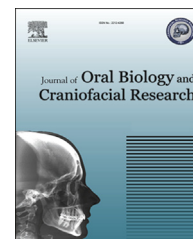


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Review Article

Alloplastic or autogenous reconstruction of the TMJ



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ABSTRACT

Reconstruction of the irreparably damaged temporomandibular joint (TMJ) is dependent on the cause of damage and the patient's age. In childhood the current preference is for autogenous reconstruction which can potentially "grow" with the child. This is either with soft tissue interposition (temporalis fascial interposition), local osteotomy, distraction osteogenesis, non-vascularised tissue (costochondral, sternoclavicular) or vascularised tissue (second metatarsal). Current debate centres around the possibility of alloplastic reconstruction particularly where autogenous tissue has failed. The resultant failure of growth – if this occurs, can be dealt with in late adolescence with either osteotomy, distraction osteogenesis or replacement of the condylar component of the prosthesis.

In the adult the choice is currently in favour of alloplastic reconstruction as this gives a more stable long term result and facilitates early mobilisation. Initial cost is clearly an issue, but when weighted against the reduced length of stay and reduced morbidity, often the costs are equivalent in the short term and come to benefit alloplasts in the medium term. Their long term outcomes beyond 15 years are however not clear.

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1. Introduction

Reconstruction of the TMJ has gone through a major rethinking process over the last 10 years and there remains significant variance as to the ideal method of reconstruction. The aim of reconstruction is to restore mandibular form and function, to reduce suffering and disability, to reduce morbidity and disease progression whilst preventing excessive treatment and cost. This is complicated by the disease process and the number of previous surgical interventions. Ultimately any reconstructive option should aim to improve function and in childhood encourage growth.

In childhood the majority remain in favour of autogenous reconstruction which in theory permits ongoing growth in the reconstructed joint. Increasingly however debate lies around whether functional reconstruction permits growth through

Moss' theory of functional growth and a number of clinicians are reporting short term outcomes of limited cases of alloplastic reconstruction permitting good function and some functional growth.

In the western world where cost is less of an issue the reverse is true in adults and alloplastic reconstruction has become resurgent with good outcomes being reported from several high volume centres.^{1–3} There remains a cohort of clinicians who continue to deliver good results with alternative autogenous reconstruction who argue against the use of alloplasts.⁴

The ensuing will discuss the management of patients requiring reconstruction of the TMJ in both the adult and child, but will assume the reader is largely familiar with the techniques involved. References to those techniques will be included for further reading.

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2. Management in the child

Reconstruction of the TMJ in childhood is usually secondary to ankylosis or trauma causing cessation of growth. Rarely early onset rheumatoid disease will cause either failure of growth, joint collapse or ankylosis. It is important when considering reconstruction that the disease process causing the problem is appropriately managed.

2.1. Trauma

In trauma there is often a one off event which should have been appropriately managed at the time by repositioning the occlusion. Internal fixation of condylar fractures in children is controversial and early mobilisation with light elastic traction to guide the occlusion is usually the method of choice. Occasionally lack of vascular supply to the proximal segment leads to joint collapse or failure of growth over several years. The preference is to leave the child until growth is complete and then manage the occlusion with standard orthognathic techniques if the joint remains functional but deformed. Interim distraction osteogenesis can manage severe deformity to allow some semblance of normal function until a definitive procedure can occur in the late teens. Where the joint is painful or function is limited or ankylosis occurs then joint reconstruction is required.

2.2. Rheumatoid diseases

The rheumatoid diseases rarely cause significant issues in early childhood⁵ and involvement of the TMJ is uncommon. The generalised process should be managed under the care of a rheumatologist and conservative measures to support the joint with potentially arthrocentesis to wash out the inflammatory mediators or the use of stabilisation splints to maintain the occlusion until growth is complete. At this stage if the joint is symptom free then orthognathic procedures can be used to reconstruct the occlusion. If the joint is collapsed management should continue as in adults.

2.3. Ankylosis

The most common need for urgent reconstruction in the child is to manage ankylosis. This presents a challenge to both surgeon and anaesthetist and it is essential to work closely with an experienced difficult airway anaesthetist who can place transnasal tubes utilising fibroptic techniques. The alternative airway management is tracheostomy with local anaesthesia. This may be required if there is severe mandibular hypoplasia, particularly in the perinatal period, causing airway embarrassment.

The other consideration in ankylosis surgery is whether there is involvement of the maxillary artery or one of its branches in the ankylotic mass. Vascular imaging and endovascular occlusion of the artery may be required prior to surgery to prevent intra-operative haemorrhage. Alternatively the operative procedure should be planned to control the terminal carotid at its division into the maxillary and superficial temporal arteries prior to resection of the mass. This can

be accessed through the retromandibular incision deep to digastric.⁶

2.4. Surgical management and interposition options

The ankylotic mass can be accessed via a preauricular approach and if a simple gap arthroplasty is planned and there is no bleeding this may be the only access required. Gap arthroplasty alone has been shown to be inadequate with a high rate of recurrent ankylosis.

Temporalis interposition has become the method of choice in the first instance, but it is essential to consider a gap of traditionally at least 1 cm. Recent short term studies suggest this can be even more limited although the long term recurrence is not known. Care should be exercised in performing the interposition to avoid the temporal branch of the facial nerve.

The alternative interpositions which have been suggested include native disc, skin, dermis, buccal fat pad and auricular cartilage,^{7–11} although as the temporalis is within the operative field and is vascularised then this is the method of choice.

The main risk with gap arthroplasty is collapse of the occlusion, although if the ankylosis does not recur then definitive reconstruction can be carried out later in life when none of the reconstructive options have been used. At this stage the Kaban protocol¹² suggests consideration of coronoidectomy if the mouth opening has not improved. This may be necessary bilaterally. Use of the coronoid fragment has been suggested as a free bone graft fixed to the distal ramal stump, although this is quite a thin bone segment and tends to resorb in time.

2.5. Osteotomy

The other autogenous methods used to reconstruct the joint should be considered prior to the resection. Osteotomy of the vertical ramus of the mandible with vertical slide of the proximal segment can provide a reasonable local solution. Access to the segment should be achieved via a retro-mandibular approach and the inferior alveolar canal should be avoided during the osteotomy. The segment is advanced vertically to provide some stability to the ramal height and should abut onto the temporalis interposition. The fragment is then fixed to the distal ramus using miniplates.¹³

2.6. Costochondral graft

The workhorse of condylar reconstruction has been the costochondral graft. Harvest of the contralateral 5–7th rib segment including 1–2 cm of proximal cartilage with overlying perichondrium¹⁴ can then be fixed to the ramus with miniplates or bicortical screws. Whilst traditionally this is via a retro- or sub-mandibular approach, recent studies suggest a transoral endoscopically assisted technique carries less morbidity.¹⁵ The main issues with the costochondral graft relate to its high propensity to failure over the medium term. Around 1/3 are successful, 1/3 overgrow and 1/3 either reankylose or fail to grow. The graft may also fracture, especially as the screws are being placed with vertical splits occurring

along the line of the graft. A free graft requires a good vascular bed to take and scarred tissue carries less vascularity¹⁶ with capillaries able to penetrate a maximum thickness of 180–220 microns (μm) of tissue, whilst scar tissue surrounding previously operated sites averages 440 microns (μm) thickness. Revision surgery with costochondral, or indeed any non-vascularised graft therefore carries a high risk of failure and alternative techniques using either vascularised or allogenic materials should be used for revisions. The main risk of costochondral grafts relates to the donor site morbidity including pleural tear and chronic costochondritis pain. There is also a need for IMF. These issues lead to a prolonged post-operative stay.

2.7. Sternoclavicular graft

Wolford has described good success using free sternoclavicular grafts for TMJ reconstruction.¹⁷ Logically the sternoclavicular joint is the only other joint in the body with the same endochondral origins as the TMJ. The site harvest carries significant risk of haemorrhage from the major vessels which lie deep to the clavicle and also the scarring is unsightly and lies in a site prone to keloid formation. It should not be used for rheumatoid reconstruction as the disease process recurs in the graft.

2.8. Vascularised free flaps

Vascularised grafts specific to TMJ reconstruction include second metatarsal free flaps, although there are limited reports of their use in children.¹⁸ The donor site morbidity includes difficulty in walking and difficulty obtaining adequate footwear. Microvascular experience is required to use this reconstruction and the vessels are particularly small and short. The advantage is that this technique can be used in revision replacement when the soft tissues do not provide a good vascular bed for free non-vascularised tissue transfer. The other vascularised free grafts, the free fibula and the deep circumflex iliac artery free flap have been used. These have not been used for TMJ reconstruction in childhood but are extensively used in adults requiring oncologic resection which includes the condyle.

All of the above techniques require a period of post-operative intermaxillary fixation (IMF) and a second operative site. These both complicate recovery from anaesthesia and restrict dietary intake with increased post-operative stay, which can be particularly prolonged if pleural complications and a chest drain have been required. IMF limits early mobilisation and potentially therefore aids the reformation of the ankylotic mass as mobilisation helps to prevent ossification.

3. Reconstruction in adults

The choice of reconstruction in adults is similar to children although alloplastic reconstruction carries significant advantages which will be discussed later. The indications for reconstruction are similar, but in addition degenerative change and iatrogenic causes have to be considered.

3.1. Trauma

In adults traumatic injuries to the condyle have a greater tendency to be extracapsular and numerous centres internally fix these fractures either via a retromandibular approach or various types of endoscopic assisted techniques. The issue of more concern is soft tissue damage within the capsule which is rarely considered but may occur in 30% or more of cases. This is particularly true of fracture dislocations which by definition will have torn the retrodiscal tissues. Consideration for MRI to assess the joint and intra-articular repair may well prove to be the way ahead with condylar trauma. In addition haemarthrosis should be managed with early arthrocentesis as this may prevent organisation of the clot into an intra-articular ankylosis.

3.2. Rheumatoid disease

The rheumatoid diseases affecting the TMJ include ankylosing spondylitis, psoriatic arthropathy and rheumatoid arthritis. These are listed in order of the frequency in which, when the TMJ is involved, ankylosis ensues. Rheumatoid arthritis more commonly leads to erosion and joint collapse. This leads to a retrusive chin and shortening of the ramus with a consequent anterior open bite or premature contact of the molars on the side of involvement. If there is no malocclusion then conservative measures and arthrocentesis can be very successful. There is a small tendency to ankylosis which is greater in psoriatic arthropathy and almost always occurs in ankylosing spondylitis when the TMJ is involved. Management of the rheumatoid joint is more successful with alloplastic reconstruction as there is a tendency to recurrence of the disease in an autogenous reconstruction as new synovium forms around most TMJ reconstructions.¹⁹

3.3. Ankylosis

Ankylosis is managed similarly to in childhood with a gap arthroplasty of at least 1 cm and some form of interposition. Recurrence is frequent and therefore larger gaps have been used. Wolford has described a reduction in frequency of recurrence when an alloplastic reconstruction is used in conjunction with abdominal free fat packed around the prosthesis.²⁰ Once recurrence has occurred with an autogenous reconstruction the host bed is so poorly vascularised that only a vascularised graft or alloplast should be used.

3.4. Degenerative disease

Like most joints in the body the final common pathway of many disease processes is degeneration. Whilst this is less common in the TMJ and certainly is not the end stage of the click-lock-degeneration process as once suggested it does occur. Radiographic signs of degeneration alone do not warrant joint replacement as remodelling invariably occurs following any surgery to the joint or even following condylar fracture or orthognathic surgery. Strict guidelines for reconstruction should be used and were established by NICE in the UK in 2009²¹ following the BAOMS guidelines of 2008.²²

3.5. Iatrogenic disease

There is no doubt that in the USA the commonest cause for joint reconstruction is iatrogenic disease. Too many operations with limited indications have been performed with disastrous consequences including neurogenic pain. Doing the same operation more than once and expecting a different outcome can only be considered poorly thought out at best and stupid at worst (Einstein paraphrased). Ultimately the more previous operations the poorer the outcome of the final reconstruction due to loss of vascularity and nerve damage.

4. Alloplastic total joint replacement

This is now considered as the gold standard in reconstruction of the irreparably damaged adult TMJ. The current prostheses now have up to 20 years of follow up with good outcomes in the short, medium and long term. It remains to be seen whether the outcomes are maintained over 20 years, particularly as the average age for TMJ replacement in the UK is 43 years. One would hope for a reconstruction which can last 40 years. The metal on high molecular weight polyethylene joints (TMJ Concepts and Biomet) seem to have similar outcomes and are made to a similar construct as total knee replacement, although the latter which succeed beyond 10 years start to fail at 20 years due to wear debris. No case of wear debris has yet been reported following TMJ replacement with these prostheses. The converse is true of the metal on metal joint replacement system in which a number of cases show metal debris surrounding the prosthesis. Debridement of this proves difficult if not impossible and often patients are left with ongoing symptoms of pain and swelling despite adequate revision. It seems illogical to use this type of reconstruction where it has been abandoned some time ago for knee replacement and more recently is being avoided in hip replacement where even this well constrained joint is showing metallosis.

Pre-operative testing for allergy to the components of cobalt chrome, whilst controversial seems to have eliminated the issue of rejection due to allergy for TMJ replacement.^{23–25} The use of a close fitted custom made prosthesis eliminates the other issue of micromovement and the thickness of the fossa lowers the fulcrum and hence reduces the moment arm of the joint. Numerous short and medium term studies of both prostheses show good outcomes with improvements of pain score and diet in the region of 70–90% after one year, which is maintained for up to 10 years.

Initially there is more work up required for these prostheses including 3-D CT scan and models, but the reduced operative time (60–90 min per side), length of hospital stay (1–2 days) and reduced secondary donor site and complications far outweigh the initial cost of the prosthesis (\$10,000 in UK). Likewise the patient is able to open the mouth and manage a more normal diet from the outset, not usually requiring any period of IMF.

There seems to be little other than initial costs which suggest any other form of reconstruction in the adult at this stage, although the development of custom made cartilage

grafts using stem cells may be the way forward for all types of joint reconstruction in the future.

5. Summary

Current reconstructive techniques lie in favour of autogenous replacement in children and alloplasts in adults. The balance seems to be swinging towards alloplasts in older children,²⁶ whilst the use of distraction osteogenesis is also being explored although long-term outcomes are not yet available.^{27,28} Newer techniques of cartilage reconstruction may ultimately surpass any form of reconstruction.

Conflicts of interest

The author has none to declare.

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