

## Reconstruction of the temporomandibular joint autogenous compared with alloplastic

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**SUMMARY.** The aims of and indications for temporomandibular joint (TMJ) reconstruction are well-established but the method of reconstruction is controversial. We describe a retrospective, two-centre audit of 49 patients treated with costochondral grafting and 50 patients treated with alloplastic joints. The characteristics of the patients were similar in both centres and the minimum follow-up period was 2 years. For each patient a number of variables were recorded including both subjective scores (pain and interference with eating) and objective data (interincisal distance). Patients in both groups showed an improvement in symptoms but more patients required reoperation in the autogenous group.

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### INTRODUCTION

The indications for reconstruction of the temporomandibular joint (TMJ) include ankylosis, severe osteoarthritis, rheumatoid arthropathy, neoplastic disease, posttraumatic dysfunction, and congenital disease.<sup>1–4</sup> The aims of reconstruction include the restoration of mandibular function and form, decreased patient disability and suffering, and the prevention of disease progression.<sup>3</sup> The method of reconstruction, however, is controversial and numerous techniques both autogenous (fibula, metatarsal, sternoclavicular, iliac, and costochondral) and alloplastic (acrylic, synthetic fibres, ulnar head prosthesis, compressible silicone rubber, and total joint systems) have been described.<sup>4–6</sup>

The most widely accepted autogenous technique is a costochondral graft, and as stated by MacIntosh<sup>7</sup> the advantages of this graft are its biological compatibility, workability, functional adaptability, and minimal additional detriment to the patient. The growth potential of the costochondral graft makes it the ideal choice in children.<sup>8,9</sup> Potential problems include fracture, further ankylosis, donor site morbidity, and the variable growth behaviour of the graft.<sup>10</sup>

To avoid these problems a number of alloplastic materials and systems have been developed for use in reconstruction of the TMJ.<sup>11</sup> Alloplastic joints are said to allow a closer reproduction of the normal anatomy of the

joint (with restoration of vertical dimension), avoidance of donor site morbidity, reduction in operation time and reduction in the chance of recurrent ankylosis. All these factors allow immediate physiotherapy and rehabilitation with consequent increased benefit to the patient.

The potential disadvantages of alloplastic reconstruction relate mainly to wear or failure of the material. Wear particles can generate a giant cell foreign body reaction with potential loosening of the implant, resulting in occlusal change or displacement or fracture.<sup>4,7,12</sup> Other problems relate to long-term stability, cost, dystrophic bone formation, and lack of growth which precludes the use of such joints in children.<sup>3,13</sup> With the exception of Henry and Wolford<sup>14</sup> there seem to be few reports comparing autogenous and alloplastic reconstruction of the TMJ. The objective of this study was to make a direct clinical comparison of these two options.

### PATIENTS AND METHODS

We reviewed the casenotes of all adult patients who were given costochondral grafts for reconstruction of the TMJ under the care of JNK at the Louisiana State University Medical Centre from 1986–1997. A similar review of patients who had their TMJs reconstructed with the Christensen alloplastic joint system (TMJ Implants Inc., Golden, CO, USA) at Cheltenham General Hospital or

Gloucestershire Royal Hospital from 1994–1999 was undertaken. All operations were either done by or supervised by consultants.

For each patient a number of variables were recorded, including their demographic details, the initial diagnoses (before any surgical intervention), the preoperative diagnoses, the previous surgical history, any complications, and the follow-up period.

Objective assessment was recorded as the interincisal distance (millimetre) both preoperatively and at each follow-up appointment. Subjective data were recorded as visual analogue scales for pain and interference with eating. In terms of pain a scale of 1–10 was used (1 = least, 10 = worst) and in terms of interference with eating a 1–4 scale used (1 = liquid diet, 2 = soft, 3 = restricted, 4 = normal). Any operation after reconstruction was noted. Patients were included only if complete data sets were available and if there was a minimum follow-up period of 24 months.

For costochondral grafting surgical exposure was usually by combined preauricular and submandibular incisions. After complete debridement of the TMJ the rib graft was shaped and attached to the lateral border of the ramus (or to the posterior border if the graft was straight) by 4–6 screws. A soft tissue graft (usually perichondrium) was placed between the glenoid fossa and the rib cartilage. Immediate postoperative physiotherapy was given and night-time intermaxillary fixation was often required for 3 months.

The surgical technique for placement of the Christensen joints has been described elsewhere<sup>15</sup> and access was by a preauricular and a lower border incision. The latter incision was just below the lower border of the mandible and the dissection included identification of the marginal mandibular branch of the facial nerve. In both groups of patients ankylosis was treated by the addition of coronoidectomy. Operating time was usually 2–3 h and patients were usually discharged from hospital after 3 days.

## Statistical methods

Paired data were analysed by the Wilcoxon signed ranks test and the unpaired data by the Mann–Whitney *U* test.

## RESULTS

### Patient details

A total of 99 patients fulfilled the inclusion criteria. Around 49 patients had costochondral grafting and 50 patients were treated with the Christensen joint system. The 49 patients treated by autogenous reconstruction

**Table 1** Initial diagnoses

Diagnosis	Autogenous	Alloplastic
Degenerative joint disease	5 (10)	10 (20)
Rheumatoid arthritis	4 (8)	6 (12)
Internal derangement	26 (53)	15 (30)
Trauma	10 (21)	12 (24)
Congenital disease	3 (6)	1 (2)
Other	1 (2)	6 (12)
Total	49 (100)	50 (100)

Figures are number (percentage) of patients.

were given 66 costochondral grafts (17 left, 15 right, 17 bilateral). The male:female ratio was 1:6 (7 men to 42 women) and the mean age at the time of operation was 38 years (range 16–67). The minimum follow-up period was 2 years with a mean of 49 months (range 24–94). The 50 patients treated by alloplastic reconstruction were given 68 joints (15 left, 17 right, 18 bilateral). The male:female ratio was 1:4 (10 men to 40 women) and the mean age at the time of operation was 38 years (range 21–68). The mean follow-up period was 43 months (range 24–82).

### Initial and preoperative diagnoses

The initial diagnoses (before any surgical intervention) is shown in [Table 1](#) and the immediate preoperative diagnoses in [Table 2](#). The range of diseases was similar in both groups, internal derangement being the most common diagnosis before any intervention. The major diagnosis before reconstruction was ankylosis or degenerative joint disease and the proportion of each differed between the two groups. The number of previous operations varied from 0 to 9 (mean 2) for the autogenous group and from 0 to 16 (mean 2.5) for the alloplastic group.

### Objective and subjective assessment

The mean changes in pain and interference with eating scores are shown in [Table 3](#), as are the changes in interincisal opening. The changes in all three variables were highly significant ( $P < 0.001$ ) in patients treated by

**Table 2** Preoperative diagnoses

Diagnosis	Autogenous	Alloplastic
Degenerative joint disease	5 (11)	24 (48)
Rheumatoid arthritis	2 (4)	5 (10)
Ankylosis	35 (71)	15 (30)
Erosion	3 (6)	1 (2)
Congenital disease	2 (4)	0 (0)
Other	2 (4)	5 (10)
Total	49 (100)	50 (100)

Figures are number (percentage) of patients.

**Table 3** Mean (SD) changes in outcome variables before and after operation

Reconstruction	Number of patients	Preoperative			Postoperative		
		Diet	Pain	Opening (mm)	Diet	Pain	Opening (mm)
Autogenous	49	2.3 (1.0)	7.6 (2.8)	23.2 (11.7)	3.0 (0.9)	3.8 (2.7)	24.6 (8.1)
Alloplastic	50	2.0 (1.0)	6.7 (2.9)	17.1 (9.5)	3.6 (0.8)	2.4 (3.3)	25.2 (8.9)

alloplastic reconstruction. In the costochondral group the changes in pain and diet scores were also highly significant ( $P < 0.001$ ) but the change in opening failed to reach significance. There was greater improvement in diet scores ( $P < 0.001$ ) and opening ( $P = 0.002$ ) but not pain in those patients treated with the Christensen joint system.

### Complications and further surgery

In those patients treated with costochondral grafting 27 complications occurred in 23 patients. These included minor infection (1), malocclusion (1), fractured graft (1), neurological (2), overgrowth (3), and ankylosis (18). Recurrent ankylosis was the major problem and occurred in more than a third of the patients ( $n = 18, 37\%$ ). There were no serious donor site complications. Twenty-six further invasive procedures have been required in 18 patients including resurfacing (cleavage or soft tissue graft) in 16, removal of the graft in 5, osteotomy in 2 and total alloplastic joint replacement in 3.

In the alloplastic group there was 34 complications in 28 patients. In contrast to the autogenous group these were mainly self-limiting and temporary weakness of the facial nerve (11) or temporary altered sensation of the lip (7) were the most common. Other complications included Frey's syndrome (5), infection (1), joint dislocation (2), cold neuralgia (3) and some permanent neurological deficit (2). Joint failure has occurred in only three patients (6%) and presented with increasing pain and swelling and required eventual removal of the joints. In total six further invasive procedures have been required in six patients including coronoidectomy (1), repositioning (2), and further alloplastic joints (3). The lower rate of second operations in the alloplastic group was significant ( $P = 0.003$ ).

### DISCUSSION

Both the costochondral graft and Christensen joint system have been used for reconstruction of the TMJ relating to rheumatoid arthritis, osteoarthritis, posttraumatic dysfunction, neoplastic disease, and ankylosis (often following previous alloplastic or autogenous grafts).<sup>16–24</sup> The rationale for using the costochondral graft has been summarised by MacIntosh<sup>7</sup> and it is recognised to be a biological anatomical reconstruction with minimal

additional detriment to the patient. Certainly in children the growth potential of the costochondral graft makes it the ideal choice and as an initial reconstruction in adults with congenital deformity or arthritis it does well. It is, however, the variable biological behaviour of the graft that can cause problems including overgrowth, resorption, and particularly recurrent ankylosis.

The Christensen system now consists of a fossa and condyle prosthesis fabricated from cobalt–chrome alloy. There are 33 preformed fossa templates and the most suitable is chosen and secured to the zygomatic arch with compatible alloy screws. The condylar prosthesis is sized using a metal template and is available in 45, 50, and 55 mm lengths. This is secured to the ramus of the mandible with compatible alloy screws. The original Christensen system had a polymethylmethacrylate condylar head but since March 1997 the all metal condyle has been available and this metal on metal articulation seems to generate fewer wear particles.

In both groups of patients there was significant improvement in symptoms with a more favourable outcome in those treated by alloplastic reconstruction. Although the complication rate was similar in both groups most of those in the alloplastic group were self-limiting. In addition in the alloplastic group only one-third of the patients compared with the costochondral group have required further invasive operations and only a quarter of the number of procedures have been done. For these reasons we prefer an alloplastic reconstruction, which although biomechanical in nature, can mimic normal anatomy and restore vertical dimension. There is no donor site morbidity and immediate physiotherapy can be given.

There is no doubt that costochondral graft reconstruction of the TMJ can produce excellent results but the incidence of recurrent ankylosis and further operations are greater than alloplastic reconstruction particularly in patients having several operations.<sup>14</sup> We recommend alloplastic reconstruction in patients with a history of ankylosis, multiple operations, and after previous alloplastic joints.

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