients became symptom-free, respectively. 33% of the Erlangen patients had multimodal treatments. The glands were preserved in all cases in both centers.

CONCLUSIONS: The Ho:YAG laser proved to be effective in the treatment of sialolithiasis. Stone size, location, and involved gland were important additional parameters. Our experience and the literature results show that the laser presetting with a frequency of 3-6 Hz, an energy level of 0.5-1.2 J, and effective power of between 3 and 4.8 W is sufficient to achieve maximum success without any increased risk for complications.

Key Words:
Sialolithiasis, Treatment, Salivary gland, Sialendoscopy, Laser, Intraductal lithotripsy.

Introduction

Sialendoscopy-controlled extraction is now considered the treatment of the first choice in patients with sialolithiasis. However, more than 80% of the stones have to be fragmented beforehand, and various methods of intracorporeal and extracorporeal stone fragmentation have been developed in order to prepare the extraction of larger stones[1-16]. The success rates of > 90% have been reported for larger salivary stones after intraductal pneumatic lithotripsy[17,18] and > 80% after laser lithotripsy (LL)[19-36], particularly with the use of Ho:YAG lasers in some recent publications[31-35]. The detailed information regarding the suitable values for Ho:YAG laser presetting – i.e., the energy, frequency, and pulse duration – have only been published for renal stones[37-44], but not for salivary stones. The purpose of this study was to describe and compare the effectiveness of the two different Ho:YAG laser systems, taking into consideration the preset parameters, precise stone locations, procedures, and success rates.

Patients and Methods

This retrospective study was approved by the institutional Ethics Committee at the Friedrich

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Alexander University of Erlangen-Nuremberg, Germany, and the Institutional Review Board at MacKay Memorial Hospital, Taipei, Taiwan. The data were collected separately from the two institutions. The patient data were recorded and reviewed, including epidemiologic data, the status of the disease, treatment settings, and clinical outcomes. The analyses of the parameters (Tables I-III) are calculated on the basis of individual stones or per patient. The outcomes, such as the stone-free rate or symptom-free rate, were calculated on the basis of the patient numbers.

Erlangen Group

From March to September 2016, patients who had been diagnosed with sialolithiasis using ultrasound were treated with a laser lithotriptor (Calculase II™, Karl Storz, Tuttlingen, Germany; Figures 1A-D) at the Department of Otorhinolaryngology, Head and Neck Surgery at the University of Erlangen-Nuremberg. Calculase II™ has previously been used in urolithiasis, but it was now available for the treatment of sialolithiasis. The indication for treatment using the Calculase II™ laser lithotriptor was established in accordance with the department's well-tried treatment algorithm[9], which was comparable with the algorithms recently published for the use of pneumatic lithotripsy[17]. The sialendoscopes included in the Erlangen Set were used (Karl Storz, Tuttlingen, Germany)[12,17]. Calculase II™ is a low-powered Ho:YAG laser system. The laser energy is transferred via laser fibers that fit through the endoscope's different working channels (235 µm/1.1 mm and 235/365 µm/1.6 mm sialendoscope). The low pulse frequencies and energy levels were used (4 Hz, 1.2 J, 4.8 W). The tip of the fiber was in direct contact with, or at least very close to, the surface of the stone. A visual control was provided by a green pilot-laser, and the continuous irrigation was performed to avoid thermal damage to the tissue or sialendoscopes (Figures 1A-D). The aim was to achieve the complete fragmentation of the stones into small fragments (< 1.0-1.5 mm) to allow endoscopically controlled extraction or spontaneous discharge. If necessary, LL was repeated. The stents were implanted to avoid

Table I. The Erlangen Group: location and size of the stones, details of laser lithotripsy, and success rates (mean ± SEM, median, range).

	Both Glands (Patients n = 12, Stones n = 12)	Submandibular Gland (Patients n = 6, Stones n = 6)	Parotid gland (Patients n = 6, Stones n = 6)	SMG *vs.* PG Mann-Whitney *U* Test
Gender				
Male	6	6	4	–
Female	6	2	4	–
Location				
Distal duct papilla	2	–	2	–
Middle duct	–	–	–	–
Proximal duct	1	–	1	–
Hilum/posthilar duct	9	6	3	–
Size of stone (mm)	5.45 ± 1.58 (M 5.35, R 4-10)	5.98 ± 2.09 (M 5.40, R 4-10)	4.193 ± 0.69 (M 4.95, R 4-5.7)	n.s.
Lithotripsies/stone (n)	1.08 ± 0.29 (M 1.0, R 1-2)	1.0 ± 0.00 (M 1, R 1-1)	1.17 ± 0.40 (M 1.0, R 1-2)	n.s.
Shock waves/stone (n)	158.50 ± 202.98 (M 78, R 38-727)	241.0 ± 270.65 (M 123.0, R 42-727)	76.0 ± 32.42 (M 76.0, R 38-128)	n.s.
Total energy needed/stone (J)	190.87 ± 243.31 (M 97.2, R 45.6-826.8)	289.20 ± 324.78 (M 147, R 50.4-872.4)	92.53 ± 39.43 (M 94.8, R 45.6-153.6)	n.s.
Duration of lithotripsy/ stone (min)	70.05 ± 37.32 (M 55.80, R 35-169)	70.50 ± 49.24 (M 53.50; R 35-169)	69.60 ± 25.29 (M 68.3, R 42-104)	n.s.
Stones with complete fragmentation (n, %)	12/12 (100%)	6/6 (100%)	6/6 (100%)	n.s.
Papillotomy (n, %)	1 (8.3%)	1 (16.7%)	–	–
Stent placement (n, %)	3 (25%)	–	3 (50%)	–
Patients stone-free (n, %)	12/12 (100%)	6/6 (100%)	6/6 (100%)	n.s.
Patients symptom-free (n, %)	12/12 (100%)	6/6 (100%)	6/6 (100%)	n.s.

M, median; R, range

Table II. The MacKay Group: location and size of the stones, details of laser lithotripsy, success rates (mean ± SEM, median, range).

	Both Glands (Patients n = 54)	Submandibular Gland (Patients n = 45)	Parotid Gland (Patients n = 9)	SMG *vs.* PG Mann-Whitney *U* Test
Gender				
Male	21	17	4	
Female	33	28	5	
Location				
Distal duct/papilla	1	0	1	
Middle duct	8	5	3	
Proximal duct	18	16	2	
Hilum/posthilar duct system	48	44	4	
Size of stone (mm)	6.68 ± 3.5 (75*)	7 ± 3.56 (65*)	4.6 ± 2.19 (10*)	0.026
Lithotripsies/stone (n)	1	1	1	n.s.
Shock waves/stone	374 ± 42.8 (M 215, R 40-1208)	417 ± 47.1 (M 238, R 40-1208)	90.9 ± 12.9 (M 80.5, R 48-150)	0.001
Total energy needed/stone (J)	188 ± 21.5 (M 104.5, R 20-604)	210 ± 23.7 (M 120.75, R 20-604)	45.5 ± 6.45 (M 40.25, R 24-75)	0.001
Duration of lithotripsy/stone (min)	106 ± 7.45 (M 92, R 17-318)	111 ± 8.3 (M 93, R 17-318)	70.1 ± 8.42 (M 63.5, R 48-150)	0.048
Stones with complete fragmentation (%)	98.67% (74/75*)	98.46% (64/65*)	100% (n = 10/10*)	n.s.
Papillotomy rate (%)	81.48% (44/54**)	97.78 (44/45**)	0/9% (0/9**)	n.s.
Stent placement (%)	98.15% (53/54**)	97.78 (44/45**)	100% (9/9**)	n.s.
Patients stone-free (%)	92.59% (50/54**)	91.11% (41/45**)	100% (9/9**)	n.s.
Patients symptom-free (%)	94.44% (51/54**)	93.33% (42/45**)	100% (9/9**)	n.s.

*Number of stones; **number of patients. M, median; R, range.

Table III. Comparison of important parameters and results between the Erlangen and MacKay patients (mean ± SEM, median, range).

	Erlangen Group (Patients n = 12)	Mackay Group (Patients n = 54)	Mann-Whitney *U* Test
Laser type used	Calculase.II™	VersaPulse®-PowerSuite™	–
Joule/pulse	1.2	0.5	0.0001
Power (Watt)	4.8	3	0.0001
Stone size all Glands	5.45 ± 1.58	6.68 ± 3.5 (75*)	n.s.
Stone size SMG	5.98 ± 2.09	7 ± 3.56 (65*)	0.026
Stone size PG	4.193 ± 0.69	4.6 ± 2.19 (10*)	n.s.
Shock waves/stone All Glands	158.50 ± 202.98	374 ± 42.8	0.007
Shock waves/stone SMG	241.0 ± 270.65	417 ± 47.1	n.s.
Shock waves/stone PG	76.0 ± 32.42	90.9 ± 12.9	n.s.
Total Energy/stone (Joule) All Glands	190.87 ± 243.31	188 ± 21.5	n.s.
Total Energy/stone (Joule) SMG	289.20 ± 324.7	210 ± 23.7	n.s.
Total Energy/stone (Joule) PG	92.53 ± 39.43	45.5 ± 6.45	0.011
Duration of lithotripsy (min) All Glands	70.05 ± 37.32	106 ± 7.45	0.009
Duration of lithotripsy (min) SMG	70.50 ± 49.24	111 ± 8.3	0.046
Duration of lithotripsy (min) PG	69.60 ± 25.29	70.1 ± 8.42	n.s.
Number of lithotripsies/stone All Glands	1.08	1	0.012
Number of lithotripsies/stone SMG	1	1	n.s.
Number of lithotripsies/stone PG	1.17	1	n.s.
Stent placement All Glands	8.3% (1/12)	98.15% (53/54)	0.0001
Stent placement SMG	0%	97.78% (44/45)	0.0001
Stent placement PG	16.7% (1/6)	100% (9/9)	0.031

*Number of stones; **number of patients.

Figure 1. The Calculase II™ Ho:YAG laser (Storz, Tuttlingen, Germany *(A)* with the larger (365 µm) water-free and coated laser fiber inserted into the working channel of the 1.6-mm sialendoscope (insertion on the upper right side). ***(B)*** The intraoperative situation with a posthilar stone in the right submandibular gland ***(C)*** the laser fiber (blue) is on the surface of the stone (indicated by the green pilot laser), which is then fragmented ***(D)***.

stenosis or to treat the accompanying stenosis as described[17,45]. Follow-up care was performed as described previously[9,17]. The check-up sialendoscopy and ultrasound examinations were planned at 4-8 weeks and 1 year later. If a patient was not willing or able to attend for the check-ups, a telephone interview was carried out.

MacKay Group

Fifty-four patients in whom sialolithiasis had been confirmed on computed tomography were enrolled at the MacKay Memorial Hospital. All of the patients received LL at the Department of Otorhinolaryngology from May 2013 to March 2015. The indications for LL were the stones that were not treatable using simple interventional sialendoscopy or other surgical means due to their size (mostly > 4 mm) or location (deep in the submandibular gland and unsuitable for simple transoral extraction), or unfavorable preconditions (e.g., anatomy of the floor of mouth or combination with ductal stenosis). The sialendoscopes described before[35] and a sialendoscope with an outer diameter of 1.3 mm and a working channel of 1.15 mm (11577KE model, Karl Storz, Tuttlingen, Germany), through which the laser fiber could pass, were used. The position of the laser fiber was controlled by the red pilot-laser (Figures.2A-D). LL was performed with a Ho:YAG laser (VersaPulse®-PowerSuite™-System; Lumenis, Yokneam, Israel) using low energy levels (3 W, 6 Hz, 0.5 J). The energy was directly released onto the stone surface using a 365 µm laser fiber (Figures 2A-D). After successful stone fragmentation, the fragments were removed using a wire basket and grasping forceps. The stenting was carried out routinely to avoid subsequent duct stenosis (Schaitkin Salivary Duct Cannula®, Hood Laboratories Inc., Pembroke, MA, USA). For each LL, the salivary ducts were checked under the sialendoscope to make sure there were no remaining fragments, and the immediate outcome of the procedure was defined as the complete stone fragmentation and stone-free-status. The postoperative care was described above[35], and the patients were followed up for at least 12 months.

End Points of the Study

The endpoints were the rates of the complete stone fragmentation, stone-free-status, and symptom-free-status.

Statistical Analysis

The software program IBM SPSS Statistics for Windows, version 21, was used (IBM Corp., Armonk, NY, USA). All data are given as means plus or minus standard error of the mean (SEM), range, and median. The bivariate correlations were calculated using the Pearson correlation coefficient. The differences between the sub-groups within the two patient cohorts (SMG, PG) and also between the two patient cohorts (Erlangen, Taipei) were calculated using the Mann-Whitney U-Test. The significance level was $p \leq 0.05$.

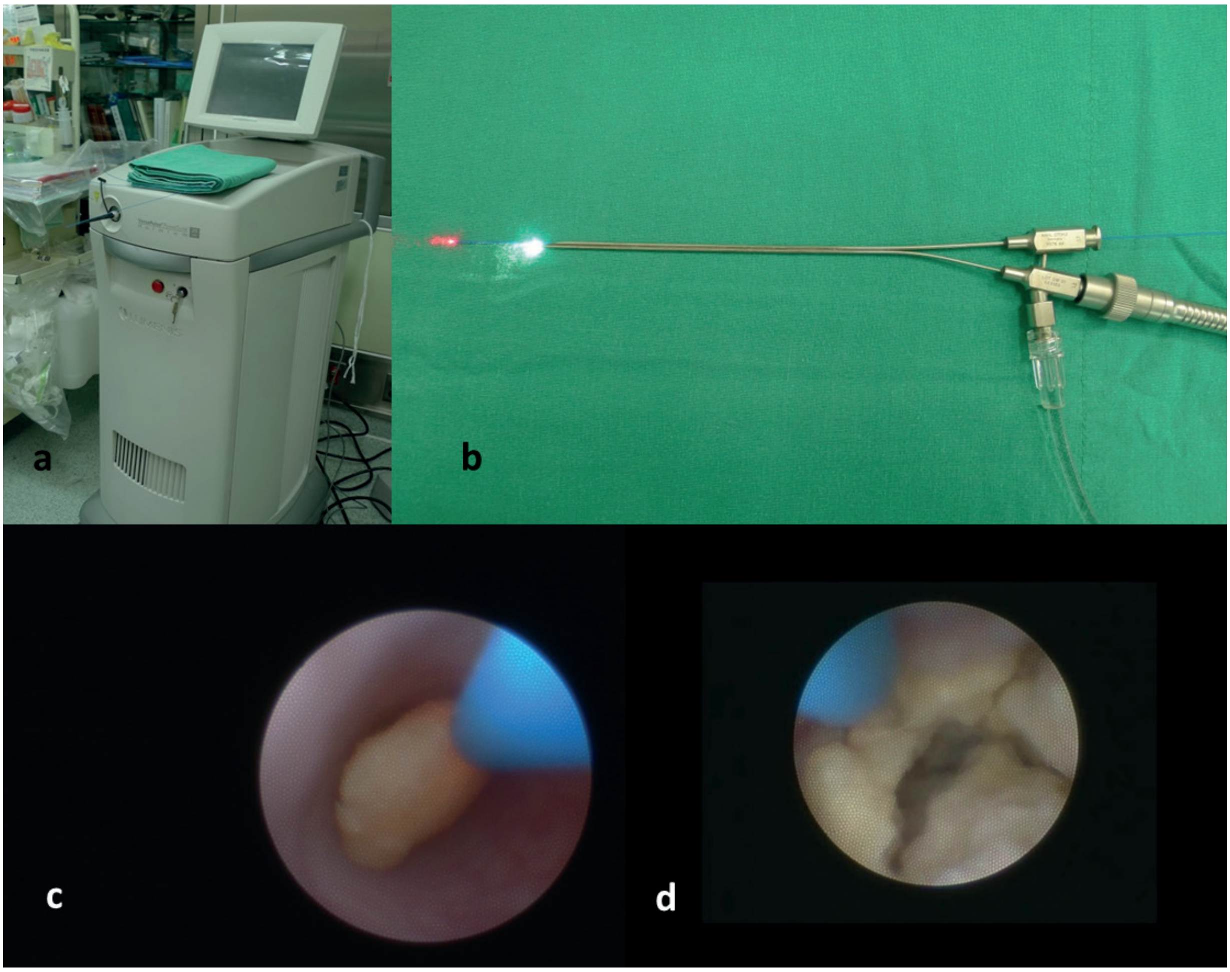

Figure 2. The VersaPulse® PowerSuite™ Ho:YAG laser (Lumenis, Yokneam, Israel). Right-sided insertion on the upper side ***(A)***, with the larger (365 µm) water-free and coated laser fiber inserted into the working channel of the 2-mm sialendoscope with a red pilot laser ***(B)***. The intraoperative situation with a posthilar stone in the right submandibular gland: the laser fiber (blue) is on the surface of the stone ***(C)***, which is then fragmented ***(D)***.

Results

Erlangen Group

Calculase II™ was used to treat 12 stones in 12 patients. Six of the stones (50%) were located in the submandibular gland (SMG) and six in the parotid gland (PG); the male to female ratio was 1:1 and the patients' mean age was 47.1 years (median 47, range 19-71). All of the procedures were carried out with the patients under local anesthesia using 5-10 mL articaine 2% (Ultracain®, Sanofi-Aventis, Frankfurt, Germany). The stones were 4-10 mm in size. In 58.3% of the patients (7/12), a 0.235 mm fiber was used. Two lithotripsies were carried out in one patient. The mean duration of the procedures was 70.05 min. A complete stone fragmentation was achieved in all cases. The stone sizes significantly correlated with the numbers of shock waves (p = 0.01), the total energy (p = 0.01) needed for complete fragmentation, and the duration of the lithotripsy (p = 0.01) for submandibular stones, but not for parotid stones. The submandibular stones needed a larger number of pulses and greater energy to achieve a complete fragmentation in comparison with the parotid stones (detailed data are given in Table I). All of the patients presented with difficult sialolithiasis. One-third of them had multiple sialolithiasis, and LL formed part of the multimodal treatment regimen including four after/combined with transoral ductal surgery in the SMG (one: recurrent stone, one: second distal stone, and two: residual posthilar to intraparenchymal stone) and simple basket extraction (one: distal stone in the PG). In two patients with parotid stones, one and two extracorporeal shock-wave lithotripsies were performed beforehand, because the stone was not primarily adequately accessible with the sialendoscope. In one patient, one stenosis (distal duct, PG), and, in another patient, three stenoses (distal, middle, and proximal duct, PG) were dilated simultaneously, followed by stent implantation. All patients became stone-free and symptom-free, with no significant symptoms after the procedure (Table I). No severe complications relating to the duct or tissue next to it were noted. The check-up endoscopies on the first and second days and after 4-8 weeks were carried out in all patients, and there were no complications observable. The lens of the sialendoscope was damaged in one case (1.1 mm sialendoscope, 4.8 W) and the working channel in another (1.1 mm sialendoscope, 4.8 W). The check-up sialendoscopies were carried out after 1 year in 10 patients. Two patients who also received treatment for stenosis with stent implantation underwent a second dilation at the check-up sialendoscopy (slight to medium stenosis distally in one patient and two residual medium-grade stenoses in the other) and then again became symptom-free. Two patients decided not to attend for check-ups, as they lived too far away and did not have any relevant symptoms. The telephone interviews were carried out, and their symptom-free status was confirmed. The examinations by the local practitioners did not reveal any suspicion of stones.

MacKay Group

LL procedures were performed in 54 patients (61.1% women, 33/54). Their average age was 35.7 years (median 35, range 12-71). All of the procedures were performed with the patients under general anesthesia. The average sizes of the parotid and submandibular stones were 4.6 and 7 mm, respectively. The 0.365 mm fiber was used in all cases (detailed data are shown in Table II). The percentages of stones with complete postoperative fragmentation in the PG and SMG were 100% and 98.5%, respectively. No complications or side effects in the patients or instruments were noted. The size of the stones significantly correlated with the number of shock waves applied (p = 0.05), the total energy (p = 0.05) needed for complete fragmentation, and the duration of lithotripsy (p = 0.05) in the submandibular stones, but not in the parotid stones. The submandibular stones needed significantly larger numbers of pulses and greater energy to achieve a complete fragmentation in comparison with parotid stones (p = 0.001 each). The procedure lasted longer in the SMG's in comparison with the PG's, and the significant differences between the glands were noted (p = 0.048). All patients with parotid sialolithiasis became stone-free and symptom-free after 12 months of follow-up. In patients with submandibular sialolithiasis, 91.1% were stone-free, and 93.3% remained symptom-free.

Comparison of Important Parameters and results between the Erlangen and MacKay Patients

Significant higher energy levels/pulse with resulting power were used in Erlangen patients. The stone sizes were larger in the MacKay patients, with a significant difference in the SMG's (p = 0.026). In both groups, the size of the stones was significantly correlated with the number of shock waves, the energy needed to fragment the stones completely, and the duration of lithotripsy (p = 0.01, 0.01, and 0.05 each, respectively) only in the SMG's. The average number of the strikes/stone needed for the complete fragmentation was significantly lower in the Erlangen patients in comparison with the MacKay patients ($p = 0.007$) for all glands, but not if SMG's or PG's were separately compared. The total energy needed to fragment the stones showed significant differences only on PG's with higher values in the Erlangen group ($p = 0.011$). Taking all glands and also the SMG's into account, the average duration of lithotripsy was significantly longer in the MacKay group in comparison with the Erlangen patients (p = 0.009 and 0.046, respectively). In general, SMG stones in comparison with PG stones, needed a larger number of pulses and more energy to achieve the complete fragmentation, so the procedures lasted longer (Tables I-III). When the SMGs were separately compared, the only significantly different parameter was the average duration of LL, which was significantly longer in patients in the MacKay group (111.8 *vs.* 70.05 min, $p = 0.046$, Tables I-III). The stents were significantly placed more often in Mackay patients. No differences were noted with regard to endpoint parameters (Table III).

Discussion

Although LL is not a new technique, it has not as yet been widely used in the treatment of sialolithiasis. Technical problems – in particular, the availability of suitable sialendoscopes and instruments – were reasons for mostly unsatisfactory results reported in the earlier literature[7]. Following the development of newer sialendoscopes and instruments, the constant success rates higher than 80% have been reported in some recent publications, most often after the use of Ho:YAG lasers[30,32-35], with complete fragmentation in up to 100%, complete success in over 80%, and gland preservation in up to 90-100% of cases after LL with different types of Ho:YAG laser[32-35]. In addition, a recent *in vitro* study showed that the Ho:YAG laser was highly effective in all stones tested independently from their composition[46]. Up to now, the successful use of the Calculase II™ system has been described for the treatment of the ureteral or renal stones[37,41], but not for salivary ones. In the present study, initial experience with the Calculase II™ laser system in Erlangen was compared with the results obtained by a Taiwanese group after the use of an established device for treating sialolithiasis. The results presented here show the effectivity of the Ho:YAG laser in general and the effectivity of the Calculase II™, in particular in sialolithiasis. Excellent results, with stone-free rates of 95-100% and complete fragmentation rates and symptom-free rates of 100% were reported by both groups (Tables I-II). LL was performed with a significantly higher energy/pulse (1.2 *vs.* 0.5 J) and resulting power (4.8 *vs.* 3 W) in the Erlangen patients. On the other hand, the stone size was bigger in Taiwanese patients, but with significant differences for submandibular stones only. This may in part explain the long duration of lithotripsies (significant for SMG's only) and higher numbers of shock waves reported by the MacKay group (significant for all glands, but not if SMG and PG were compared separately). Notably, the total energy needed to completely fragment the stones was nearly equal if all glands and SMG's were assessed. However, if only PG's were compared, significant more energy was needed in the Erlangen patients, being a less good accessibility/stone-location the most probable explanation for this (Table III). If the results were separately analyzed for both patient cohorts, the size of the stones in the SMG, but not in the PG, correlated significantly with the number of shock waves, the energy needed to fragment the stones completely, and the duration of the lithotripsy. The size of the stones, the number of pulses, and the total energy/Joule needed to achieve the complete stone fragmentation was higher in SMG's in comparison with the PG's, with significant differences only in the Taiwanese patients (Tables I-II). The small number of patients treated in Erlangen may be one reason why significant results were observed only for MacKay patients. In both glands, more time was needed to fragment the stones in the Taiwanese patients, which may be explained in part by the different presetting parameters. Importantly, the data presented here indicate that intraductal lithotripsy seems to be a more elaborate procedure in SMG's in comparison with the PG's, as has also been reported previously[17]. These differences may be explained by the ductal anatomy, characterized by a narrow and curving hilar/posthilar duct system in the "comma area" and the composition of submandibular stones, which was reported to be harder and more anorganic[17]. In comparison, the ductal system in the PG has a wider diameter and typically a straighter course, and the stones more often show less mineralization[17,47-50]. Altogether, involved gland, stone-size and stone-location, the latter being difficult in nearly all patients in Erlangen and 92.6% in Taipei, turned out to be important clinical parameters influencing the course of LL and its success rates. With regard to the energy levels needed to achieve successful fragmentation, the definitive values have not been reported in the literature. With the VersaPulse PowerSuite™ Ho:YAG laser, the frequency used was reported to be 5-6 Hz and the energy 0.5-0.7 J, and the resulting power was 2.5-3.5 W[33-35]. The use of the Medilas H20 Ho:YAG laser (Dornier MedTech Europe GmbH, Wessling, Germany) has been described in two reports[32,46]. In one clinical study, the preset parameters were 5 Hz and 0.5-0.8 J, with a resulting power of 2.5-3.5 W[32]. In an *in vitro* study, a frequency of 3Hz and energy levels of 0.5, 1.0, and 1.5 J, reaching power of 2.5-3.5 W was used. Of note, it was reported that sufficient fragmentation was achieved even at the lowest energy level (3 Hz, 0.5 J). The fragmentation rate per pulse was significantly increased by raising the energy to 1 J/pulse ($p < 0.030$). Increasing it to 1.5 J/pulse (resulting in 4.5 W) the authors did not record any further significant improvement in effectiveness, but observed an increased risk for tissue damage[46]. The Erlangen group used the Calculase II™ system at 4 Hz and 1.2 J, resulting in 100% fragmentation and stone-free rates, above the levels in the earlier reports. Rates greater than 90-95% were achieved by the MacKay group in the present study, using 6 Hz and 0.5 J. Summarizing this, it can be stated that a laser presetting in the range of 4-6 Hz with the energy level set between 0.5-1.2 J, with a resulting power of 3.0-4.8 W, appears adequate to achieve excellent fragmentation rates with simultaneous balancing of photo-mechanical and photo-thermal effects on stones or tissues. Another issue is the presetting and energy levels to be used in order to avoid the damage to the instruments and sialendoscopes. In the Erlangen department, it was evident that, due to its smaller size (working channel 0.45 mm), the 1.1-mm sialendoscope, but not the 1.6 mm device, appears to be at greater risk of damage during LL at 4.8 W (4 Hz, 1.2 J). This was not reported by the MacKay group, with levels preset at 3 W (6 Hz, 0.5 J) after the use of sialendoscopes with larger working channels. In view of these findings and the available literature results, a laser presetting with a frequency of 3-6 Hz and the energy level set between 0.5-0.8 J (3-3.5 W, using smaller sialendoscopes and/or treating smaller stones) and up to 1.2 J (up to 4.8 W, using bigger sialendoscopes and/or treating bigger stones) may be recommended to achieve the effective fragmentation while avoiding the damage to the instruments and the sialendoscopes used, as well as tissue complications. Larger sialendoscopes with wider working channels are preferable if LL is planned. However, the natural ostium is often too narrow for larger sialendoscopes to be inserted into the Wharton's duct, and one must be prepared to carry out a ductal incision initially. This is reflected by the high papillotomy rate reported by the MacKay group, and was previously also reported by our own group[17]. The stents may be implanted as a prophylactic measure if there is a pronounced maceration of a smaller duct lumen, or if stenosis needs to be treated at the same time. The absence of substantial tissue complications in the two groups indicates that LL using Ho:YAG laser devices is a safe method.

Conclusions

The present findings with two different Ho:YAG laser devices confirm the published literature results showing that the laser lithotripsy is an effective and safe procedure. As it is mainly indicated in patients with difficult sialolithiasis, its effective use depends on the size, location, and accessibility of the stone and on the anatomic conditions in the duct. The preset parameters with a pulse frequency between 3-6 Hz and energy per pulse between 0.5-1.2 J, with a resulting power of 3.0-4.8 W, may be best suited for achieving effective stone fragmentation and avoiding complications.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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