ORAL AND MAXILLOFACIAL SURGERY

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Oral & Maxillofacial surgery is a speciality born out of war, in particular the Great War when the nature of trench warfare and new high velocity weaponry meant that horrific wounds to the head and neck were commonplace. Such was the scale of this form of injury that specialist units were set up in Sidcup in 1917, by the New Zealander Sir Harold Gillies, and in Croydon, by Sir Frank Colyer. Queen's Hospital, Sidcup had over 1000 beds and Gillies, who was originally an Ear, Nose and Throat surgeon and William Kelsey-Fry, a dentally and medically qualified facial surgeon, both Majors in the Royal Army Medical Corps, developed new and ingenious techniques for facial reconstruction, both becoming eminent in this field (1,2).

However it was an American, Charles Valadier, working in Paris at the outbreak of war, who contributed as much as anyone to the initial treatment of facial injuries (3). Having initially volunteered his services with the British Red Cross, preferring this to the Legion d'Etrangere, he later became an honorary Major in the RAMC and was reputed to have treated General Sir Douglas Haig during the Battle of the Aisne after no serving Dental Officer could be found. This is often given as the reason why the number of dentists in the British Army increased from 36 in February 1915 to 463 by the end of the 1916. He established a fifty-bedded unit for the treatment of facial injuries attached to a field hospital at Wimereux, educating many who later became luminaries in the field of facial surgery including Gillies and C Bowdler Henry. Having become a British citizen in 1920, Valadier was knighted by the King for his services in 1921.

Between the wars the drive to develop oral and maxillofacial services was not lost; in 1936 an Army Advisory Standing Committee, which included Kelsey Fry and Gillies, recommended that special hospitals should be created for the treatment of maxillofacial injuries. Duly, this was taken up by the Department of Health and units were established in East Grinstead, Roehampton, Basingstoke and Hill End. It was also recognised at this time that dental officers should be on the strength of field ambulances and located in dressing stations to perform the initial treatment of jaw injuries, an establishment that remains to this day.

Data from military conflicts in the second half of the 20th century showed that approximately 16% of battlefield injuries involved the head and neck area (4-6). This prevalence was reproduced in a study of penetrating missile wounds treated in a British field hospital in the 2003 Gulf Conflict (7). However this cohort of patients included both friend and foe, while the use of Kevlar body armour in military conflicts of the 21st century has led to less thoraco-abdominal injuries and a proportional increase in trauma to the head and neck area (21-25%) and the limbs (8,9).

In the second half of the 20th Century oral surgery developed from its dental origins into the fully recognised surgical speciality of oral and maxillofacial surgery (O&MFS) with mandatory dental, medical and surgical training. Oral and maxillofacial surgeons use knowledge and skills from these backgrounds to treat a wide range of both simple and more complex conditions including oro-facial neoplasia, facial trauma, salivary gland disease, deformity surgery including reconstructive, orthognathic (corrective jaw surgery) and craniofacial surgery, as well as pathology of the teeth, jaws and temporomandibular joint.

Trauma Surgery and Reconstructive Surgery

After dentoalveolar surgery, trauma comprises largest part of the workload for oral and maxillofacial surgeons. There are approximately 30,000 facial fractures in the UK each year, excluding simple nasal fractures (10). A weeklong prospective accident and emergency based facial injury survey was conducted by the British Association of Oral and Maxillofacial Surgeons (BAOMS) in 1997 (10) involving 163 Accident & Emergency departments across the United Kingdom (catchment area of 40 million). 6,114 patients presented with facial injuries in this week, one in three of whom required specialist treatment or hospital admission; this equates to 500 000 people suffering facial injuries annually in the UK, 125 000 of them in assaults. Since the 1980s refinement of the use of internal fixation with titanium 'miniplates' for fractures of the facial skeleton has replaced traditional techniques of intermaxillary fixation of the teeth and the use of external fixators. Open reduction and internal fixation with miniplates in a 'load sharing' manner or the use of thicker 'load bearing' plates for complex fractures or bony defects results in early restoration of form and function.

In warfare, with avulsive facial wounds due to high-energy transfer, both traditional wiring and more modern plating techniques are used for primary stabilization of facial tissues. Recent developments in this field include the use of self-drilling, self-tapping screws to achieve quick and simple intermaxillary fixation. The specially designed screws are placed between the roots of teeth and wires are wrapped around them to hold the teeth together as a method of splintage, reducing and stabilizing fractures (11). Modern locking ('unilock') reconstruction plates that have milled screw holes with special screws to match accurately and rigidly hold reduced fractures in position without the need the perfect plate bending and adaptation to bone required in older systems (12).

Resorbable plates made of amorphous injection moulded copolymer of L-lactide/D-lactide/trimethylene carbonate have been developed to treat fractures of the facial skeleton (13).

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These plates are larger and more demanding to apply than those made of titanium and have yet to meet with universal acceptance due to the excellent strength and biocompatibility of titanium that results in very low complication rates. However, resorbable plates are of particular benefit in children, as they are less likely to interfere with growth and in individuals exposed to very cold climates, where titanium plates close to the surface of the face can be troublesome.

In secondary reconstruction of traumatic injuries it is still prudent to follow the well-established 'reconstructive ladder' of primary closure, local flaps, distant pedicled flaps, non-vascularised grafts and vascularised free tissue transfer. However it is the advent and refinement of vascularised free tissue transfer to the head and neck region, developed mainly for the treatment of patients with neoplasia, that has greatly improved the ability of the facial surgeon to restore form and function after significant injury. The complexity of defects that result from the resection of oro-facial tumours has inspired surgeons on to devise ever more ingenious flaps and osteocutaneous and osteomyocutaneous flaps such as fibula and iliac crest free flaps are particularly valuable in facial reconstruction when bone has been lost. These are now routinely used to reconstruct the facial skeleton, with excellent success rates (14); however, the use of free tissue transfer in high-energy transfer wounds must be used with caution as damage to vessels that can extend far from the site of injury. (15,16).

Other more simple and aesthetic methods of replacing lost bone are constantly being sought. Osteogenic distraction, now commonplace in limb reconstruction, has been used to regenerate missing bone of the facial skeleton, being particularly successful in managing traumatic mandibular defects. Initially soft tissues are apposed and allowed to heal; the mandible is then sectioned a few centimetres away from the sight of the missing bone and an external fixation device is placed, although this device can still be contained within the oral cavity. After a few days, when callus formation is just starting at the site of the osteotomy, the distal fragment of bone is distracted generating new bone in its wake. When sufficient bone has been generated to bridge the defect a miniplate is placed to maintain stability and the external fixator is left in situ for several more weeks to help support the immature bone while it matures before being removed (17).

Titanium has proved itself as an excellent implantable material, with very low infection rates and exceptional biocompatibility. Yet this has always been in the form of mass-produced fixation devices that cannot be used to replace lost bone. With advancements in computer-aided design it is now possible to construct custom made titanium implants for the facial skeleton. In routine maxillofacial surgery this technique is frequently used for the reconstruction of complex orbital floor or wall defects following severe 'blow-out' type fractures and for cranioplasties to repair craniotomy defects; however increasingly more complex patterns of hard tissue loss are being addressed. The process first involves delineating the defect using three-dimension helical computed tomography and then specific software to 'reconstruct' the area in question, either via a mirror image if one side is undamaged or by predictive programming. From this computer data, an accurate resin model of the head and face is made upon which the implant can then be created. Accurate biocompatible porous polyethylene implants have also been made using this rapid modelling rapid prototyping technique (18). Provided soft tissue coverage can be achieved over the implant the replacement of bone defect with titanium implants is proving to be a sound secondary reconstructive technique.

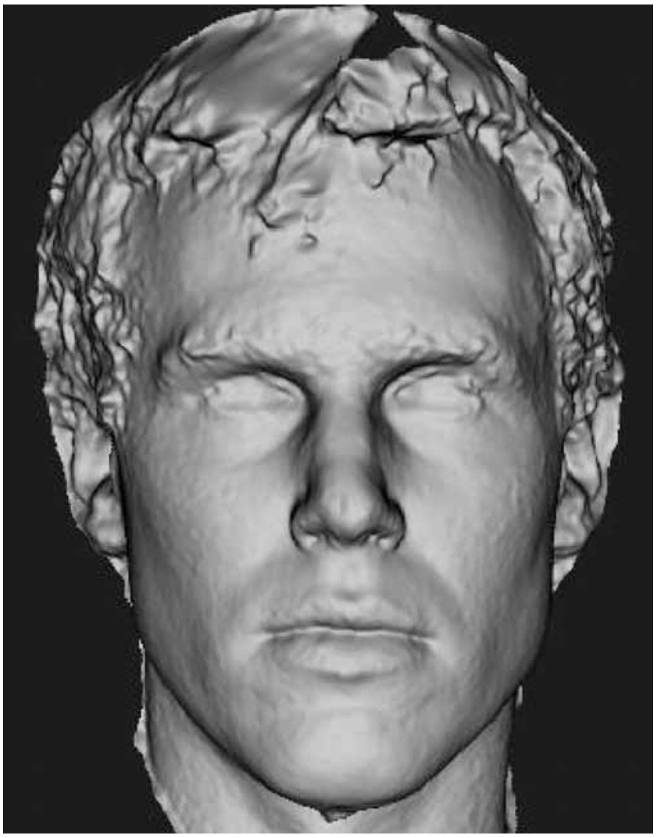

Figure 1. Three dimensional image generated by digital photography

Three-dimensional computed tomography still involves significant radiation doses and is expensive (19). For soft tissue defects there now exists a system that uses simple digital photography with multiple cameras and specialised software to 'map' the face, producing a three dimensional image (Figure 1). Using the same rapid prototyping techniques as above, soft tissue models can be created which can be used by the surgeon as a template when performing reconstructive or correctional surgery. The system also allows the construction manufacture of burn and radiotherapy masks and can be used in the creation of prosthetic ears.

Salivary Gland Surgery

Approximately 50% of salivary gland disease is the result of stones (sialoliths), the incidence of symptomatic salivary calculi being 5.9/ 100,000 / annum in the UK (20). In keeping with the overall trend in surgery towards minimally invasive procedures, techniques have been developed with the intention of preserving glandular tissue in both submandibular and parotid surgery. Chronic submandibular sialadenitis caused by proximal ductal or hilar stones is traditionally treated by sialadenectomy (removal of the gland) via an extraoral approach, while distal stones can be relatively easily removed through the floor of mouth. Sialadenectomy has a high success rate in relieving symptoms (21,22), however morbidity can be very significant as scarring is inevitable and transient facial weakness occurs in up to 30% of cases (22-24), being persistent in up to 7% (25). Complaints of oral dryness are also common (25,26) with unilateral submandibular gland excision having been shown to result in a halving of the rate of resting salivary flow. (25,26). Extracorporeal shockwave lithotripsy has been used to treat submandibular calculi, but only cures about 1/3rd of patients (27,28), while radiologically guided basket retrieval is possible if the stone is in the duct, mobile and less than 5mm in diameter (29).

Recent revival of a technique first described in 1953 by Seldin and later refined by Seward (30) in 1968 whereby large (>5mm) or fixed proximal and hilar stones are remove via an intraoral approach has produced similar success rates in relieving symptoms when compared to sialadenectomy and with no risk of scarring or facial nerve injury (31). The submandibular duct is exposed in the floor of the mouth and the lingual nerve identified and protected (Figures 2 & 3). There are then two techniques described for actual removal of the stone; Zenk et al. (31) open the duct from its orifice proximally until the stone is identified and removed, then the duct is marsupialised to the floor of mouth. McGurk et al. (32) describe a limited ductotomy directly over the calculus, that is removed (Figure 4) and then the duct and floor of mouth are closed. The case for this mode of treatment is strengthened by the scintigraphic demonstration of significant increases in the functional fraction and the excretion rate of submandibular glands after removal of calculi and the return to normal glandular function in the majority of patients (34-36).

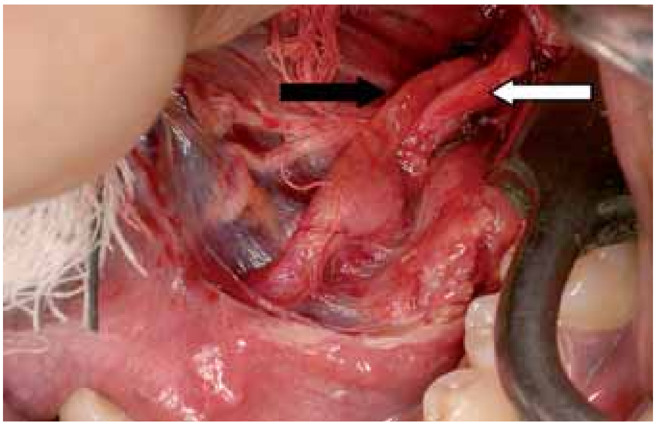

Figure 2. Exposure of structures in the floor of the mouth.
Figure 3. Clear identification of the submandibular duct (dark arrow) and lingual nerve (white arrow).
Figure 4. Removal of the siaololith from the submandibular duct.

The vast majority of parotid gland surgery is carried out to treat benign tumours, 85% of which are pleomorphic adenomas (PA). Historically these tumours have a reputation for recurrence unless excised with a wide margin. This fact, combined with fear of permanent damage to the facial nerve and difficulty in confirming that the lesion is not malignant pre-operatively led to the practice of performing superficial or total parotidectomies for any form most forms of parotid lump, dependant on their relationship to the facial nerve. However advances in pre-operative cytological diagnostic techniques (37) and questioning of the recurrence potential of PA's has resulted in a much more conservative technique of extracapsular dissection of masses shown to have no evidence of malignancy on aspiration cytology or fine 'trucut' biopsy. This is not limited to small lesions, indeed is in some ways more appropriate for large lesions where the shape and natural history will help to confirm that there is no malignancy present.

The parotid gland is approached in the same manner as for a parotidectomy by raising a suprafascial flap; a cruciate incision is then performed in the parotid fascia immediately over the lesion and the fascia is lifted with fine mosquito clips. A plane of dissection is developed approximately two millimetres away from the 'capsule' all around the lesion, taking care to avoid branches of the facial nerve. Once the lesion is excised the parotid fascia is closed to reduce the risk of Frey's syndrome (gustatory sweating on the cheek).

Postoperatively the incidence of facial nerve palsy is very low, Frey's syndrome is less common than with traditional techniques, while the facial contour is better preserved (38,39). Focal capsular exposure has been shown to occur in virtually all surgery for PA, regardless of type of surgery; lesions are often dissected from the facial nerve during superficial parotidectomy, leading to a positive margin in 25% of cases (39). Meta analysis has shown that capsular rupture does result in a significantly higher rate of recurrence but again does not seem to vary between types of surgery (39,40).

Oral Cancer Surgery

Despite recent advancements in medicine and surgery, the overall 5-year survival rate from oral cancer has not reduced in the last 30 years (41,42), with a significant increase in the incidence and mortality in younger males in that period (43,44). Large tumours, associated lymph node involvement and especially those with extracapsular spread are associated with poorer prognosis (43,45,46). The treatment of regional lymph nodes has been refined in that neck dissection (ND) has become an increasingly selective procedure. If a patient clinically and on computerised tomography (CT) has no evidence of cervical nodal metastases (the 'N0' neck), a ND is still performed as there is still a significant risk (21-29%) of

Figure 5. The use of a gamma probe to aid identification of the sentinel lymph node. (The lead shield is used to block radiation from the site of injection around the primary lesion)

occult metastases which cannot be found preoperatively due to their small size (47,50). Selective ND still has significant associated morbidity and as the majority of necks have no nodal metastases most ND's are non-therapeutic. This has led to the use of lymphscintigraphy and blue dye to identify the first draining lymph node from a tumour, the 'sentinel node' (SN), a technique that is now commonplace in the management of breast cancer and malignant melanoma (48). The premise is that if this node is free from tumour then a ND is not required. Early oral cancer (lesions less than 4cm in diameter) is suitable for this technique as it has a relatively predictable local lymphatic spread and it very rarely spreads systemically if the neck is clinically N0 (49).

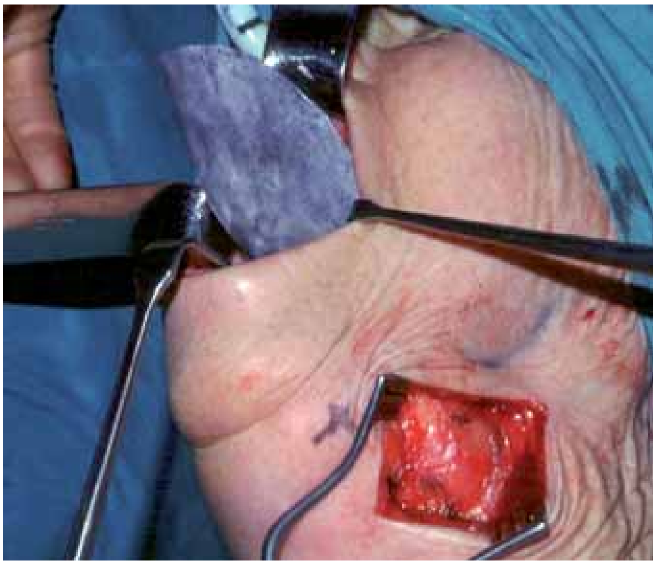

Figure 6. The presence of blue dye aiding identification of the sentinel node.

The technique involves the pre-operative injection of a radio-labelled colloid into the sub-mucosal tissue immediately surrounding the lesion in the oral cavity, followed by a scintigraphy scan to identify the sentinel node, or nodes, which are marked on the skin with dye. Within 24 hours of this procedure the operation to excise the sentinel node is completed. The first stage is the injection of blue dye, again immediately around the tumour. The neck is then opened at the site of the marking made during scintigraphy and a gamma probe as well as the presence of blue dye is used to identify the node (Figures 5 & 6), which is then removed. If the node is infiltrated with tumour a neck dissection is then carried out shortly afterwards at a second operation.

In theory oral squamous cell carcinoma should be very suitable for sentinel node biopsy as it spreads by lymphatic extension, there is relatively predictable lymphatic drainage in the neck and systemic dissemination is rare. At the Second International Conference on Sentinel Node Biopsy results from 20 centres for N0 necks comprising 379 patients were analysed. The SN was identified in 97% of cases, revealing 29% occult metastasis. There was a 4% false negative rate and a negative predictive value of 96% (50). Hence 4% of patients had a delayed diagnosis while 71% were saved a ND. There is currently a European trial in progress to establish the efficacy of this technique.

Pathology of the mouth and jaws and temporomandibular joint surgery

The removal of third molars was the sixth most common operation undertaken in the National Health Service during the 1980s. The development evidence based guidelines by the National Institute of Clinical Excellence (NICE) have led to a more conservative approach and the prophylactic removal of disease free third molars has declined (51). Within the armed forces, personnel may serve in arduous conditions for long periods of time without easy access to dental and medical services. This factor must be included when weighing the risks and benefits on an individual basis of third molar removal in military personnel. The impact of third molar related pathology on operational deployments, with special reference to NICE guidelines, is currently being audited.

The use of botulinum toxin type A for facial aesthetic surgery is well established. However, it has also been used to treat Frey's Syndrome (gustatory sweating) following parotidectomy and for hyperactivity disorders of the muscles of mastication including masseteric hypertrophy and bruxism related temporomandibular dysfunction (52). With an aging population the incidence of trigeminal neuralgia has increased. Many elderly suffers have side effects from medication but are not fit for general anaesthetic procedures. For such patients, the use of alcohol injections to treat peripheral trigger points has proved particularly useful (53).

In the United Kingdom, 300 000 people take warfarin. Traditionally, this medication was stopped 2 days before any dental extractions were done. This has been shown to be unnecessary and despite the small increased risk of bleeding, it is safer for patients to continue taking warfarin if their international normalised ratio (INR) is below 4 (54).

Arthrocentesis of the temporomandibular joint has become a popular method of treating closed lock where the meniscus has become displaced and mouth opening is limited (55). Adhesions within the joint are broken up and painful inflammatory mediators are washed away. This method of treatment has far less complications than open surgery.

Conclusion

Oral and Maxillofacial surgery is a surgical speciality drawing on the skills of dentistry and medicine to provide comprehensive treatment for conditions of the mouth, face and jaws. The speciality's unique perspective has led to it developing and embracing changes in technology, materials, and surgical techniques as well as evidence based guidelines. This knowledge base is particularly relevant for the treatment of wounds from military conflict.

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