Treatment of temporomandibular joint ankylosis by a modified fossa prosthesis

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SUMMARY. Background and objective: Treatment of temporomandibular joint ankylosis is a challenge and suffers from a high incidence of recurrence. Although treatment of ankylosis has been tried as early as nearly 200 years ago, no single technique produced satisfactory results. An alternative technique and a modified spacer system are described in this paper. Material and methods: Fifteen patients, nine of whom had unilateral and the remaining six had bilateral ankylosis were evaluated. Modified fossa implants were used in all cases. Results: The highest incidence of ankylosis was observed in the 11–20 year age group (nine patients). Falls during childhood was the common aetiological factor. Eight patients had been previously operated upon. Postoperative interinsicial opening values were remarkably different from the preoperative ones and the long-term results were satisfactory. Conclusion: With continued research and development in the treatment of ankylosis, temporomandibular joint implants will become more predictable and reliable. This specially designed fossa implant seems to be promising in the treatment of TMJ ankylosis. © 2004 European Association for Cranio-Maxillofacial Surgery.

Keywords: Temporomandibular joint; Ankylosis; Arthroplasty; Fossa implant; Spacer

INTRODUCTION

Temporomandibular joint ankylosis is a disabling condition of the masticatory system and is most commonly due to trauma, infections and some systemic diseases. Hypomobility affects surrounding structures as well as the joint itself. Ankylosis arising in early childhood usually leads to facial asymmetry and in rare cases also to upper airway obstruction or obstructive sleep apnoea. The maxilla is usually affected secondarily, with shortening of the posterior facial height. Thus facial asymmetry is the classic feature in unilateral cases. The chin deviates towards the affected side, and the vertical height of the affected side is reduced when compared with the unaffected side.

Secondary effects on the soft tissues surrounding the mandible occur in the form of shortening of the pterygo-masseteric muscle sling and the ligaments attaching the mandible to the skull base (sphenomandibular and stylomandibular; El-Sheikh et al., 1996).

The masticatory muscles may become hypertrophic as a result of long-standing isometric contractions. Hypertrophy of the temporalis muscle may lead to thickening and elongation of the coronoid process. For this reason, coronoidectomy is required in long-standing cases. The suprhyoid muscles also become shorter and hypertrophic as they try to pull the chin inferiorly and simultaneously posteriorly causing shortening of the chin–hyoid distance, and thus contributing to partial obstruction of the airway (El-Sheikh et al., 1996).

The degree of recession and asymmetry of the mandible depends on the growth condition and the time of onset of ankylosis. On the other hand, complete limitation of the mouth opening and symmetrical recession of the chin are typical characteristics of bilateral ankylosis. Timing, the type of operation, and the policy of treatment vary from one country to another. However, the main principles include resection of the ankylosed segment, use of interpositional material, plus early, aggressive and persistent postoperative physiotherapy.

According to Verneuil (1860), the first arthroplasty was made by Percy and Barton in 1826. Verneuil was the first to suggest the interposition of muscle and fascia between the bones and many other materials like cartilage (Kummoona, 1978), muscle and dermis (Topazian, 1966), fat (Murphy, 1914), or fascia (Narang and Dixon, 1975). Metatarsal (Stutville and Larfranchi, 1955) and sternoclavicular joints (El-Sheikh, 1996) were proposed for TMJ arthroplasty. Numerous alloplastic materials have been used for partial and total reconstruction of the temporomandibular joint to prevent re-ankylosis. They were either made of silicone, acrylic, polyoxymethylene, ceramic or various metals, (Cobey, 1967; Borçbakan, 1968; Christensen, 1971; Davis and Jones, 1971; Tauras et al., 1972; Kent et al., 1983; Szabo et al., 1990).
Variable success rates for TMJ prostheses have been reported. Few reports included short follow-up periods. Failure and success were not clearly defined. In this paper, the use of a modified fossa implant composed of titanium mesh and acrylic for the treatment of TMJ ankylosis will be described and their long-term consequences will be presented.

PATIENTS AND METHODS

The survey is based on 15 patients who were treated between 1985 and 2000. The factors evaluated were sex, age, cause and type of the ankylosis, preoperative and postoperative maximum interincisal distances (Table 1).

All 15 patients had a history of trauma and the differentiation regarding degree and severity of the ankylosis process was made according to the classification of Sawhney (1986, Table 1). Falling during childhood was the most common aetiological factor in this study (10 patients). Two more patients had been injured in traffic accidents and their disorders were attributed to inadequate treatment of maxillofacial injury after the accident (Table 1). Three more patients were unable to provide details regarding the aetiology of ankylosis.

Surgical technique

Patients were operated upon under general anaesthesia using nasal intubation. Retro- or preauricular incision was used to avoid injury to the superficial temporal vessels and the facial nerve. The dissection proceeded to the zygomatic arch and extended anteriorly and posteriorly to expose the ankylosed TMJ. The periosteum covering the zygomatic arch and ramus was incised and elevated. Following exposure the bone was drilled using a round bur until thin, just cortical bone was left in the wound depths. The two segments were gently split to avoid injury to the internal maxillary artery or pterygoid plexus of veins. The irregular edges of the segments were smoothed (shaved) by a bur and the ramus was completely disconnected from the upper bony block. The coronoid process was resected together with the ankylosed bony mass in long-standing cases (Table 1).

In all unilateral cases, the contralateral TMJ was mobilized effectively immediately after mobilization of the ankylotic side, in spite of having remained almost functionless for many years.

A modified fossa implant composed of a titanium mesh and acrylic was used as a spacer to prevent reankylosis (Figs 1 and 2). Data from a 3-D CT was used to create a custom made and well fitted fossa implant. It was shaped using pink wax prior to surgery. The wax model adhered to the titanium mesh bar and was converted into a custom fitting implant using heat cured acrylic applying conventional laboratory techniques. The implant was steam...
sterilized and minor adjustments during the operation were easy using a micro motor and pliers. Availability of more than one pre-prepared custom implant of slightly different size reduced the adjustment time during surgery. The acrylic fossa implant was secured to the upper (stabile) segment with three or four self-tapping screws after creating a gap (Fig. 2). However, lateral decortication was not necessary to improve the fit of the prosthesis, since it was easy to bend and shape with the titanium plate.

After the operation, patients were encouraged to do vigorous exercises. Although physiotherapy was painful during the first week, most of the patients tolerated the therapy in time. Furthermore, different types of gags were used to increase mouth-opening gradually (Güven, 2000).

RESULTS

All patients presented gross malocclusions with poor oral hygiene. Nine patients had unilateral and six had bilateral ankylosis. Most patients (8) with ankylosis were in the 11–20 age group; followed by five patients in the 21–30 age group and two patients were under 14. Of the falls during childhood, two suffered an accidental fall at the age of 2, two at the age of 3 and two other patients at the age of 4. Eight patients had been previously operated to release ankylosis. Six of these had been treated by gap arthroplasty. Spherical acrylic spacers (Borbakan, 1968; Güven, 2000) and silastic sheets were removed in two more patients who had undergone previous surgery. In four patients, the retro-auricular, and in three the preauricular approach was used, the intraoral approach was used in addition in seven patients with severe ankylosis (Table 1). Five patients had bilateral and four had unilateral coronoidectomies as well.

Preoperative and postoperative interincisal distances were remarkably different and satisfactory results were achieved in the long-term follow-up (Figs 3 and 4). However, there were slight differences between the immediate and long-term results (Table 1).

DISCUSSION

Trauma, particularly in childhood is the predominant factor in TMJ ankylosis (Güven, 1992). Up to the second year of life, there are many vascular channels within the condylar head, but they vanish shortly thereafter (Myall, 1994). Active movement of the mandible is particularly important in preventing ankylosis in this highly vascularized and osteogenic environment. There is an enormous potential for regeneration and reshaping in children compared with adults and even adolescents (Murphy, 1914; Güven and Keskin, 2001). According to Raveh et al. (1989), the type of condylar fracture is not very important for the development of TMJ ankylosis,
Fig 3 – (A) Preoperative mouth opening of 16 year old girl (Case No: 8) with unilateral ankylosis (left) and mouth opening of the same patient, 6 years postoperatively (right). (B) Preoperative facial frontal view (left) and frontal view at completion of treatment (right). (C) Preoperative (left) and postoperative lateral view at completion of treatment (right). (D) Preoperative (left) and postoperative radiograph of fossa (right).

Fig 4 – (A) Preoperative CT of 7-years old girl (Case No: 14) with bilateral ankylosis. (B) Fossa implants 6 months postoperatively (orthopantomogram). (C) Postoperative mouth opening after 6 months (left) and 3 years (right). (D) Postoperative frontal view reveals no evidence of abnormal growth.
and surgical treatment of condylar fractures is essential even in childhood. In contrast to the study by Raveh et al. (1989), Güven and Keskin (2001) reported successful results achieved by conservative management of condylar fractures in children. TMJ ankylosis can be prevented by early diagnosis and proper early treatment of condylar fractures.

Interposition arthroplasty for TMJ ankylosis has been in use for over 100 years; Risdon (1934) used gold foil. Later, Eggers (1946) used tantalum foil, whilst Borchakan (1968) and Sawhney (1986) reported acrylic spacers for treating ankylosis. The purpose of using mobile spacers was to enable free movement of the mandible. But, if an alloplastic prosthesis is not stable at the time of implantation, it may fail. Poor fixation of the prosthesis will promote loosening of the device during function and finally failure (Mercuri, 2000).

Some authors concluded that reconstruction with alloplastic condylar prostheses may lead to a predictable result in treatment of functionless TMJs. Gold (Tauras et al., 1972), stainless steel (Spießl et al., 1976), vitallium (Silver et al., 1977), and ticonium (Kent et al., 1983) were used for this purpose. But the possibility of glenoid fossa erosion was the major problem with this type of prosthesis. The use of some auto-grafts has also been reported for the treatment of ankylosis (El-Sheikh and Medra, 1997; MacIntosh, 2000). However, the difficulty in fixing the metatarsal bone to the mandibular fragment, and excessive growth of costochondral grafts in younger patients were the disadvantages of these techniques. According to Mercuri (2000), placing autogenous grafts which can grow and remodel makes no sense particularly in patients with ankylosis. This is why, in orthopaedic surgery, alloplastic joint reconstruction is always preferred in similar situations (Mercuri, 2000).

A total TMJ prosthesis was first described by Kiehn et al. (1974). In that paper, they reported a single case, but in the following years they reported 28 patients treated with total joint prostheses made of vitallium (Kiehn et al., 1979). Kent et al. (1983) reported on a TMJ prostheses comprising a fossa made of a fluorinated ethylene propylene and a chrome-cobalt condyle. However, failure of the implant became such a problem that manufacturing ceased (Vitek) in 1990 (Speculand et al., 2000). In the ensuing years, Mc Bride (1992), Cope et al. (1993) and Mercuri (2000) reported different total TMJ implants with various success rates.

The first reported fossa implant was metallic (Christensen, 1963). Then, Christensen (1972) reported almost 160 implants with a 98% success rate. In the following years, Besette et al. (1985) described silicone fossa implants and then, Chase et al. (1995) reported placement of Christensen fossa implants, made of vitallium, in patients with internal disarrangement or degenerative joint disease. Speculand et al. (2000) reported their experiences with the Vitek VKII and demonstrated histological evidence of a foreign body reaction in four cases.

In this study, a fossa implant composed of a titanium mesh and acrylic was used to prevent re-ankylosis. Heat cured acrylic and titanium are well known in maxillofacial surgery having been used separately for a long time as spacers without any complication (Borchakan, 1968; Sawhney, 1986). Therefore, a spacer made of titanium mesh and heat treated acrylic should not cause any foreign body reaction. Wolford et al. (1994), found that the foreign body giant cell reaction to Proplast-Teflon implants was proliferative, and worsened in time as more particles were generated. Abnormalities in lymphocyte subset ratios were also found which then improved towards normal when the Proplast-Teflon implants were removed and replaced with the Techmedica custom-made total joint prosthesis (Speculand et al., 2000). It is still not clear whether the foreign body reactions were caused by the particulate matter from wear of the artificial articular surface (Kent et al., 1983; Speculand et al., 2000). One of the most important considerations for evaluating any type of implant is failure. In this study group, not a single immediate or late rejection was encountered, and none of the implants has had to be removed so far.

Two different approaches were proposed for the treatment of ankylosis. The meticulous and radical elimination of the ankylosis was recommended by Raveh et al. (1989) and Kaban et al. (1990): An incomplete removal of the ankylosed bone would lead to re-ankylosis. The resulting opposing surface areas of healing bone, therefore, are considerable and scar tissue may form between them. Radical resection and complete removal of the ankylosed bone may be the logical alternative. However, the risk of aggressive surgery is considerable and the advantage gained is marginal, since complete elimination of the ankylosed bone still creates an extensive area of healing bone where scar tissue inevitably will form (Salins, 2000).

In subankylosmic approaches, a pseudoarthrosis is encouraged below the base of the ankylosed mass. Therefore in this series, the ankylosed bone was removed as far as possible, and a generous gap was created. In long-standing cases the coronoid process was resected as well. Additional resection of the contra-lateral coronoid process via the intra-oral approach improved mouth opening and facilitated post-operative rehabilitation.

Most interpositional, alloplastic grafting techniques provide very limited augmentation of ramus height. In this study, however, the thickness of the acrylic parts of the implant was adjusted appropriately during the manufacturing stage in the laboratory. More than one pre-prepared, custom-made implant that slightly differed in size were made available for the operation.

The follow-up period ranged from 18 months to 8 years. Eleven patients have been followed up for 4 years or more. The average interincisal distance was 38 mm with minimum of 34 mm as measured long-term (Table 1).
Screws fixing an implant may loosen with time and function. However, stability of an implant depends not only on fixation but also on adaptation of the implant to the bone to which it is fixed. Clinical experience has shown that the better the adaptation of the fossa implant to the bone, the more stable the implant and the longer the device will survive under function (Swanson and Freeman, 1977).

The effect of TMJ implants on facial growth in childhood is still debated. In this study, there were only two patients under the age of 14 (Table 1). These have been under surveillance for 3 years, but no evidence of abnormal jaw growth has been detected (Fig 4d). The main objective in growing patients with treated ankylosis is to provide normal jaw function following release. This will prevent re-ankylosis and should promote normal growth.

CONCLUSION

The occurrence of TMJ ankylosis is closely related to the cultural and economic environment of the patients. Early onset of ankylosis can be a deterrent to normal mandibular growth. The fossa implant presented is readily available and is not expensive. Titanium mesh is available in most maxillofacial units and to produce a custom made implant of different sizes is not a time consuming process in the laboratory. The implant presented here provides free anterior, posterior and lateral excursions of the mandible. With continued research and development in this field, TMJ implants will become functionally even more stable, predictable and reliable in severe anatomical disorders and disabling conditions of the TMJ.

References


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