125 years of developments in dentistry, 1880–2005

Part 4: Clinical dentistry

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INTRODUCTION

The late 1800s saw increased decay in richer people as they could afford to consume more sugar. Many of them lost all their teeth to decay and gum disease by the age of 30. Queen Victoria had so many missing teeth that Sir Charles Tomes was consulted in 1897 about making a denture but she would not let him take an impression. The Queen had previously refused to keep an appointment with John Fairbank when she complained of indigestion as she had previously found him to be too slow.¹ A year later she allowed Tomes' partner, Harry Baldwin, to construct a denture, but she constantly asked for adjustments.

The period under discussion saw many changes in clinical dentistry. Numerous technical advances were made possible by the Industrial Revolution but it was the introduction of the National Health Service in 1948 which made treatments more widely available for the population.

RESTORATIVE DENTISTRY

In 1906 Greene Vardiman Black's theories on cavity preparation stressed that caries must be eliminated from cavities, there should be sufficient mechanical retention for filling materials and no food-retaining areas such as deep fissures should remain. Preparations were later modified as improved adhesive restorative materials which could be bonded to the teeth became available.

Fig. 1 A Taggart casting machine

In 1907 William Henry Taggart opened up new methods for restoring or replacing tooth tissue when he described how to cast an inlay to fit a prepared cavity (Fig. 1). A modified industrial lost-wax technique relieved patients from unpleasant treatments and dentists from prolonged chairside procedures. His technique was modified by others and applied to advanced inlay casting² and the development of crowns, bridges and dentures.³ By 1948, vacuum investment led to increased accuracy in casting.

From the mid-1950s acrylic crowns were fairly common, although porcelain had been invented in America in 1886 and introduced to England in 1906. Crowns remained brittle until the 1960s invention of high aluminous porcelain by John McLean and his colleagues at the Government Chemist's laboratory. These techniques for more realistic and stronger crowns meant that dentists became reliant on highly skilled technicians as well as on their own hands.

ANTISEPTIC PROCEDURES AND ROOT CANAL THERAPY

There was little room for complacency until dentists could save teeth by sterilising infected root canals. By 1900 a variety of substances were used including creosote, carbolic, phenol, formaldehyde and iodoform. Apicectomies increased from the 1940s onwards following the introduction of antibiotics and better instruments in the forms of reamers and files for cleansing canals. However, the use of apicectomies has more recently diminished. From the mid-nineteenth century gutta percha and gold wire were used to occlude the canals.

RELIEF FROM PAIN

It is fine developing better operative techniques but many are painful. It was a blessing when cocaine could be injected for pain relief in 1884, not being fully replaced by novocaine (procaine) until the 1930s. Early liquid anaesthetics were drawn into metal or glass-barrelled syringes by dentists. Cartridge syringes appeared in World War I but were not popular until the 1920s. Improved design and the use of stainless steel for more easily sterilisable needles reduced the danger of infection. After use syringes were 'sterilised' in sodium

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125 YEARS

biborate, phenol, glycerine and water. For added 'safety' syringes were boiled monthly.

A major breakthrough came with the synthesis of xylocaine in 1948. One correspondent to the *BDJ* wrote that after waiting 20 years for an ideal drug he believed it had "appeared in the form of Xylocaine and Xylotox".⁴ He had used it for over 100 difficult cases and was "amazed" by the results, sometimes where procaine had not worked. Together with the later appearance of pre-sterilised disposable needles and syringes xylocaine made local anaesthesia more acceptable. Nevertheless until the 1960s its use was not widespread for cavity and crown preparation as there was still an aversion to needles.¹

Electroanalgesia was tried in the 1890s to relieve pain during extractions.⁵ Terminals were placed close to the tooth nerves and a current was passed prior to the extraction.

By 1880 general anaesthesia (GA) was commonly used to put patients to sleep during extractions. In 1872 death was not uncommon when chloroform was used. As a result ether was re-introduced. Nitrous oxide was a bit safer and was originally used alone for speedy extractions. The effects were partly due to the gas, but oxygen-deprivation frequently played a major part (some patients turning black). Ethyl chloride was sometimes added to prolong anaesthesia. Nitrous oxide was commonly mixed with oxygen in the 1960s, when the author qualified, sometimes supplemented by halothane. It occasionally presented an exciting time for surgery staff. Many a heavily-built, heavy drinker could not be fully anaesthetised and chased them round the surgery, usually remembering nothing about it afterwards. At that time general anaesthetics were commonly administered by dentists who sometimes also did the extractions.

Although GA was sometimes also used for prolonged procedures an advance was the use of brietal and other intravenous anaesthetics in the 1960s and 1970s, revolutionising treatment for some nervous patients. Relative analgesia later supplemented their use.

PERIODONTAL DISEASE AND TREATMENTS

In the early nineteenth century little was known about periodontal disease. Leonard Koecker had published his *Principles of dental surgery* in 1826. The chapter 'Of the devastations or absorption of the gums and sockets of the teeth' recognised the important elements for basic periodontal therapy.⁶ However many dentists disbelieved him and continued to use "bizarre treatments".⁷ Later in the century John Riggs was an enthusiastic advocate of Koecker's approach; thorough scaling and tooth brushing.

By the turn of the century there was a greater awareness of the part played by micro-organisms in relation to diseases. In 1883 George Verdiman Black published *Formation of poisons by microorganisms* where he suggested disease is caused by "organic germs" and

reviewed the theories of Koch, Lister, Virchow and others.⁸

Willoughby D Miller's 1890 *The Micro-organisms of the human mouth* made dentists aware that dental disease could be prevented by continuous attention to oral care (Fig. 2).⁹ He had worked with Robert Koch and

Fig. 2 W. D. Miller

Miller's studies on the causes of tooth and gum diseases profoundly influenced the dental scene. In 1903 K. Goadby focused attention on oral soft tissues and promoted the idea of vaccination against periodontal disease. On the basis of possible systemic complications from foci of infection William Hunter's 1911 book¹⁰ probably caused the extraction of many teeth with only mild pyorrhoea alveolaris, especially in North America. It was perhaps only halted by Martin Rushton's 1953 paper on 'The rise and fall of focal sepsis'.¹¹ According to Ronald Doyle Emslie there was a general feeling that pyorrhoea alveolaris was untreatable but important histological research by William Warwick James and Edward Arthur Counsell in 1927¹² was a milestone.

Although there was not much sophisticated treatment at the time, in 1945 King devised a measure which later formed the basis of Massler and Schour's periodontal PMA index.¹³ It helped to assess the prevalence and incidence of periodontal disease in individual patients and community groups.

Although periodontal care was advanced in the USA little happened in Britain until George Cross emulated the Americans.¹⁴ He was also influenced by Wilfred Fish. From 1948 Cross headed the first UK department at the Eastman Dental Hospital. In the following year he was a prime mover in establishing the British Society for Periodontology. It was not until about 1954 that all the schools had a periodontal department.

With a realisation of the need to eliminate bacterial plaque, hygienists were trained to help with prevention at the chairside and for groups.

Fig. 3 An early flyer for denture treatment

Fig. 4 A box of walkerite phenoformaldehyde denture base

PROSTHETIC DENTISTRY

In 1880, most treatment involved the extraction of teeth, followed in richer patients by the supply of dentures (Fig. 3). Typically there was a beeswax impression, plaster cast and metal dies.¹⁵ Sometimes gold and platinum denture bases were then swaged. The advantage of full palatal coverage was only slowly realised. The main material used until the late 1930s was vulcanite. A 1930 demonstration at the BDA conference showed celluloid (invented in 1869 and used for denture bases from the 1870s), Walkerite (a synthetic resin material introduced in 1925) (Fig. 4), stainless steel and vulcanite. Lillian Lindsay said vulcanite was “ugly, smelt nasty and was dirty to manipulate”; and its ease of use and adaptability were dangerous as it destroyed craftsmanship.¹⁶

An early proponent of the use of chrome cobalt alloys for partial dentures was Kenneth Peters Liddel, in 1949. Two-part dentures introduced in 1963 by John Hamley Lee enabled the anatomical contours to aid retention.

The 1953 book *Principles of full dentures* by Harold Robert Backwell Fenn, Liddel and Arthur Percival Gimson was followed in 1954 by John Osborne and George Alexander Lammie's *Partial dentures*. André Amédée Grant suggests they represent “the points at which the British approach to clinical prosthetics in the more modern era were first set out in texts”.¹⁵

There were also important developments in relation to elastomeric and functional impression materials, resilient linings and tissue treatment materials for denture surfaces.

Overdentures are prostheses supported by one or more abutment teeth which are completely enclosed by the impression surface. Early references to the use of roots to support a denture appeared in the mid-nineteenth century.¹⁷ Precision attachments came in the 1950s. Loss of bone through resorption means it is sometimes difficult to stabilise dentures. One answer was the development of subperiosteal and endosseous implant dentures. Alloys, ceramics, polymers and titanium have been used in their construction.

Dental technology and prosthetics were longstanding dental school disciplines. The new Belfast school appointed a professor of dental mechanics in 1880. The first chair in dental prosthetics was held by Fenn at Guys' from 1935. In the 1930s 2,500 hours were devoted to these subjects. Over the years this allocation dramatically reduced as dental technicians were trained to take on the work. So dentists no longer need to be quite so skilled in this area of work. However they do need sound scientific knowledge to understand the ways that materials react. It was in 1973 that Michael Braden was appointed to the first chair in dental materials, at the London Hospital Medical College.

1948 saw a large increase in dentures for patients who previously could not afford them. They contributed to a massive increase in National Health Service expenditure so patient charges were imposed in 1962, the first break from a free NHS.

ORAL SURGERY

In the early period under consideration most oral surgery except for the extraction of erupted teeth was carried out by general surgeons. One exception was Frederick Newland Pedley of Guy's. He criticised the results obtained by general surgeons, for example those who used plaster bandages to treat fractured mandibles. Pedley worked in the hospital and in practice. Like today there were sometimes signs of two standards: he used iron wire for splints in hospital practice but preferred gold for private patients.¹⁸ According to Ward¹⁸ as late as 1910 Fry noted two famous surgeons carrying out oral work: Sir Charters Symonds removed a wisdom tooth and Sir Arbuthnot Lane plated a fractured mandible and separately undertook a semi-mandibular resection for a dental cyst with no technique to prevent disfigurement or loss of function. Even in 1929 Fry said treatment of jaw diseases was a “no man's land”. General surgeons admitted cases to the wards but when possible later called on a dentist to help.

Major developments in oral surgery during the two world wars led to the development of hospital dental services which is discussed in Part 7.

125 YEARS

DENTISTRY FOR CHILDREN

At first there was little of what we think of as paediatric dentistry. Victorian flyers advertise the 'regulation' of children's teeth but give no clues as to what was meant. There were few relevant textbooks and little reference to the problems of children's teeth except for arch irregularity and conditions due to teething.¹⁹ A 17-page paper by Samuel MacLean in the *Transactions of the Odontological Society*²⁰ had dealt in 1856 with the symmetrical extraction of the four first permanent molars to relieve crowding. It was discussed over many years by Ashley William Barrett (1878),²¹ Alan Ayscough Wilkinson (1948)²² and many others. This was the age of Angle's book (1898) *Malocclusion of the teeth*. Maurice Hallett was probably correct in saying: "miniature engineering of regulation appliances appealed to the dentist's mind."¹⁹

The nineteenth century was a period of empiricism and early science. To reduce gum inflammation leeches were sometimes used intra-orally or on the anterior jugular vein.¹⁹ Although local anaesthesia was developing, much treatment for children involved the extraction of teeth under a general anaesthetic; ether, chloroform or nitrous oxide. Some children died during such treatment.

In 1893 James Frank Colyer's *Diseases and injuries of the teeth* supported W. D. Miller's chemico-parasitic theory. It dealt briefly with tooth fractures and referred to the extraction of deciduous teeth to make space for their successors. It was not until the seventh edition in 1938 that a chapter appeared on the treatment of disease in children.

In 1914 Godfrey Norman Bennett, long interested in dentistry for children, edited *Science and practice of dental surgery* with 30 authors. George Northcroft's four-page chapter on 'The treatment of children and their teeth' was the shortest in the book but 200 pages were devoted to abnormalities of tooth position and their treatment.

ORAL DISEASE IN CHILDREN

Alfred Coleman's 1881 *Manual of dental surgery and pathology*²³ notes that "caries often appears in very superficial form attacking the front teeth at once and giving them the appearance of having been eaten away with an acid solvent". It thus mirrored the sugar dummy and feeder bottle labial caries seen by modern day clinicians. Coleman recommended brushing the teeth at night-time.

The problem of terrible oral health in some children was highlighted by William McPherson Fisher's historic paper on 'Compulsory attention to the teeth of school children' to the 1885 BDA conference in Cambridge.²⁴ He described his appalling epidemiological findings and advocated the urgent establishment of a service for state school children. Fisher argued that teeth should have care equal to that for other parts of the body and urged that children's mouths should be examined and treated on starting school and at least annually. Further, qualified dentists should be available to treat poor children, perhaps through dispensaries. As a result, in 1890 the BDA established a

Children's Committee with Fisher, George Cunningham, Sidney Spokes and six others "to continue and to conduct the collective investigation as to the teeth of school children and to report to the association's Representative Board". Annual reports from 1891 to 1897 showed an enormous amount of information on the teeth of 12,318 children aged four to 17 years.²⁵

In 1921 the Medical Research Council asked Norman Ainsworth to examine and report on dental disease in English and Welsh children. His detailed examination of 4,270 children in 34 schools described caries, chronic gingivitis, hypoplasia and malocclusion.

There was such a problem that between 1930 and 1942 some local authorities, led by Derbyshire and Sheffield, used dental dressers to treat children's teeth.²⁶

SOME TREATMENTS FOR CHILDREN

A common treatment in children was Howe's ammoniacal silver nitrate, introduced in 1917. Initially used to sterilise root canals it was later applied to deep enamel pits and dentine to prevent the spread of caries. Although silver nitrate turned teeth to an unsightly black it was still used in the 1960s. Stannous and other topical fluorides were later introduced to prevent pit and fissure caries.

Hyatt's prophylactic odontotomy came in 1922. Tooth fissures were ground to eliminate food-retaining areas. For the same reason copper cements and later fissure sealants were used to occlude fissures.

Hallett reminds us not to forget the pioneering work of Evangeline Jordon. Her series of articles published between 1914 and 1923 pioneering the concept of children's dentistry were pulled together in a 1925 book *Operative dentistry for children*.

ORTHODONTICS

Many developments in orthodontics are well described by Jeffery Rose and his colleagues.²⁷ There was little mention of the subject in the early nineteenth century. John Hunter had considered the growth and development of the jaws and face in 1771 but it was 1880 before William Matthews focussed attention on the aetiology of malocclusions, especially hereditary factors.²⁸ He showed differences between alveolar and basal bone.

In September 1880 a Dental Students Supplement in the *British Journal of Dental Science* outlined the training requirements for admission to the LDS examination. It noted the lectures and practical instruction offered by medical as well as dental schools. Few of them mentioned orthodontics or topics basic to orthodontics except for Anderson's College in Glasgow, the Dental Hospital of London and the National Dental Hospital. Amongst the contributors to the Dental Hospital of London course were John and Charles Tomes. The latter's course in dental anatomy and physiology specifically covered the comparative anatomy of tooth and jaw development including their bearing on irregularities of the teeth.

Although it was 1904 before the first British textbook on orthodontics was written by James Frank Colyer²⁹ there was an increased number of relevant papers published towards the end of the nineteenth century. In 1893 George Goring Campion described³⁰ a number of morphological anomalies of the teeth including enamel nodules, germination and dilaceration. In 1899 Edward Hartley Angle classified dental arch relationships. An important paper by Reginald Ernest Rix in 1946 described the role of oro-facial muscles in swallowing food and the pressures they exerted on tooth position.³¹ Two years later Clifford Ballard wrote on the “immutability” of the maxillary and mandibular basal bone.³²

Significant advances in treatment followed the introduction of vulcanite. In 1876 Francis Hancock Balkwill described vulcanite appliances which were tied to the teeth and relied on pressure from wooden wedges to move them.³³ An influential early user of removable appliances was Victor Hugo Jackson. In 1877 he described a clasp made from precious metals which skirted the gingival margins and engaged undercuts. Jackson saw patients weekly instead of the usual daily.³⁴ In 1893 Percy Montague Scholefield described removable appliances with clasps and piano wire springs.³⁵ Later the Coffin plate (Fig. 5) and Jack screw were utilised to move a whole arch or individual teeth as well to provide mesio-distal tooth movements with extraoral traction. Before 1894 few fixed appliances were used in the UK but in that year Norman Kingsley (the ‘father of orthodontics’) read a paper on their use to the Odontological Society of Scotland.³⁶ He introduced a range of appliances, stressed the importance of retention and used occipital anchorage.³⁷ Kingsley also spoke of the importance of treating children at the correct age. Although agreeing that teeth sometimes needed to be removed he was against the wholesale removal of first permanent molars. In 1925 Angle developed the edgewise arch.

Fig. 5 Example of a coffin plate

In the 1930s modern materials such as acrylic and stainless steel allowed for cheaper and more effective appliances. A change from the use of precious metals to stainless steel was eased by the invention of the spot welder

by Harold Gladstone Watkin. A major advance was the development of modified arrowhead clasps by Charles Philip Adams which dramatically improved the retention of removable appliances.³⁸ By the mid-1960s many general practitioners and school dentists used such appliances to carry out simple treatment. However as orthodontics became highly specialised mainly fixed appliances were used and most treatments began to be carried out by specialists. The introduction of the NHS led to an explosion in the demand for orthodontic treatment and the first NHS consultant in the specialty was appointed in the early 1950s. There was controversy about too much unnecessary orthodontic treatment being provided, resulting in publication of a report by Schanschieff.³⁹

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