1 Evolution of the Modern Surgical Management of Temporomandibular Disorders

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Abstract

One of the authors (MAP) was fortunate enough to be a trainee to a very prominent British oral and maxillofacial surgeon many years ago. This gentleman was the only person who claimed to be able to cure all of his patients with temporomandibular joint problems. His technique was that if any patient complained of temporomandibular joint problems, he wired their jaws together for 6 weeks. At the end of 6 weeks, he released the fixation and asked how they were feeling. If they said everything felt okay, he counted them as a cure, and if they still complained of temporomandibular joint problems, he put them into intramaxillary fixation for another 6 weeks. At the end of the second 6 weeks, he asked them again, and only the occasional recalcitrant patient had to undergo three 6-week courses of intramaxillary fixation before they admitted that they were cured!

Unfortunately, we will never know how successful this treatment was. There is no doubt that a period of complete rest for a joint can be very helpful, and even curative, for a number of conditions, and this almost certainly applies to temporomandibular joints, but it is probably something short of 100%. Sometimes the success of the treatment depends on the personality of the treater.

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The temporomandibular joints (TMJs) are the most complex joints in the human body. They are the only joints that both hinge and slide and one of only three joints that has a meniscus dividing it into an upper and a lower joint compartment (the others being the knee and sternoclavicular joints). They are also the only joints which are fixed to each other so that if one moves the other has no choice but to move. Also, the way the teeth meet can determine how the joint moves. The occlusion may not always be optimal, and it is therefore not surprising that the temporomandibular joints are prone to problems. It is sometimes helpful to consider the three components, two joints, and the bite as one unit functioning together; the TMJ is also traditionally the only joint not managed by orthopedic surgeons but rather by dental surgeons.

It is estimated that today in the United States some 30 million people suffer, or have suffered, from temporomandibular joint problems, and at any one time, somewhere between 3 and 7% of Americans have TMJ problems [1]. It is estimated that one million new patients present every year, and the incidence is in some ways tied to lifestyle. The more highly developed the country, the higher seems to be the rate of temporomandibular joint problems. It may be responsible for up to 17.8 million days off work per 100 million full-time working adults per year in the United States [2]. All studies report a higher incidence of females presenting for treatment (1.5–35 times greater) though the incidence in the population at large may show a smaller gender difference [3].

Historically, reports of TMJ problems go back several hundred years. John Hunter, the surgeon/anatomist, mentions it in his book *A practical treatise on the diseases of the teeth* published in 1778 [4]. He noted the possible relationship of TMJ problems to the occlusion of the teeth, but he also describes the unpredictability of any treatment and concludes that "Sea bathing has been in some cases of singular service." There were isolated reports of attempted TMJ surgery in the nineteenth century [5] but little constructive thought. By the 1930s, however, more complex temporomandibular joint problems were being recognized, which today would fall into the categories of degenerative joint disease and internal derangement of the joints. Costen, an ENT surgeon from Washington University School of Medicine in St. Louis, in 1934 attempted to unite a disparate group of symptoms including deafness, tinnitus, vertigo, dizziness, joint clicking, joint locking, and joint pain, as well as stuffiness in the ears and burning throat, tongue, and the side of the nose [6]. His concept was that in some way the temporomandibular joint or its meniscus became displaced and put pressure on the external and middle ear as well as the Eustachian tube, causing a variety of symptoms. This concept has now been discarded, but nevertheless his description did focus thought on the problems of the temporomandibular joint. There were few attempts to operate on the temporomandibular joints in the 1930s and 1940s, but people like Reed O. Dingman were carrying out meniscectomies at that time for temporomandibular joint dysfunction with a high reported rate of success [7]. Interestingly enough, he carried these operations out under local anesthesia, even though lidocaine was not available at that time, so he presumably used procaine. However, he later stated that the meniscectomy patients did not uniformly do well, and he also started to use general

anesthesia [8]. It is now known that meniscectomy without replacement can give good results for many years but does tend to lead to later degenerative joint disease, and so most authorities now recommend repositioning or replacing the disc, preferably with autogenous material [9].

The problem of ankylosis continued to demand attention, and its causes ranged from birth trauma to complications of mastoiditis and middle ear infections, as well as later trauma. It was generally found that attempts to free up the joint locally seemed fraught with a high rate of recurrence of the ankylosis. A generation later, Robins attempted to explain this tendency to reankylosis by remembering that embryologically the present neo-TMJ is a late development, since the embryological jaw joint is between the malleus and the incus [10]. The current temporomandibular joint is embryologically similar to a cranial suture that never fuses, but it can have a tendency to fuse, like any other cranial suture, causing ankylosis. People like Terrance Ward recognized this tendency and advocated carrying out a gap arthroplasty lower down the ascending ramus of the mandible so that this became the new joint. He devised a metallic joint surface, and we are assured that the model for the size and shape of the new joint came from the old British penny [4].

In the 1960s, a number of procedures were advocated including closed condylotomy (performed blindly with a Gigli saw) to allow the condyle to reposition itself in a physiological position to increase the joint space [4], condylectomy [11] (which often caused deviation of the mandible), and high condylar shave [12] (which essentially increased the joint space and smoothed down the condylar head if it was irregular), often combined with meniscal surgery.

From the 1970s onward, it has tended to be imaging and technological advances which have led to new developments in TMJ investigation and surgery. Paul Toller developed a number of investigative techniques for the temporomandibular joint including transpharyngeal radiographs and arthrography [13, 14] and devised a capsular rearrangement operation which was designed to reposition a displaced disc and increase the joint space and provide for reinforcement for the capsule of the joint [15]. This was one of the first serious attempts to treat what we now know as internal derangement, where there is an in-coordination between the condyle head and the meniscus, leading to meniscal displacement. The actual procedure was based on Toller's preliminary work utilizing TMJ arthrography with plain films. The procedure itself involved entering the joint spaces from a lateral approach, freeing the attachments of the meniscus to allow it to reposition, severing branches of the auriculotemporal nerve to denervate the joint, and reconstructing and reinforcing the lateral capsule of the joint with a temporalis muscle and fascia flap turned down over the arch of the zygoma. When irregularities of the joint surface were diagnosed, a high condylectomy could be carried out. In many ways this procedure forms the basis of many of the contemporary temporomandibular joint surgical procedures.

In the early 1970s, CT scanning of the temporomandibular joints became a practical proposition, and although these would show the morphology of the condyle head and the glenoid fossa, it did not show the disc itself unless combined with arthrography.

For some years this was the definitive imaging technique, although it was time-consuming and uncomfortable. Nevertheless, it was utilized for diagnostic purposes [16]. It did start to show that many of the problems with the temporomandibular joints appear to be due to anterior dislocation at the meniscus, and considerable efforts were made to try and reposition the discs both nonsurgically and surgically [17, 18].

In 1980, the first commercial magnetic resonance imaging (MRI) scanner became available, and by the early 1980s, MRI scans were becoming more widely available. When coupled with surface coils, images of the temporomandibular joints showed the meniscus without the need for arthrography.

The presence of an anteriorly and medially displaced disc was often diagnosed and felt to be the cause of the patient's symptoms, and considerable efforts were made both with splint and other nonsurgical therapy to cause the disc to reposition [19] (almost always unsuccessfully), and surgical procedures were employed to either remove the disc and replace it or surgically reposition and fix the displaced disc [20]. Unfortunately, these procedures proved to be as unpredictable as previous procedures, and moreover, MRI studies on normal asymptomatic individuals actually showed an incidence of disc displacement of around 30%, even though they had never had any TMJ problems. Thus, it would appear that discal position was not as important as previously thought [21, 22].

One consequence of this regime of meniscectomy and replacement of the disc was the utilization of a Proplast/Teflon disc replacement in the late 1970s, which was shown to fragment during function causing degeneration in the joint and the typical giant cell inflammatory reaction. It lead to many more temporomandibular joint problems and was very difficult to treat [23]. This particular episode led to the initial involvement of the FDA in device approval and monitoring.

When the joints were so badly affected by disease that they were no longer functional and were better replaced (either for agenesis as in hemifacial microsomia, severe degenerative disease, resorption, or sometimes ankylosis), attempts were made to replace the joints with autogenous tissue. Costochondral grafts have probably been the most popular and were described by Gillies in 1920 [24]. It is relatively easy to obtain grafts from the sixth or seventh ribs with a cartilage cap which can realistically replace the temporomandibular joint. Long-term studies have shown that these grafts can be very successful and the ribs are incorporated into the mandible and become functional [25]. They have been used to replace the temporomandibular joints in children, where on occasion there can be growth of the condyle from the cartilage cap. However, this is unpredictable, and in some cases, there was actually overgrowth of the neocondyle [26]. Other autogenous sites have included a metatarsal [27, 28] and the sternoclavicular joint [29], but since the advent of more successful alloplasts, these have tended to fall out of favor.

The miniaturization of fiber-optic arthroscopes and instrumentation allowed arthroscopy of the temporomandibular joint to become a practical proposition in the 1980s. The techniques originated in Japan [30] and started to be practiced in the United States in the mid-1980s [31, 32]. Arthroscopy is normally performed in the

superior joint compartment but can be extended to the inferior compartment, although this is more difficult. Arthroscopy can be diagnostic or therapeutic. Diagnostic arthroscopy can reveal many interesting features in the temporomandibular joint compartments, but many of them are of academic interest only and can also be diagnosed less invasively on an MRI scan. It is possible to detect meniscal perforations which may not be shown by other imaging techniques. As far as therapeutic arthroscopy is concerned, lavage and instillation of steroids and other medications into the joint have proved beneficial in many cases, but these can often be performed blindly without the use of an arthroscope [33]. Arthroscopic surgery itself, performed with miniaturized instruments to smooth the joint surface and remove irregularities and also to reposition and even suture the disc back in position, has been performed with relatively limited success. The results have been less satisfactory than arthroscopic surgery on larger joints such as the knee because of the limitations imposed by the size of the joint and the consequent size of instruments utilized, as well as the fact that the TMJ can only be approached from the lateral and with more difficulty from the anterior and posterior approach, the latter via the external auditory meatus. The inability to access the joint from the medial side obviously limits access.

On the heels of the relative success of hip replacement surgery, attempts were made from 1970 onward to make a functional alloplastic temporomandibular joint. The early Christensen joints became available in 1973 (the fossa only was available from 1960). These were later withdrawn, to be reintroduced later with modifications. Vitek produced a replacement temporomandibular joint in 1972. Failures occurred due to the early types having a plastic fossa which wore easily. This was largely remedied by substituting a high molecular weight polyethylene. However, the prostheses utilized Proplast on the fitting surfaces. This material had been combined with Teflon in an interpositional (post-discectomy) discal implant, a device associated with a severe giant cell reaction and high incidence of early failure with tissue destruction [34]. This added to the confusion, and after professional and governmental concern, the total joint alloplasts were often removed, and the device was withdrawn from the market.

In 1989, Techmedica introduced its custom temporomandibular joint. It is currently marketed through TMJ Concepts [35] and has proved to be quite successful for over 20 years. In the early years of the twenty-first century, a number of other prosthetic temporomandibular joints have become FDA approved and are marketed, both as custom joints and stock joints. Most incorporate the same principles as hip replacements and feature a metal condyle (usually titanium) and a high-impact plastic (usually polyethylene) fossa component. Although only approved by the FDA to last for 15 years, it does appear that they may survive longer than this. With their current success, there does seem to be a move toward earlier use of a totally prosthetic device, although one must take into account the fact that these are often younger patients and long-term survival is important. It appears from the experience in orthopedic surgery that the smaller the joint, the harder it is to make a successful alloplastic one [36].

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