



Mark McGurk

Michael P Escudier

Bethan L Thomas and Jackie E Brown

A Revolution in the Management of Obstructive Salivary Gland Disease

Abstract: Salivary gland obstruction is the commonest cause of salivary gland disease presenting to the general dental practitioner. To date, with the exception of the most surgically accessible stones found within the anterior ducts, there has been little treatment to offer patients except surgical removal of the gland, with the associated risks to the facial and trigeminal nerves. In the last 10 years, more conservative treatment modalities have been developed, opening up a range of treatment options which combine to provide an alternative management of these cases. This paper presents data from one unit in which lithotripsy, which is the destruction of stones (calculi) using shock waves, basket retrieval, a modified minor surgical technique, and balloon dilatation have been used to treat salivary gland obstruction successfully. Over 70% of stones can now be retrieved leaving a functioning gland.

Clinical Relevance: Salivary gland obstruction is a clinical problem presenting to the general dental practitioner, and requires an understanding of the range of treatment options available.

Dent Update 2006; 33: 28-36

Obstructive salivary gland disease is a relatively uncommon condition and can present to a variety of clinical specialists such as oral and maxillofacial surgeons, ENT surgeons, general surgeons or plastic surgeons. In consequence, experience is further diluted and the average surgeon might only see four or five cases a year. Such a dilution of work means that it is difficult

to gain sufficient experience to challenge current views and develop new treatment strategies.

The situation has changed, with the development of four salivary gland centres in Europe (Pamplona, Spain; Erlangen, Germany; Milan, Italy; London, UK (Guy's Hospital)), resulting in a switch from gland excision to gland-preserving procedures. Using the new techniques, over 70% of stones can be retrieved and only a minority of glands need to be removed.¹

represent over 700,000 patients. It is clear from clinical experience that this is not a realistic estimate of the clinical problem, suggesting that most salivary gland calculi must be asymptomatic. An estimate of symptomatic disease can be obtained from national hospital admissions data. Information relating to 15 health regions in England and corresponding to a population of over 48 million was previously analysed.⁴ The distribution of calculi and sialoadenitis, or inflammation of a salivary gland, had a bell curve distribution extending from infancy (<4 years of age) to over 90 years, with a peak incidence of salivary stones occurring in the 30–34 years age group, and that for sialoadenitis a decade later in the 45–49 years age group (Figures 1 and 2). The temporal delay between the peaks provides circumstantial evidence that chronic sialoadenitis is a product of salivary calculi. The data suggest that the overall incidence of symptomatic salivary

M McGurk, Professor of Oral and Maxillofacial Surgery, MD, FDS RCS, FRCS, **M P Escudier**, Lecturer in Oral Medicine, MBBS, BDS, FDS, FDS(OM) RCS, **B L Thomas**, Lecturer in Oral Surgery, BDS, MFDS, PhD and **J E Brown**, Consultant in Oral Radiology, BDS, MSc, FDS RCPS, DDR RCR, Salivary Gland Centre, King's Dental Institute, Floor 23, Guy's Tower, Guy's Campus, King's College London, London Bridge, London SE1 9RT, UK.

Aetiology and incidence

Sialolithiasis, which is a stone (calculus) present in a salivary gland or duct, accounts for about 50% of major salivary gland disease² and post mortem studies suggest that salivary calculi are present in approximately 1.2% of the population.³ In the United Kingdom, with a population of over 60 million, this would

calculi per annum in the United Kingdom is approximately 59 cases per million population (over 3000 cases per annum). This is an underestimate of the incidence of stones, since about one third of calculi are washed to the end of the duct and can be removed easily on an outpatient basis. Based on the hospital admission data (59 cases per million), and assuming average life expectancy of 77 years, the prevalence for symptomatic sialolithiasis is 0.45%. This figure is about half that encountered in post mortem studies.

The mechanism involved in the formation of salivary stones remains obscure. Saliva is a complex visco-elastic fluid that is super-saturated with calcium, and contains a number of components and properties which act upon calcium homeostasis. It contains proteins that have calcium-binding properties and the pH of the liquid can vary, as can its visco-elastic properties under conditions of dehydration or inflammation. Thus, the salivary environment is dynamic, and within this context there are two schools of thought on how stones develop. The first recognizes that cellular debris in the form of micro calculi (microliths) are continually shed into the saliva. If the passage of these microliths is arrested along the duct system they can act as a nidus for calcium precipitation. Other factors conducive to stone formation are also likely to be required simultaneously, and hence there is an element of chance to the initiation of salivary calculi. The second proposal is that a local inflammatory process (as a result of infection or a foreign body) leads to the formation of mucus plugs, which in turn become calcified.

The association between salivary stones and either renal calculi, diabetes, hypertension or chronic liver disease is tenuous, as is the suggestion that reduced salivary flow leads to stone formation. The relationship between the salivary environment and stone formation must be complex because patients with Sjögren's syndrome are not prone to stone formation and the incidence of stones is not increased in hot climates where the risk of dehydration is greater.

Size and location of salivary calculi

Most salivary stones occur in

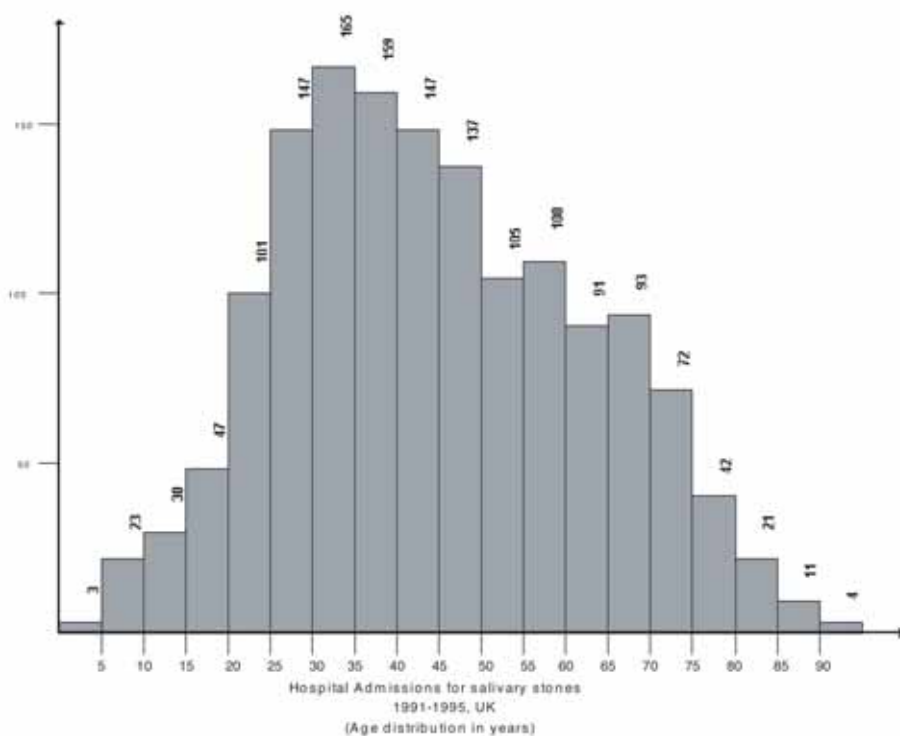


Figure 1. Graph showing hospital admissions for the management of disease resulting from salivary gland stones in the period 1991–1995 in the UK, showing the distribution of the number of patients admitted (y-axis) relative to age (x-axis). (Adapted from Escudier, 2001).²²

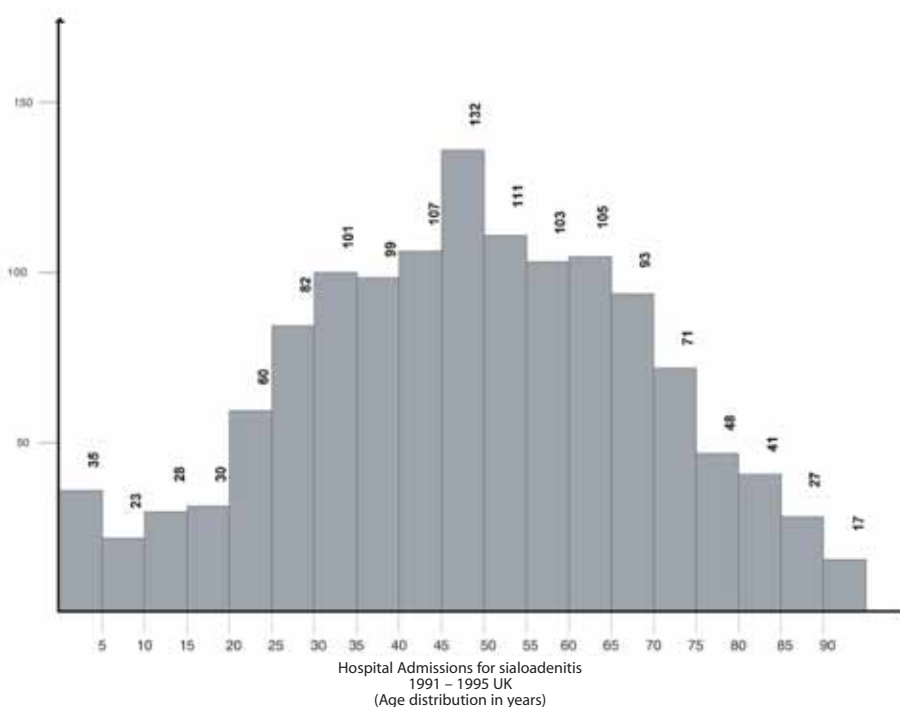


Figure 2. Graph showing hospital admissions for the management of sialoadenitis in the period 1991–1995 in the UK, showing the distribution of the number of patients admitted (y-axis) relative to age (x-axis). (Adapted from Escudier, 2001).²²

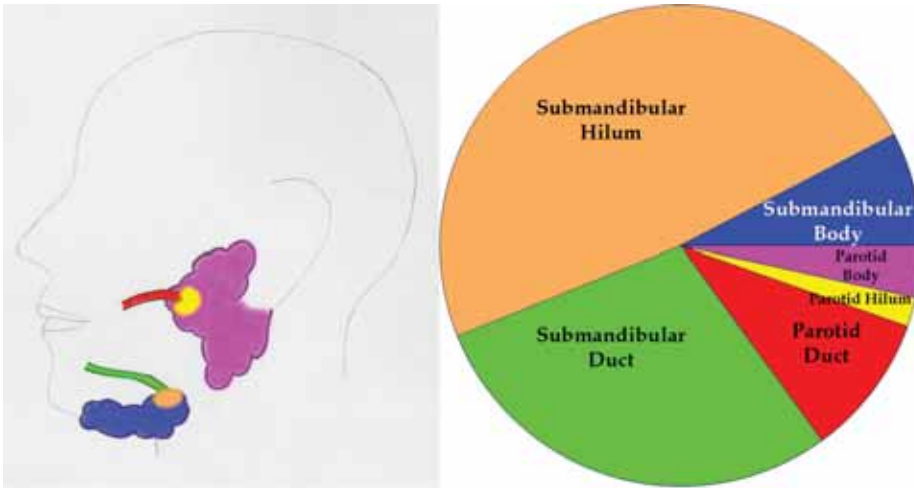


Figure 3. Distribution of the anatomical location of salivary gland stones, illustrating the relative frequency of occurrence, the most common site being the submandibular gland hilum (orange 48.5%), followed by the submandibular gland duct (light green 29%), the parotid duct (red 9.6%), body of submandibular gland (blue 7.6%), body of parotid (pink 3.6%) and hilum of parotid (yellow 1.8%).



Figure 4. Nahlieli microendoscope (Storz) with accompanying microinstruments.

the submandibular gland (63–94%) and the remainder in the parotid (6–21%).^{5–13} From a practical point of view, stones occurring in sublingual or minor salivary glands are uncommon and can be ignored. The literature indicates that, in the submandibular gland, about 9% of stones lie in the gland itself, 57% in the hilum where the gland and duct meet, and 34% are situated somewhere along the duct. In contrast, 20–30% of parotid stones are in the gland, 13% in the hilum and about 64% somewhere along the duct system (Figure 3). The different distribution between the two glands has important implications on management.^{8,13–16} Stones are equally distributed between the left and right sides of the head. Simultaneous stone formation in a contra-lateral gland occurs in about 1%

of patients.

The average size of stones is about 8 mm diameter, with submandibular stones being slightly larger than those in the parotid (8.5 mm vs 6.6 mm).^{1,13} The size of the stone has implications on treatment; smaller stones are more easily eradicated with lithotripsy than larger calculi (greater than 7 mm), and small mobile stones are amenable to basket retrieval (see below).

Modern management of salivary calculi

In the last decade it has proved possible to miniaturize the instruments successfully used since the 1980s for the elimination of renal calculi. The modern treatment for sialolithiasis has followed in the footsteps (albeit miniaturized footsteps) of its renal predecessor. New instruments available for the treatment of salivary disease include the extra-corporeal lithotripter (which refers to lithotripsy in which shock waves pass through the body from an externally applied lithotripter). In the case of parotid lithotripsy, the lithotripter is placed against the skin of the cheek. Two lithotripters are applicable to the salivary gland, the Storz Minilith SL1 (Storz Medical Kreuzlingen, Switzerland) which is specific for salivary glands and the Piezoelectric Piezolith (R Wolfe Co, Kanittlingen, Germany) which is an adapted

abdominal lithotripter. Dormia baskets are also effective, whereas intracorporeal lithotripsy by pneumoblastic and laser techniques have been abandoned. More recently, microendoscopes have been produced, with diameters of between 0.9–1.2 mm, which can be introduced easily into both the submandibular and parotid duct systems. The endoscopes contain an irrigation port and a working channel that will take miniaturized wire baskets, laser fibres and small forceps to grip stone fragments (Figure 4). Finally, to complement these developments, new surgical techniques have been developed to retrieve stones while leaving a functioning gland intact. Used in combination, these techniques can reliably relieve obstruction of the salivary glands by stone or stricture.

Dormia basket retrieval of stones

This is the treatment of choice for all small mobile stones, whether they are in the submandibular or parotid gland. It is undertaken with either radiological control or by direct vision through an endoscope. The criteria in selecting this technique is that the stone should be within the duct, that no strictures are present that would prevent the stone being delivered, once grasped, in the basket, and that the calculi is not more than 25% wider than the duct diameter. The procedure is undertaken under local anaesthetic on an ambulatory outpatient basis. The orifice of the duct is dilated and cannulated to enable the introduction of contrast medium for the identification of the stone. A Dormia basket extractor is then passed along the duct system, past the stone, then opened and withdrawn slowly with a rotating action to engage the calculus. Once in the basket, it is withdrawn to the duct ostium where delivery of the basket is assisted by a small osteal incision (Figure 5).

In a consecutive series of 166 cases treated by radiologically-guided basket extraction at Guy's Salivary Gland Service, 136 patients received this as their primary treatment modality and a further 30 had stone fragments removed following lithotripsy. Overall, complete success (eradication of stone) was achieved in 75% of cases. Partial success (removal of most but not all stone fragments, but

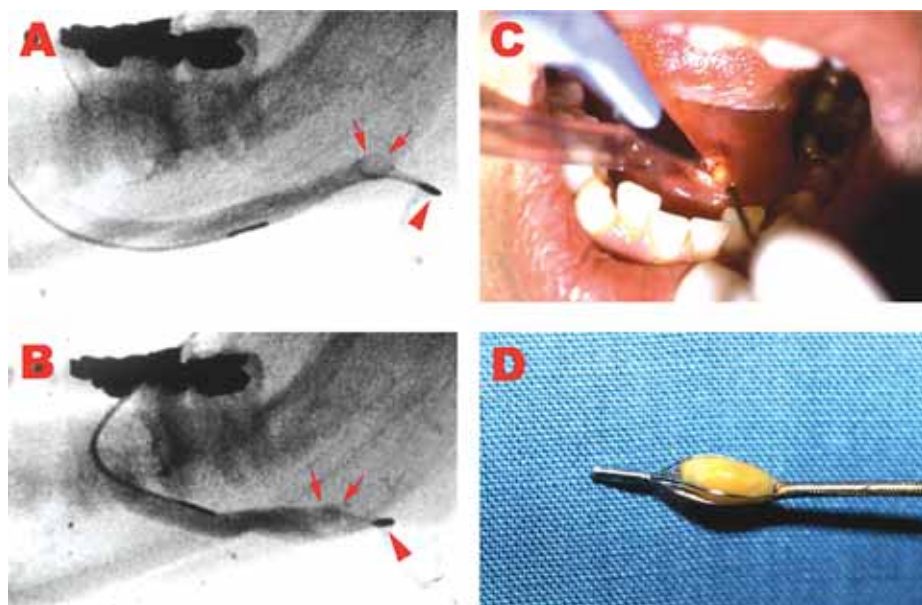


Figure 5. Removal of a stone from a submandibular gland using a Dormia basket. (A) A sialograph showing the insertion of a closed basket (arrows indicate the calculus, arrowhead indicates the tip of the basket wire). (B) The presence of the stone within the opened basket (arrows indicating stone within the basket). A relieving incision is made at the duct opening (C) to allow delivery of the stone within the basket (D).

with symptomatic relief) was achieved in 7% of cases and failure occurred in 18% of patients treated (30/166), of which 16 were cured by another technique, 11 cases declined further treatment, or were lost to follow-up, and 3 underwent gland removal.

Extra-corporeal lithotripsy

Lithotripsy is the first choice treatment for all parotid stones apart from those amenable to basket retrieval. It is now uncommon to use lithotripsy on submandibular stones except when they lie within the duct parenchyma, or if the patient's general condition precludes surgical intervention.

At Guy's, lithotripsy is undertaken using a dedicated sialolithotripter (Storz Minilith) on an outpatient basis, normally with a rest period of one week between treatment sessions. If the patient has travelled a great distance, then treatment on consecutive days can be undertaken. The patient sits in a dental chair in a semi-reclined position. The duration of each session is usually about one hour; no anaesthetic or analgesia are required. An electromagnetic shock wave is generated and targeted on the stone

using an inline ultrasound transducer (7.5 MHz) that provides continuous monitoring during treatment. Cotton wool is placed in the buccal sulcus to protect teeth in the line of the shock wave. The shock wave energy (10–36 MPa) is delivered at a frequency of two shocks per second, with approximately 3000–5000 shocks delivered in a treatment session. If the stone persists after 15000 shock wave applications alternative treatment options are considered.

Extra-corporeal shock wave lithotripsy (ECSWL) was undertaken in a consecutive series of 221 cases of both submandibular and parotid stones. It was the primary treatment in 218 cases and followed unsuccessful basket retrieval in three cases. In the cohort receiving ECSWL as the primary treatment (130 submandibular, 88 parotid calculi), complete success was achieved in 84 (39%) cases (42/130 submandibular [32%] and 42/88 parotid [48%]). Partial success (relief of symptoms but some stone debris remaining in the duct) was achieved in a further 99 cases (45%), which included 62/130 submandibular (48%) and 37/88 parotid (42%). This represents symptomatic relief in 84% of cases. Treatment failed in 35/218 (16%). Of the partial successes

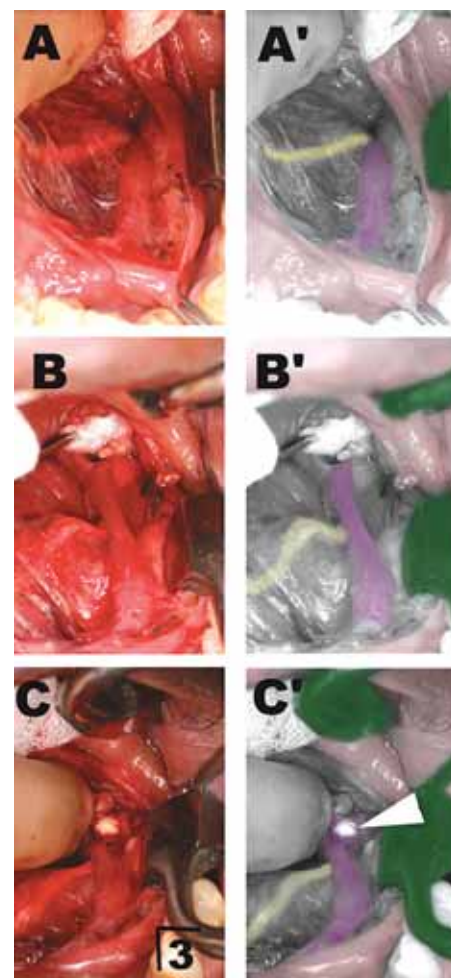


Figure 6. Surgical removal of a stone from the hilum of the left submandibular gland. Following incision through the oral mucosa and blunt dissection, the duct and lingual nerve become visible (A). Further dissection allows the duct to be freed (B), the stone identified, and released following incision through the duct wall (C), as indicated by the arrowhead. Pictures on the right indicate the lingual nerve (yellow), the salivary duct (purple), retractors (green) and surface mucosa (pink).

(99) or failures (35), 61 underwent further treatment and 73 declined intervention. In the group undergoing further treatment, 46 were subsequently cured by other techniques (basket retrieval or intra-oral surgery) and 7 patients had their glands removed.

Gland preserving surgery

Initially, all submandibular

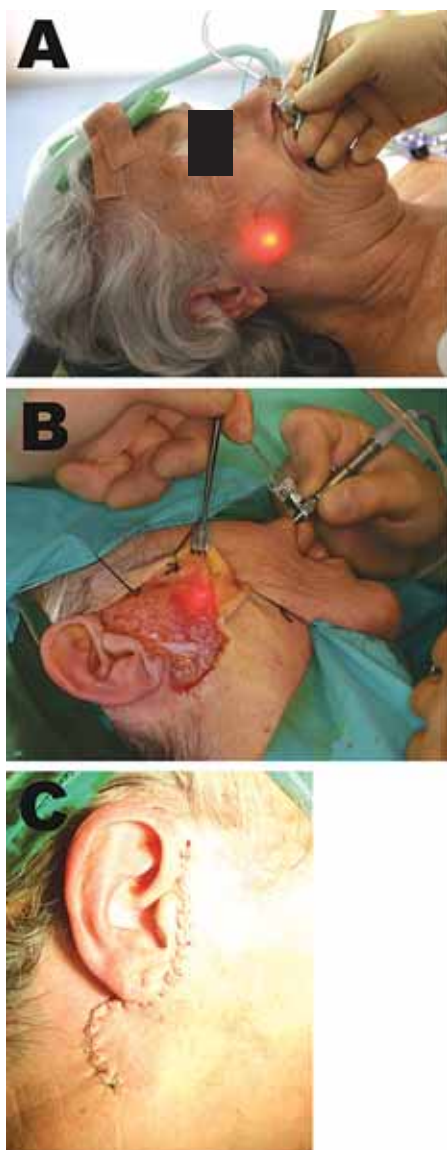


Figure 7. Surgical removal of a stone from the parotid gland. Insertion of the microendoscope into the duct to touch the calculus allows visualization from the extra-oral aspect to localize the stone (A). After raising a skin flap, the microendoscope allows accurate location of the stone to allow its removal (B). (C) Shows the extent of the incision following skin closure.

stones were treated by lithotripsy, but the technique proved inefficient in terms of number of treatments required and successful stone clearance. Consequently, a surgical technique was developed to remove stones from the duct as far as the hilum of the gland,¹⁷ which accounts for over 50% of all submandibular stones.¹⁸ The technique is usually used in a day case

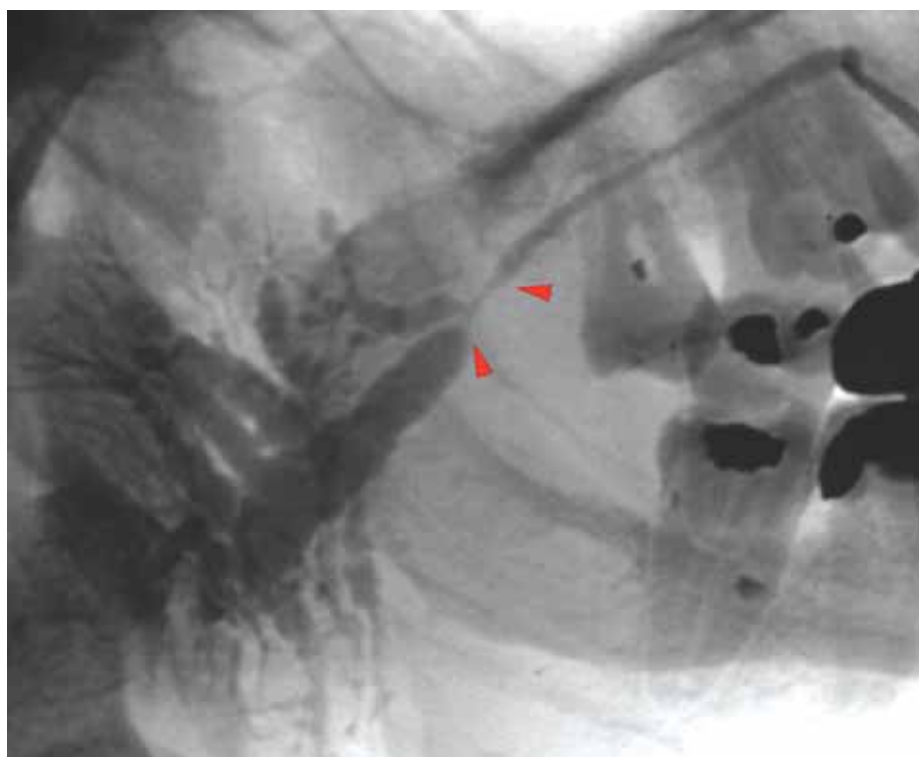


Figure 8. Sialograph showing a diffuse stricture in the parotid duct, the arrowheads marking the extent of the stricture. Proximal to this, marked dilatation of the duct is visible.

setting, but can be performed on conscious patients who are compliant. An incision is made through the mucosa of the floor of the mouth, starting at the duct orifice and extending proximally, thus allowing rotation of the sublingual gland out of the operating field to permit the duct to be traced backwards with clear vision of the lingual nerve (Figure 6). In this way, the stone can be located within the duct and an incision made through the duct wall allowing delivery of the stone. The duct wall is closed with sutures before suturing of the mucosa. In a similar way, a technique was developed to retrieve parotid stones leaving the salivary gland intact. It is important to note that opening the parotid duct at its ostium invariably leads to stenosis and should be avoided. As an alternative, an endoscope is introduced into the duct to identify the stone. A cheek flap is raised and the light from the tip of the endoscope used to guide the surgeon directly on to the stone, which is released through a longitudinal incision (Figure 7). The duct is then closed, returning the gland to normal function.¹⁹

Intra-oral removal of

submandibular stones was undertaken for 143 calculi. It was the primary event in 101 cases and followed unsuccessful treatment by other techniques in 42 cases. Complete success was achieved in 137/143 (96%) of cases. In the parotid gland, 10 stones have been approached via combined endoscopic and surgical techniques. In 8 cases, the stones were retrieved satisfactorily and the glands continued to function normally. In 2 cases, the stone was retrieved or stricture removed and the duct ligated without further problem.

Using the combination of approaches described, in a series of 455 patients with salivary calculi over a 10-year period, clearance of the stone was achieved in 76% of cases and only 11 patients required gland removal.

Salivary strictures

Strictures may take a number of forms; either a single band, multiple bands or a continuous or 'diffuse' stricture (Figure 8). A recent analysis of 1405 sialograms performed for obstructive symptoms

over a 10-year period at Guy's Hospital showed 24% demonstrated obstruction due to stricture formation, while 72% suffered stone formation. The remaining 4% possessed mucus plugs. The commonest strictures identified comprised a single band or point stricture (64%), with strictures being more commonly found in the parotid (75.6%) rather than the submandibular ducts and generally seen more in women than in men.

Under radiological control, strictures can be dilated using high-pressure angioplasty balloons (Figure 9). Prior to dilatation, a sialogram is performed to visualize the stricture, the ionic contrast medium being mixed with local anaesthetic in a 50/50 ratio and left *in situ* for 5 minutes to aid intra-ductal anaesthesia. In addition, an inferior alveolar nerve block and infiltration of the floor of mouth is used for submandibular gland procedures and a local infiltration around the papillae for parotid cases. The duct orifice is dilated and a hydrophilic steerable guide wire (V-18 control wire Medi Tec, Boston Scientific) introduced through the duct orifice followed by an angioplasty balloon (4–3.4 F diameter, 2 cm long; Symmetry Stiff Shaft, Meditech, Boston Scientific). The inflated diameter of the balloon used is 2.5 mm for the parotid and 3.5 mm for the submandibular duct. This is inflated to 15 atmospheres for a period of 5–10 minutes.

In a series of 82 patients it was possible to negotiate the stricture and inflate the balloon in 76 cases (93%). The balloon inflated completely in 44/76 (48%) but in 32/76 (42%) a waist remained, even when the balloon was fully inflated. An immediate post-treatment sialogram confirmed complete elimination of stricture in 77% and partial elimination in 6%, with 17% remaining unchanged. It is our clinical experience that, although patients remain asymptomatic, a number of these strictures reform over 1–2 years but can be re-dilated.

Discussion

The introduction of these new salivary techniques has radically changed the practice of salivary gland surgery in our centre. Hospital admission data would suggest that currently over 3000 patients a year are admitted to hospital in the UK for management of sialoadenitis

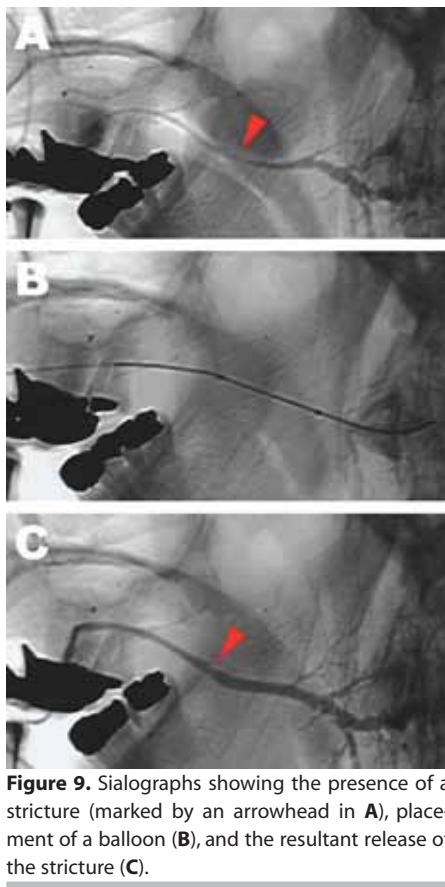


Figure 9. Sialograms showing the presence of a stricture (marked by an arrowhead in **A**), placement of a balloon (**B**), and the resultant release of the stricture (**C**).

or sialolithiasis.⁴ The current standard for treatment of symptomatic salivary stones in the middle or proximal duct is gland excision. Surgery in the parotid, and to a lesser extent the submandibular gland, is associated with well-recognized morbidity.²⁰

Our experience with a series of 455 patients treated with gland preserving techniques indicates that, in at least 76% of cases, the stones and obstructions can be eradicated and only 2% of cases require gland removal. This is a radical deviation from current practice. A further advantage is that the techniques used in this series (extra-corporeal shock wave lithotripsy, radiologically guided basket retrieval, balloon dilatation) can be performed under local anaesthetic on an outpatient basis and have a low morbidity. The intra-oral removal of submandibular stones can also be undertaken under local anaesthetic for appropriate patients, but most stones are retrieved in day case surgery under GA.

It is obvious that salivary duct architecture and function are adversely

affected by obstruction and it is unclear at present whether the glands remain asymptomatic for a protracted period of time following stone removal. Scintigraphy results suggest that, although gland function improves, it does not return to normal values,¹⁸ but there is accumulating data to show significant gland regeneration occurs following release of obstruction and, with a medium follow-up of 4 years, there is no evidence that patients are developing chronic sialoadenitis. Similar outcomes have been reported with 10-year follow-ups following lithotripsy.²¹

The results from our centre, as well as others, suggest that the optimum management of salivary obstruction should focus on gland preservation techniques.

References

1. McGurk M, Escudier MP, Brown JE. Modern management of salivary calculi. *Br J Surg* 2005; **92**: 107–112.
2. Epker BN. Obstructive and inflammatory diseases of the major salivary glands. *Oral Surg Oral Med Oral Path* 1972; **33**: 2–27.
3. Rauch S, Gorlin RJ. Diseases of the salivary glands. In: *Thoma's Oral Pathology* 6th ed. Gorlin RJ, Goldman HM, eds. St Louis: Mosby, 1970: pp. 997–1003.
4. Escudier MP, McGurk M. Symptomatic sialoadenitis and sialolithiasis in the English population, an estimate of the cost of hospital treatment. *Br Dent J* 1999; **186**: 463–466.
5. Zenk J, Iro H. Die Sialolithiasis und deren Behandlung. *Laryngo-Rhino-Otol* 2001; **80**: 115–136.
6. Antoniadis D, Mendonidou L. Clinical study of sialolithiasis. Findings from 100 cases. *Hell Stomatol Chron* 1989; **33**: 245–251.
7. Iro H, Zenk J, Waldfahrer F, Benzel W. Aktueller Stand minimal invasiver Behandlungsverfahren bei der Sialolithiasis. *HNO* 1996; **44**: 78–84.
8. Laforgia PD, Favia GF, et al. Clinico-statistical, morphologic and microstructural analysis of 400 cases of sialolithiasis. *Minerva Stomatol* 1989; **38**: 1329–1336.
9. Lustmann J, Regev E, Melamed Y. Sialolithiasis. A survey on 245 patients

- and a review of the literature. *Int J Oral Maxillofac Surg* 1990; **19**: 135–138.
10. Rauch S, Gorlin RJ. Diseases of the salivary glands. In: *Oral Pathology*. Gorlin RJ, Goldman HM, eds. St Louis: Mosby, 1970: p. 962.
 11. Seifert G, Miehle A, Haubrich J, Chilla R. *Speicheldrüsenerkrankheiten*. Stuttgart: Thieme Verlag, 1984: pp.91–97.
 12. Topazian RG, Goldberg MH. *Infections of the Salivary Glands. Oral and Maxillofacial Infections* 2nd ed. Philadelphia: PA Saunders, 1987: pp. 248–257.
 13. Zenk J, Constantinidis J, Kydles S, Hornung J, Iro H. Kkinische und diagnostische Befunde bei der sialolithiasis. *HNO* 1999; **47**: 963–969.
 14. Dechaume M, Bonneau M, Payen J. La lithiase sous maxillaire. *Presse Med* 1952; **60**: 908–910.
 15. Dechaume M, Grellet M, Bonneaux M, Payen J, Massoud E. Sur la lithiase parotidienne. *Rev Stomal Chir Maxillofac* 1961; **62**: 313–316.
 16. Yoel J. *Pathology and Surgery of the Salivary Glands*. Springfield Ill: Charles C Thomas, 1975: pp. 345–397.
 17. McGurk M. Surgical release of a stone from the hilum of the submandibular gland: a technique note. *Int J Oral Maxillofac Surg* 2005; **34**: 208–210.
 18. Makdissi J, Escudier MP, Brown JE, Osailan S, Drage N, McGurk M. Glandular function after intraoral removal of salivary calculi from the hilum of the submandibular gland. *Br J Oral Maxillofac Surg* 2004; **42**: 538–541.
 19. McGurk M, MacBean A, Fan KF, Sproat C. Endoscope assisted removal of parotid stones. *Br J Oral Maxillofac Surg* 2005, in press.
 20. McGurk M, Makdissi J, Brown JE. Intraoral removal of stones from the hilum of the submandibular gland: report of technique and morbidity. *Int J Oral Maxillofac Surg* 2004; **33**: 683–686.
 21. Zenk J, Bozzato A, Winter M, Gottwald F, Iro H. Extra-corporeal shockwave lithotripsy of submandibular stones: evaluation after 10 years. *Annls Otol Rhinol Laryngol* 2004; **113**: 378–383.
 22. Escudier M. Epidemiology and aetiology of salivary calculi. In: *Controversies in the Management of Salivary Gland Disease*. McGurk M, Renehan A, eds. Oxford: Oxford University Press, 2001: pp. 249–255.

Book Review

Paediatric Dentistry 3rd edn. By RR Welbury, MS Duggal and MT Hosey, eds. Oxford: Oxford Medical Publications, 2005 (443pp. p/b, £39.95). ISBN 978-0-19-8565833.

This softback, full-colour textbook has now reached its third edition and has proven to be an invaluable reference work to both the undergraduate and qualified dentist. Since the book's launch in 1997, 4,500 copies have been sold, and it is currently available in several countries worldwide.

Initially written with the undergraduate dental student in mind, *Paediatric Dentistry* has evolved over the years into a well-balanced, comprehensive text; equally embraced by general practitioners and those with a special interest alike.

Originally edited by Professor Richard R. Welbury, *Paediatric Dentistry* was intended to 'draw together all the different aspects of paediatric dentistry'. Moreover, this latest edition welcomes the addition of Professor Monty Duggal and Dr Marie-Thérèse Hosey as co-editors, thus broadening the equilibrium of the book. It is the editors' intention to 'maintain a contemporary outlook and publish changes in techniques and philosophies as soon as they have an evidence base' (Prof. RR Welbury, January 2005); these words are faithfully reflected throughout the pages of this publication.

Cover-to-cover, *Paediatric Dentistry* contains over 550 photographs, of which over

350 are high-quality colour images. In addition, the book contains over 60 tables and diagrams to complement the thoughtfully presented text. There are 23 contributors to the chapters contained within this third edition, many of whom are new to the book, though all are significant individuals in the specialty or their related disciplines. This array of editors and contributors from both the UK and overseas, dental schools and general practice do not 'fragment' this reference book, but conversely integrate its content and give it a unique richness through its clinical experience.

Readers familiar with the earlier editions of *Paediatric Dentistry* will recognize that previous successful attributes have been maintained in the latest publication. Key learning points, bullet points and sub-headed paragraphs make the text not only reader-friendly, but its content very accessible. Furthermore, each chapter concludes with a summary of its pertinent points and lists further reading for the topic.

The change of some contributors has brought with it further development of each chapter; pre-existing content has not however been discarded, but built upon. Chapter 3 (formerly 'History, examination and treatment planning') now includes risk assessment for targeting resources. The previous chapter 7 ('Operative treatment of dental caries') has been separated into chapters on the operative treatment of the deciduous and permanent dentitions. The 2nd edition's

chapter 8 on 'Endodontics' has been integrated into the new trauma and operative chapters.

In short, *Paediatric Dentistry* is an invaluable resource for both the undergraduate and postgraduate dental clinician. It possesses a great wealth of information; thoughtfully constructed for accessibility and clarity. It satisfies its intended objective, and is favourably priced. I am a strong advocate of this textbook, and thoroughly recommend it to both generalists and specialists.

Kris Coomaraswamy
University of Birmingham School
of Dentistry

