

Interpositional Arthroplasty in the Treatment of Temporomandibular Joint Ankylosis: A Review of Literature

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Abstract

We have reviewed the clinical and experimental reports regarding interpositional arthroplasty materials in the treatment of temporomandibular joint (TMJ) ankylosis. The aim of this review is to determine what constitutes an ideal interpositional material and whether any of the existing materials reported in the literature provide all requirements of an effective disc substitute following the surgical excision of ankylotic mass. We evaluated these reports in terms of the maximum mouth opening (MMO), aetiology, type of ankylosis, type of graft used, recurrence and other complications. Also we compared the results of the other experimental studies with those of our former experimental study. This was the first report that human amniotic membrane (HAM) had been used as an interposition material. The study has clearly demonstrated that HAM was superior to gap arthroplasty evidenced by vertical, left and right jaw movements in the rabbits clinically. This was supported by histological and radiological investigations, as well. However HAM had the inability to achieve the vertical height of the mandibular ramus, so that a total functional reconstruction was not obtained. In reviewing the literature, it is obvious that there is no ideal interpositional material that provides all the criteria for replacement of a missing articular disc following TMJ discectomy. Although HAM as an interpositional material in tmj ankylosis treatment has not yet been used in human beings, we consider HAM as an interface material with replacing the disc using a cartilage graft might be effective to prevent reankylosis method for treatment of type 1 and 2 of TMJ ankylosis.

Introduction

TMJ ankylosis can be described as a fusion of joint surfaces. This condition can lead to chewing, digestion, speech, aesthetic, oral hygienic problems [1-3]. When occurs during the growing period, it leads to varying degrees of facial deformity and psychological problems [4-7].

TMJ ankylosis is classified into true or intraarticular and false or extraarticular types. Intraarticular ankylosis most commonly occurs after trauma or infection, whereas extraarticular type can occur by a large variety of disorders including myogenic, neurogenic and inflammatory processes, bone and soft tissue tumors [2-8].

Various procedures have described for the treatment of TMJ ankylosis in the literature. These include gap arthroplasty, interpositional arthroplasty and total joint reconstruction using alloplastic or autogenous materials [5-8]. Since 1893, interpositional arthroplasty has been an advocated treatment method in which an autogenous tissue or alloplastic material is inserted into the gap, separating the bone ends [1]. Although temporalis myofascial flap is referred as a gold standard in the treatment of TMJ ankylosis in the literature, there have been a number of reports that other autogenous grafts including costochondral graft, dermis fat graft, and skin graft or alloplastic materials were also suggested as successful and suitable options. Therefore, temporalis myofascial flap is no longer considered the "gold standard" in the management of ankylosis - alloplastic joint replacement is by most specialist TMJ surgeons. Another option is the use of human amniotic membrane (HAM) as an interpositional material. We have reported HAM as an interposition arthroplasty material with successful results [9]. The main disadvantage of this method was the inability to achieve the vertical height of the mandibular ramus, and a total functional reconstruction was not obtained. Therefore no single method has produced uniformly successful results up to now. Reankylosis and limited range of motion are the most frequently reported complications [3].

The goal of this paper was to review interpositional arthroplasty materials in terms of the maximal mouth opening results obtained and to provide the reader with an evidence-based review of the literature

in order to determine the most efficient way to manage TMJ ankylosis and reankylosis.

Materials and Methods

We have reviewed the clinical and experimental reports regarding interposition arthroplasty materials used in the treatment of TMJ ankylosis in terms of pre- and postoperative measurements of mouth opening, aetiology, type of graft material, type of ankylosis, recurrence and presence of other complications.

Results

Table 1 (Data included as supplementary) summarizes data on the number of patients, aetiology, type of graft used, recurrences and the other complications in the clinical studies.

In the clinical studies, the most common cause of TMJ ankylosis was trauma (24 reports) and infection (10 reports). The other causes were osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, recurrency and unknown.

The types of interposition materials were costochondral graft (6 reports), alloplastic materials (6 reports), temporalis muscle (4 reports), temporalis fascia (3 reports), temporalis muscle and fascia (2 reports), coronoid process (1 report), auricular cartilage (1 report), costal cartilage (1 report) and metatarsophalangeal joint (1 report).

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Received October 20, 2011; **Accepted** November 17, 2011; **Published** November 19, 2011

Citation: Tuncel U (2011) Interpositional Arthroplasty in the Treatment of Temporomandibular Joint Ankylosis: A Review of Literature. *Surgery* 1:103. doi:10.4172/2161-1076.1000103

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Among the complications, reankylosis was reported in 7 articles. Temporary facial nerve injury was declared in 4 reports whereas persistent palsy was in 2 reports. The other complications were deviation (1 report), graft fracture (1 report), overgrowth (2 reports), open-bite (2 reports), cross-bite (1 report), graft resorption (1 report), Frey's syndrome (2 reports), infection (3 reports), epithelial cyst (1 report) and the number of reports have no complication was 12.

Preoperative measurements of the maximal mouth opening were in a range of 0-1mm, and the same measurements in the postoperative period were in a range of 24-50mm. The most successful results obtained in terms of mouth opening were reported with using alloplastic materials, temporal muscle and costochondral graft.

In the experimental studies (Table 2), Human amniotic membrane was used in New Zealand rabbits as an interposition material in one report. Fresh disc allograft and masseter muscle were used in Merino sheeps in one each report. The maximal mouth opening measurement was 1.03mm preoperatively in the report used human amniotic membrane. The same measurement was 2.52mm postoperatively. There was statistically significant difference between the two measurements. In the report used masseter muscle, the maximal mouth opening was 35.4mm preoperatively, and 48.8mm postoperatively. There was statistically significant difference between the two measurements. And in the report used fresh disc allograft, the maximal mouth opening value was 58.5mm preoperatively, and 61.5mm postoperatively. Paired t test detected a significant difference of the values between the control osteoarthrotic joints and allogenic disk grafted joints in that study.

Infection was in only one report used masseter muscle. In that study, the operated area was infected 1 week after reconstruction with the muscle graft despite the antibiotic treatment. In report used human amniotic membrane, there was considerably mandibular deviation on the operated joint side in both control and experimental groups.

Any allergic response or graft rejection was not seen in reports used human amniotic membrane and fresh disc allograft despite any immunosuppressive agent was not used.

Discussion

In the clinical studies, the most common seen cause of TMJ ankylosis is trauma (24 reports) and infection (10 reports). Infection is the main cause of ankylosis in children. The other causes are osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, recurrency and unknown causes. In 1964 Topazian reviewed 185 intraarticular ankylosis cases from the literature and found that trauma was involved in 29%, infection in 48.7% and unknown causes in 19.5% [1]. Although joint infection has decrease nowadays, it is still a cause of disease in especially in developing and underdeveloped countries [1]. Trauma is still an important cause of the disease both in developing and developed west countries in especially 21-30 age group [3,4]. In the literature trauma is documented in 31-86% in this age group. This is the age group that commonly presents with fractures of the mandible and it has male predominance. According to the most widely accepted hypothesis in the literature, intraarticular ankylosis from trauma is

most likely to develop from the organization of a hematoma within the joint, with or without a related fracture of the condyle [1-4]. The ankylosis is basically fibrous in nature, and then ossification of the fibrous tissue may result bony union [4].

The different treatment methods of TMJ ankylosis have been described in the literature and three basic techniques have been developed for surgical correction of disease: gap arthroplasty, interpositional arthroplasty and total joint reconstruction. Kaban [2] described a protocol for the treatment of TMJ ankylosis in 14 patients with a one-year follow-up. It consists of: aggressive resection, ipsilateral coronoidectomy, contralateral coronoidectomy if needed, interposition with temporalis fascia or cartilage, reconstruction of the ramus with a costochondral graft, rigid fixation, movement as soon as possible and aggressive physical therapy [4].

Reankylosis is the major problem in all ankylosis cases. Arthroplasty without using any interpositional material requires a gap of 10-20mm. When a gap arthroplasty is performed alone, it is expected that a pseudoarthrosis will develop in the gap if sufficient bone has been removed [5]. In 1966, Topazian compared gap arthroplasty with interpositional arthroplasty in TMJ ankylosis surgery and they found interpositional arthroplasty to be more favorable results [5]. However Roychoudhury [4] reported the long-term functional results of gap arthroplasty were satisfactory and comparable to those obtained through use of other treatments. They noticed interpositioning of autograft or allograft could decrease reankylosis. Also the authors reported that a gap of 15mm should be created between the recounered glenoid fossa and the mandible for obtaining an optimal functional result. Many clinicians advocate the placement of an interpositional material in the joint after discectomy to avoid pain, crepitus, degenerative changes, limited movement and reankylosis. Only gap arthroplasty including condylectomy may result in a false joint space and it was showed in the literature that the gap arthroplasty without using any interposition material for TMJ ankylosis could not restore the TMJ functionally and histologically [5-12].

Brusati [6] and Julie Ann Smith [5] used temporalis muscle in the treatment of TMJ ankylosis and reported good functional results without any complication. The authors used the method on 12 patients and 13 joints and then 24 patients of 28 joints. They noticed that this method was a sound biological procedure to separate the bone articular surfaces with a vital structure similar to the absent or damaged disc, further the anatomical location of the muscle flap makes the harvesting of the graft very easy.

Su-Gwan [7] used temporalis muscle and fascia flap with Kaban's procedure. In this study trauma was the most common cause of ankylosis (85.7%), and the patients was mostly in 21-30 years-old age group. They obtained statistically significant results on the maximal mouth opening. Patients had a preoperative maximal interincisal opening of 9-20mm, and the maximal mouth opening of 34-39mm was obtained after surgery. The authors stressed that early postoperative opening exercise, active postoperative physiotherapy, and strict follow-up were essential to prevent postoperative adhesions.

Authors	Type and number of animals	Type of graft	Maximal mouth opening at 3 months after ankylosis	Maximal mouth opening at 3 months after reconstruction	Complications or recurrence
Tuncel and Ozgenel,2011	New Zealand rabbit(24)	Human amniotic membrane	1.03mm	2.52mm	Deviation
Shimizu et al,2006	Merino sheep(5)	Masseter muscle	35.4mm	48.8mm	Infection (1)
Ogi et al,1997	Merino sheep(4)	Fresh disc allograft	58.5mm	61.5mm	No

Table 2: the summary of some experimental reports.

Balaji [8] evaluated the long-term results of temporalis muscle flap interpositioning with submandibular anchorage and costochondral graft in the management of TMJ reankylosis. They used the method in 31 patients who had recurrence of ankylosis after gap arthroplasty with a mouth opening less than 5mm. The patients were followed for 6 years in that study and mouth opening of 38mm was obtained. In the study the temporalis muscle flap with costochondral replacement of the temporomandibular joint was found to be an ideal interpositional material due to its close proximity to the site, good vascular supply and minimal risk of nerve damage.

In 2009 Bayat [10] stressed that the gap arthroplasty with temporalis muscle flap as an interpositional material was an effective method in the treatment of TMJ ankylosis. Also they suggested that the osteoarthrectomy of the callus to create at least 10mm gap and enough bulk of temporalis muscle flap as interpositional graft and follow the patients by at least a 6 months physiotherapy which play an important role in prevention of reankylosis.

In 2010 Yazdani [11] compared temporalis myofascial flap(10 cases) with dermal graft(10 cases) during a short-time follow-up. The dermal graft was harvested from the abdominal region in this study and trauma was the common cause in the cases. There was no statistically significant mouth opening results between the two procedures and the clinical outcomes of the 2 procedures were the same.

There have been various reports with costochondral graft in the literature [12-17]. Of these, Saeed [12] reported a retrospective study including 49 patients treated with costochondral graft and 50 patients treated with alloplastic materials. They found costochondral grafting method was greater than alloplastic reconstruction in terms the incidence of recurrent ankylosis in patients having several operations. The authors recommended TMJ reconstruction with alloplastic materials in patients with a history of ankylosis, multiple operations, and after previous alloplastic joints. In another study the same authors suggested that costochondral graft should be preferred in the growing child and initial reconstruction in many adult deformities although it has the potential problems [13].

In the study performed by Erol [14] costochondral graft was compared with gap arthroplasty in the management of TMJ ankylosis. Gap arthroplasty was applied in 34 of the 59 cases and interpositional arthroplasty with costochondral graft was used in 25 cases. Reankylosis was noted in 3 cases (5%) in whom gap arthroplasty had been used. The other complications were temporary and mild degree facial nerve paresis postoperatively was observed in 10 cases. The authors suggested that gap and interpositional arthroplasties had only little different on outcome, and also radical and sufficient resection of the ankylosed bone, early postoperative exercises and close follow-up of the patient play important roles in the prevention of postoperative adhesions and reankylosis.

Zhi [15] treated twenty-five patients with gap arthroplasty, 17 patients with interpositional material using remainder of the disc, costochondral graft in 5 cases, and temporalis fascia flap in 3 cases. The recurrence rate was 7.14% (3 cases), in the bilateral cases which received a gap arthroplasty. The statistically significant maximal mouth opening values were obtained in the remaining cases. Temporary and mild-degree facial nerve paresis were observed in 3 cases but there was no permanent one and no case of Frey's syndrome. The authors stressed importance of restoring the normal structure of the TMJ and considered using the remains of the disc and temporalis superficial fascia flap were effective methods.

The study performed by Manganello-Souza [16] presented 14 patients who had aetiology of trauma(4 cases), ear infection(2 cases), systemic infection(1 case), congenital(1 case) and unknown(6 cases). Costochondral graft was used in 9 patients. The alloplastic material was used in others. The alloplastic material group included more aged patients. They found one case of recurrence occurred in the first group and no recurrences in the second group.

Medra [17] have replaced the resected condyles with costochondral grafts and the patients were followed clinically and radiologically for 7-10 years. The author found good remodeling in 50(59%), reankylosis in 8(9%), resorption of the graft in 21(25%) and overgrowth of the graft in 3(4%). Mouth opening was satisfactory in 32 of the 55 patients and the operation was a failure in 13(24%). They suggested costochondral graft had the need for an additional operation that caused morbidity at the donor site and a subsequent unpredictable pattern of growth. The early postoperative status of the graft was difficult to establish because the cartilaginous portion was radiolucent and particularly in children, the rib was poorly calcified and the graft might not be easily identifiable.

Tripathy [18] have used costochondral graft in 7, temporalis fascia in 9 and alloplastic material in 11 patients. The postoperative period was uneventful in all cases and none required reoperation for recurrence. They obtained the mouth opening more than 50mm in 5 patients of the 7 patients used costochondral graft. In the temporalis fascia group, the same value was achieved in all patients. They suggested interpositional arthroplasty, especially with the pedicled temporal fascia flap was the best method to prevent recurrence and establish enough mouth opening.

The other methods described in the literature for TMJ ankylosis are skin graft and dermal-fat graft. Chossegros [19] reported the reliability of the full-thickness skin graft with satisfactory results in 20 patients with follow-up longer than one year. Thangavelu [20] advocated versatility of full thickness skin-fat graft as an interpositional material in the management of TMJ ankylosis. The success rate was 100% in that study for up to 2 years following ankylosis release and they obtained maximal mouth opening from 0-8mm to 27-44mm at follow-up. The full thickness skin graft with subcutaneous fat could fill the dead space within the joint cavity. Dimitroulis [21] used dermal-fat graft to fill the resultant gap after removing of a segment of bone and fibrous tissue between glenoid fossa and neck of the mandibular condyle in 11 adult patients. The average interincisal opening was 15.6mm on presentation which improved to an average of 35.7mm following surgery. Reankylosis was identified in only one patient treated with dermis-fat grafting method. In these 3 studies the skin graft and dermal graft were advocated to have a minimal donor site morbidity because of primary closure. Although the main disadvantage of the method has a potential of developing an epidermoid cyst [18,19], Chossegros suggested the skin quality might implicate in the occurrence of this complication. Another important disadvantage of this method, it might not maintain ramus height adequately.

The other method is costal cartilage graft that was used by Demir [22] and Huang [23]. According to these authors, the disadvantages of costochondral graft are the poor quality of medullar and cortical bone, the possibility of resorption or infection, bone flexibility, elasticity that may cause the graft to be deformed, possible separation of the cartilage from the bone, and occasional fractures. The authors also criticized the other methods including dermis, skin-fat, muscle and auricular cartilage grafting and suggested that these methods could not obtain ramus height sufficiently and although they may protect against reankylosis, there might be a risk of restricted mouth opening.

Auricular cartilage has been used to replace the TMJ meniscus by Zhou Lei [24]. The author reported seven patients who had aetiology of trauma (5 cases) and ear infection (2 cases). The patients were treated with autologous auricular cartilage graft. At 6-year period, no relapse occurred and no deformities resulted in the ear from which the cartilage graft had been harvested. Although auricular cartilage is considerably easy and safe method and have a low risk of donor-site morbidity, the graft may tear or perforate under pressure from the condyle postoperative period. Also the graft may show some degree of cartilage proliferation and may not maintain ramus height well when the wide resection of ankylotic mass require.

The mandibular coronoid process as a bone graft has been widely applied in the cranio-maxillofacial field for a long time [25]. In the surgery of TMJ ankylosis, it is mandatory to perform a complete resection of coronoid process to avoid a possible reankylosis. Song-song Zhou used autogenous coronoid process for condylar reconstruction in patients with TMJ ankylosis [25]. The authors obtained satisfactory clinical outcomes and suggested autogenous coronoid process may be a suitable bone resource for condylar reconstruction in patients with TMJ ankylosis. Avoiding the patients from second surgical site and donor site morbidity, longer and thicker in patients with TMJ ankylosis, and have less bone resorption owing to its membranous origin are the advantages of this method. The main disadvantage of the method is whether the coronoid process is involved by the ankylosed bone. This situation restrict to use of this graft. Therefore the method can be suitable to use in only type 1 and 2 ankylosis cases.

In 1998 Ozcan [26] used free microvascular transfer of the metatarsophalangeal joint in treatment of TMJ ankylosis. The patient had a history of trauma when he was 7-year old. A condylectomy procedure was performed in another hospital. The authors criticised the use of other biological materials to be the inability to preserve the vertical height of the mandibular ramus, and open-bite deformity may develop. In this study, free vascularized joint could retain its normal gross and histological architecture and development. So it can be preferred in growing patients. As it is a vascularized structure, the risk of degeneration and reankylosis is low. However free transfer of the joint may require some facilities and equipment, and it can be used in only selected patients who are suitable for free flap surgery.

The other method described in the literature is total joint replacement with alloplastic materials. Karaca [27] have used custom made inverted T-shaped silicone implants for 10 years. The cause of ankylosis was trauma in all patients. Preoperative interincisal opening was mean 7mm and postoperatively 23.1mm. The authors obtained excellent long-term postoperative results in 6 patients. Jones [28] also used alloplastic material for reconstruction of TMJ. The results of this study show an increase in mandibular opening from the preoperative average of 14.4mm to an average opening of 29.7mm postoperatively. There was no tendency towards open bite. Kanatas [29] used custom-made joint prosthesis system for total reconstruction of the joint. They obtained a significant improvement in maximal mouth opening at the time of 12-month follow-up.

Total alloplastic reconstruction can be indicated for serious joint disease caused by osteoarthritis, rheumatoid arthritis, tumour and in the patients who had several operations for TMJ ankylosis. Hypersensitivity can also present a problem, with nickel, cobalt and chromium being the most common sensitizing agents in humans. This situation may be the trigger for unfavorable results with total reconstructions [28]. Metal-on-metal joints also lead to considerably more cobalt and chromium in the body and the long-term effects of

this accumulation are not known, therefore it may lead to an increase in cell toxicity, hypersensitivity and carcinogenesis [28]. The occurrence of metal hypersensitivity is significantly greater with the metal-on-metal joints. The wear particles from these metals have been shown to be a problem [28,29].

We have also reviewed three experimental studies with the same ankylosis and treatment modalities. Of these, in the study performed by Tuncel and Ozgenel the authors used human amniotic membrane (HAM) as an interpositional arthroplasty material in rabbits [9]. In that study, the considerably improvement of mouth opening was obtained after release. There was a statistically significant difference in the jaw movements between control and study groups. This was supported by histological and radiological investigations, as well. The results obtained from the study suggested interpositional arthroplasty with HAM was superior to gap arthroplasty in the rabbit model in preventing reankylosis. The method is inexpensive and has no donor site also has a low risk of infection. However the method is lack of the ability to achieve adequately ramus height of the mandible. Although various clinical and experimental studies suggest that the epithelial cells of human amnion may be immunologically inert, there have been reports to suggest cryopreserved amniotic membrane was superior to dehydrated amniotic membrane [9].

In another experimental study Shimizu [30] used the masseter muscle flap as an interpositional material in TMJ ankylosis in five Merino sheep. The maximal mouth opening remained at the preoperative level and histologically the muscle remained partially vital and partially changed to fibrous tissue also some fibrous tissue formation was observed between bone ends. The study showed that a muscle flap after gap arthroplasty for TMJ ankylosis may restore TMJ function clinically, radiologically and histologically and may cover as a barrier all the bones of the temporal and mandibular surfaces. It has not been reported how long a muscle flap survives in the TMJ [30]. It is reasonable that muscle tissue would change to fibrous tissue unless it functions as a muscle. Temporalis muscle flaps in humans also probably atrophy over a long period [30].

Ogi [31] aimed to evaluate the effect of fresh disc allograft on the osteoarthrotic TMJ in four sheep. After inducing osteoarthrosis, unilateral discotomy and fresh disc allograft repair was performed in that study. The fresh disc aseptically was harvested from the right TMJ of fresh sheep cadaver head. They found that the operated joint was fibrously repaired without ankylosis, whereas the control joint showed progressive disease. Although immunosuppressive agents were not administered, there was no immune response in the grafted joints. Ochi [32] stated that a fresh allografted meniscus is not immunogenic in mice and it may be transplanted without any special treatment to decrease its immunogenicity. The result of the study suggested that fresh allografts in the osteoarthrotic TMJ would prevent fibrous ankylosis and repair the joints fibrously in the early stages after grafting. Further long-term studies are necessary to evaluate the biologic outcome of the disc allografts.

It has been shown that keeping the disc has important effect in preventing TMJ ankylosis in animal studies [33]. Goldmann [34] suggested that the extravasation of blood into the joint, along with disruption of fibrocartilage integrity, permits the ingrowth of fibrous connective tissue into the joint, which subsequently results in ossification. Condylar fracture, destruction of the condylar cartilage, fragmented and displaced disc and the limited mandible movement are the reasons for TMJ ankylosis [35]. According to the literature, the early diagnosis and surgical intervention is an accepted mode of the

treatment [33]. The early operation can restore joint function, improve aesthetic appearance, and relieve respiratory obstruction. Thus, the disc have a protective feature against the fibrous ankylosis or the peripheral fibrous tissue observing after trauma. It is very important to restore early the normal structure of the TMJ and preserve the disc in order to prevent recurrence of traumatic TMJ ankylosis.

We have used human amniotic membrane as an interpositional material in our former experimental study and there were many reasons for our preference for using HAM in treatment of TMJ ankylosis [9]. It has been used to cover surgical wounds, burns and ulcers in various parts of the body with satisfactory results for the reconstruction of conjunctival defects, in the ear surgery and in vaginal epithelialisation[36-38]. HAM which had been used in our study didn't carry any donor area problem. It has distinction according to autologous materials as a material which can be obtained easily, has no strange-object reaction, can be saved by freezing when it's necessary and doesn't carry any infection risk [39,40]. Alloplastic materials as histologically can cause thickening in sinovium related to sinovial cell proliferation, inflammatory cell infiltration and edema [25,26]. When HAM is compared with alloplastic materials, especially, obtaining it is much more easy and the cost of HAM is very low. We can mention as the other superior features as, they don't have any foreign body reaction and infection risks. Postoperative adhesion and fibrosis can highly impress the results of surgery in TMJ ankylosis treatment. HAM have been used for preventing from adhesion development after from different operations in abdominal area and pelvis, also it had been used for epithelialization [9]. HAM pressurizes the function of transforming factor beta which is secreted from fibroblast and macrophages for injury improving and has different functions especially in collagen remodeling phase of injury improving [9]. So, it is thought that it can prevent from adhesions as a barrier and with an antiinflammatory effect. Furthermore, HAM has an antibacterial feature and it doesn't give rise to acute or chronic rejection responses because of it hasn't antigenic HLA-A,B,C and DR antigens on itself [40]. Other biologic materials such as temporalis fascia, costochondral graft, auricular cartilage or costal cartilage have no these features of HAM. These materials can only be useful as a barrier in the TMJ surgery. Although temporalis muscle flap is presented as the best interposition material in especially adults, dissecting temporalis muscle can cause scar contracture of the donor site, also the muscle may be too soft to resist the compression of the ramus [21-23]. Therefore this flap might not also reserve the ramus height and deviation or laterognatia may be seen during postoperative period. Also HAM and other biologic materials have the inability to achieve ramus height of mandible adequately, as well.

We suggest when HAM used as an interface material together with any of these materials especially costal cartilage or costochondral graft, it may provide more benefit in preventing reankylosis. However HAM as an interpositional material in tmj ankylosis treatment has not yet been used in human beings and all the statements are theoretical only. Therefore in especially younger patients we consider preserving the disc by disc repositioning when not invased with ankylotyc bone and if invased, using costochondral graft or costal cartilage with cryopreserved human aminotic membrane to interface material in the treatment of type 1 and 2 early stage of TMJ ankylosis.

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