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A comparative review between the use of costo chondral graft and abdominal graft as an interpositional material in the management of TMJ ankylosis

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Abstract

Temporomandibular joint (TMJ) ankylosis is a distressing state where there is inadequate mandibular movement that may be related with grave functional and aesthetic deformities together with trismus, temporomandibular joint (TMJ) ankylosis can be classified into fibrous and bony replacement of the articulating surfaces, consequentially fetching trouble in opening the mouth. One important and most followed treatment is the joint interpositional arthroplasty which aims at removal of the ankylosed tissue and meniscus. Once done, the joint surfaces are smoothed, and the meniscus is replaced by an autogenous or alloplastic material. Different autogenous materials used are costochondral grafts, metatarsal grafts, sternoclavicular grafts, and grafts from iliac crest, fibular grafts, coronoid grafts and parts of ramus. Of these, CCGs are found to be the most commonly followed efficient modality of treatment. The use of abdominal dermis fat grafts has also been reported over eons. This review compares the use of CCGs and abdominal grafts as interpositional materials in interpositional arthroplasty.

Keywords: costo chondral graft, abdominal graft, TMJ ankylosis

Introduction

Maxilla and Mandible are the two important bones that give form, function and shape to the face. Maxilla, with its opposite counterpart, is a pair of irregularly shaped bones that form the upper jaw. Mandible is a horse shoe shaped bone that forms the lower jaw. It is the largest and strongest of all the facial bones and it articulates with the skull through the tempo mandibular joint. Beginning to develop in the 10th week of gestational period, the joint has two components- temporal bone component and the condylar component. It is a synovial joint with a joint capsule and a synovial membrane. It is nourished with the synovial fluid. Temporomandibular joint (TMJ) ankylosis is a devastating state where there is inadequate mandibular movement that may be related with grave functional and aesthetic deformities together with trismus, disturbances of facial and mandibular growth. The definitive management objective of TMJ ankylosis is to reinstate distorted joint workings, exact associated dentofacial deformities and to prevent recurrence of ankylosis. Various treatment modalities for TMJ ankylosis include gap arthroplasty (GAP), interpositional gap arthroplasty (IPG) and/or total joint reconstruction (with autogenous costochondral grafts or alloplastic materials), and distraction osteogenesis [1]. Temporomandibular joint ankylosis is defined as hypomobility of the mandible following a fibrous or bony blending of the mandibular condyle to the cranial base. Etiological factors include trauma, infections, pathological processes and degenerative diseases [2]. However, among all the etiological factors, trauma is found to be the commonest. The cure of TMJ ankylosis is achieved surgically with either gap arthroplasty, interpositional arthroplasty, and/or joint rebuilding using autogenous grafts or alloplastic materials [3]. An effectively reconstructed TMJ must imitate regular joint construction, endow with efficient functional articulation, and consent adaptive expansion or remodeling. Failure to achieve this may be attributed to the alloplastic graft materials available in the market that are used for the reconstructive purpose. This review compares the two modes of autogenous

reconstruction materials that is the costo chondral and abdominal grafts used and the indications of what lies ahead in the field.

Management Strategies

The stage and type of ankylosis, associated deformities and the age of presentation are certain factors that determine the management strategies. The treatment objective is aimed at the removal of the ankylotic mass by resection. The three main modalities are gap arthroplasty, interpositional arthroplasty and active mobilization of the joint. Interpositional arthroplasty is more or less similar to the gap arthroplasty except for the use of an interpositional material. Some of the most commonly used autogenous interpositional materials are muscles (temporalis, pterygomasseteric sling), fascia (temporalis, fascia lata, dura), skin, cartilage (iliac crestal, costo chondral, auricular), fat and/or combined.

Costochondral Graft

As the name suggests, costochondral graft is an autogenous graft material pertaining to the rib and its cartilage. Sir Harold Gillis was the first person to use this as an interpositional material in TMJ ankylosis for reconstruction. The current technique for TMJ replacement with the CCG was popularized by Poswillo [6]. CCG has gained popularity because of its three important functional parts: the bony part which is used to manage the height of the ramus of the mandible and fixation of the graft, the cartilaginous part which acts as an interpositional material, and the growth centre which lies between the bony and the cartilaginous part [1]. The sixth or seventh rib is resected all along with 1 cm of whole costal cartilage for CCG. Usually 2.5-3cm of bone is harvested with a cap of 6-8 mm of cartilage [4]. The CCG is at all times taken from the chest opposed to the side of the reconstruction so that the greatest convexity to the splice is obtained to fabricate the maximum facial width. Unlike other graft, the rib growth continues through adolescence. The cartilaginous growth of rib is nearly linear, with some acceleration during puberty [14]. Authors have suggested thorough itemization of the periosteum and perichondrium off the transplanted rib and harvesting every other ribs if many grafts are mandatory. CCGs have proved to be the finest rebuilding material principally for the reasons like their biologic similarities and their capability to redevelop. They also contain the intrinsic growth potential. In recent times authors have suggested the use of thinner sections of cartilage (2-3mm) owing to the prospective overgrowth [7]. With more than a few biologic and anatomic similarities to the mandibular condyles, autogenous costochondral grafts are considered to be the primarily satisfactory tissue for temporomandibular joint reconstruction. The donor site complications are occasional and regeneration of the rib usually occurs in a year post operatively [4]. Its use can be justified in two ways. Initially it maintains the vertical height of the ramus and thereby aids to sustain the evenness of the face [12], even though the precise power of CCGs on mandibular growth is not identified yet. Secondly, it acts as an adaptive hub, which responds to changes in the surroundings and utility [13]. CCG is purely well-matched, workable without difficulty particularly while contouring the cartilaginous fraction to fit into the glenoid fossa, and takes a reduced duration to mend and becomes integrated into the novel location allowing restitution of the bone and cartilage mechanism [8]. CCG moreover has the competence for remolding into an adaptive mandibular condyle, and there is,

at all times, a probability at the contributor location to grow and regenerate [9]. An additional advantage in children is its growth potential [10]. Bone scintigraphy is a helpful way for evaluation of viability of CCGs. Vascular patency to the graft is discriminated by normal or diffusely increased tracer up take throughout the graft. Non-viable grafts do not concentrate tracer and appear like photon deficient region in late images with reduced flow on the perfusion study. [5] In addition to all these advantages there are also many significant disadvantages that have made way for the recent advances in the field. Some notable disadvantages are discussed. More importantly, the expansion of the CCG is awfully erratic; it can either grow or not grow. A case of mandibular overgrowth happening on the graft spot can in fact be additionally bothersome than the lack of growth. The two types of overgrowth are tumor-like overgrowth and linear overgrowth. Concern must be taken to make sure appropriate postoperative functional therapy and to scrutinize the role of cartilage thickness. A few authors have postulated a straight association amid the rates of overgrowth with reconstruction in advance or an extreme quantity of cartilaginous cap harvesting through procurement though there is no proof. [14] Overgrowth in length occurs when there is an error in the time of treatment. When the transplantation is done during the growth spurt, this complication can occur. Whilst CCG overgrowth is diagnosed, condylar shaving can be made. Likely management modalities for cases with facial asymmetry due to CCG overgrowth depend on severity of divergence and its impact on the occlusion. The undergrowth of the cartilage has also been observed. Re-ankylosis is one of the most common problems encountered in adult life. Particularly, people with history of multiple surgeries, because they are more prone to heterotrophic bone formation. Reankylosis in the range of 5-39% has been reported [15] Pleural tear at donor site, pneumothorax at donor site, pleural effusion at donor site, atelectasis and empyema at donor site, fracture separation of cartilage from bone and/or poor bone quality are the other expected complications of costochondral grafts. So the success of the CCG, lies on continued post-operative physiotherapy, follow-up and a stepwise interceptive preparation and approach.

Abdominal Dermis Fat Graft

Fat is the closest we have to a commercial filler substitute. Abdominal fat graft has also been used as an interpositional material ever since CCGs have been in use. However its first usage owes its success to Murphy which was in 1914. There are evidences in literature that prove the limitations of abdominal fat grafts that paved way for a modification which involves harvesting the dermis layer along with the fat thus making it less fragile and more stable. The harvesting is usually performed 2-3cms below the umbilicus and 3-5 cm length on the transverse midline. [20] For cosmetic reasons, the suprapubic region can be shaved to place the incision as low as possible. Under proper perfected sterile conditions, draping of abdomen is done following which the graft can be harvested. Any existing scar can also be used optimally. [21] The abdominal dermis fat serves as a physical blockade which helps to lessen the existence of pluripotential cells, and prevents the creation of widespread fibrosis and heterotopic calcification. Dennis J Kantanen *et al.* reported the usage of abdominal fat harvest in maxillofacial surgery. They described it as fairly economical, secure, and readily obtainable. Kaufman, *et al.* instituted that fat transferred into subcutaneous tissue expressed well-known 30% survival after

6 months^[16]. Keerl, *et al.* studied fat fixed into the frontal sinus of 11 patients for elimination of the frontal sinus cavity^[17]. This technique exhibits a minimum morbidity rate. However like all the other techniques, this technique also has certain limitations like seroma, contamination, hematoma, ileus, and unintended peritoneal puncture^[18]. The 6.9% occurrence of seroma development that needs aspiration is given in a report by Wolford *et al.* Seromas that occur in the abdominal region post surgically are classically evacuated with percutaneous drainage and aspiration. Infectivity rate is steady, with an incidence close to 3%^[19]. Hematoma formation is however rare while performing abdominal fat harvest, due to the petite surgical area, lesser surgical duration, and effortlessness to attain hemostasis. Through watchful awareness to achieve hemostasis, drain placement could perhaps be used. Ample positioning of fluffed gauze and stretchy bandage reduces the occurrence of hematoma⁽¹⁹⁾. One another notable disadvantage is the time consumption that has its direct effect on the viability of graft in the recipient site. To overcome this, two surgical teams can be used. When this is not feasible, the graft harvesting can be done just before the placement thus ensuring viability. In bilateral cases, the limitation is however inevitable. G Dimitroulis determined the fate of abdominal grafts by testing them on rabbit specimens following condylectomy. He divided them into two groups- group A: without abdominal grafts and group B: with abdominal grafts. According to G Dimitroulis *et al.*, At 4 weeks, fat necrosis was obvious in every one of the tested specimens. The dermis part survived and produced cysts without necrosis. By 12 weeks, there appeared viable fat deposits with no proof of necrosis. At 20 weeks, great amounts of viable fat were there in Group B specimens (with grafts). Group A (without grafts) had no fat, even though the missing condyles regenerated. With the viable fat present, Group B expressed little condyle regeneration 20 weeks after condylectomy. Non-vascularised fat grafts did not live transplantation, nevertheless it aroused neoadipogenesis. The fate of the dermis part of the graft is free of the fat part. Fat in the joint gap interrupts the regeneration of a novel condylar head. Adipogenesis inhibits augmentation of new bone and cartilage. This has scientific implications for TMJ ankylosis management. In case of TMJ ankylosis, abdominal dermis fat graft thus becomes the most favorable option because of its easiness in obtaining the graft and sufficient size. Like all the other treatment options, this also need follow up for long time. The triumph in the prevention of Reankylosis after TMJ arthroplasty is allied chiefly to the suitable surgical method through satisfactory elimination of bony mass and early forceful postoperative physiotherapy.

Conclusion

TMJ rebuilding has been one of the supreme challenges to surgeons over eons, because of the reason that TMJ is an intricate anatomic organization. Postoperative complications of TMJ can guide to inferior esthetic and practical results. Through enhanced familiarity the date is not excessively distant when the doctors will be capable to offer a healthier excellence of living with finest function and esthetics to a patient of TMJ ankylosis. The accomplishment of preventing Reankylosis following TMJ arthroplasty is interrelated first and foremost to the suitable surgical procedure by way of ample exclusion of bone and early dynamic rehabilitation. The effortlessness in harvesting and satisfactory bulk of tissue certainly makes abdominal dermal fat as a selection of

interpositional autogenous tissue in case of TMJ ankylosis.

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