Temporomandibular joint arthroplasty for osteoarthrosis: a series of 24 patients that received a uni- or bilateral inter-positional silicone sheet

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Purpose: To evaluate mid-term results from using a silicone sheet for inter-positional arthroplasty in moderate or severe cases of osteoarthrosis of the temporo-mandibular joint (TMJ). To also determine any remaining indications from this method.
Patients and methods: This retrospective study included patients that underwent surgery between 2008 and 2016. Pre- and post-operative mouth opening (MO), according to inter-incisal distance (mm) and pain score (PS: 0 = no pain to 4 = very severe pain) were recorded for 24 patients. Patients were divided according to thickness of the silicone sheet (group A: 1.0 mm, group B: 1.5 mm).
Results: The cohort included 22 females (92%). Mean age at surgery was 55 years ± 13 (26–80). Mean length of follow-up was 26 months ± 24 (6–80). Mean improvement in MO was 8.2 mm (+33%) and of PS was 1.7 (−68%). MO was not improved for two patients and worsened for one. PS score improved for all patients. No statistical difference was found between groups A and B. There was also a tendency for degradation of outcomes over time.
Conclusion: The poor reputation of prosthetic discoplasty was not as evident in our series, even though anatomical and functional status seemed to deteriorate over time. This is because total-joint prosthetic replacement is often proposed instead. However, for elderly or fragile patients that have severe pain, and regarding cost-benefit aspects, conventional arthroplasty can still be discussed, especially since French national health-care insurance does not yet support TMJ prosthetic replacement for osteoarthrosis.

1. Introduction

The term ‘‘osteoarthrosis’’ is frequently confused with ‘‘osteo-arthritis’’, which can be also used to characterize osteoarticular degradation caused by different aetiologies, either inflammatory or not [1]. The exact definition of ‘‘arthrosis’’ focuses on the loss of cartilaginous surface leading to structural modifications to the underlying bone. These degradations can be caused by excessive loading, a congenital abnormality, an inflammatory disease or a posttraumatic event, but is often simply caused by the normal ageing process. Osteoarthrosis of the temporomandibular joint (TMJ) is accompanied by severe alterations to the discal complex and can lead to its total destruction. There are several aetiologies for TMJ osteoarthrosis, including occlusal disturbances, post-traumatic sequelae, inflammatory disease or congenital condyle dysplasia. Osteoarthrosis sometimes occurs after TMJ previous surgery, by example for a simple discal dysfunction.

Clinical symptoms include articular noise, limited mouth opening (MO) and pain, which can be permanent and is always aggravated by mastication. One needs to distinguish osteoarthrosis from TMJ ankylosis, where there is much more severe difficulty in MO, but only minor or no pain and no articular noise. A diagnosis needs to be confirmed from a volumetric X-ray (CT scan or Cone Beam), which shows collapse of the joint space, condyle deformation, the presence of geodes or osteophytes and limited motion.

It is generally agreed that non-invasive treatments need to be tried first, such as pharmacotherapy, physiotherapy or occlusal adjustments, with or without splints [2,3]. Surgery is only proposed for severe and persistent pain and/or functional impairment. Even though some authors report good early results after a discectomy [4], Ioannides and Freihofer reported, in 1988, that a large number of studies had found progressive degradation of clinical and radiological status [5]. However, there is currently

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general agreement on the necessity for disc replacement, particularly in cases of osteoarthritis. This requires interposition of a biological or alloplastic material instead of a discal component.

Many interpositional materials have been used over the last decades [6]. Among them, Silicone sheets (Silastic®) is easy to use but have provided variable results. For each of these reconstruction methods, several complications and poor outcomes have been described, leading many to consider that total prosthetic replacement of the TMJ could be the best approach for cases of degenerative osteoarthrosis [7].

We have carried out interpositional discoplasty using a silicone sheet for many years in our department for cases of moderate or severe degenerative TMJ with permanent pain and limited MO. The primary objective of this study was to assess the technical specifications and evaluate mid-term results. The secondary objective was to discuss the benefit/risk ratio and compare this with total-joint prosthetic replacement and assess any remaining indications from this method.

2. Materials and methods

This retrospective study on TMJ surgery was performed between 2008 and 2016. We included a series of 24 patients who benefited from arthroplasty with discoplasty and inserting a silicone sheet. Thirty joints were operated on using this technique; a bilateral procedure was achieved for six patients. The inclusion criteria were patients were aged ≥ 18 years; limited MO (but > 15 mm: if it was less, the pathology was classified as ankylosis), severe pain that required daily analgesics, radiographic symptoms of osteoarthrosis but without fusion of the bone components, no previous traumatic lesions apart from those from a previous intervention, and failure of conservative treatments.

The surgical procedure was performed under general naso-endotracheal anaesthesia using a pre-auricular cutaneous approach. The joint was exposed after elevating the periosteum of the zygomatic arch and the capsule was incised using a T-shaped model. The first step was eminectomy, as described by Myrhaug [8], to enhance visibility and to permit removal of residual discal fragments. The articular surfaces were smoothed under direct vision with a condyloplasty that included the lateral and medial part of the condyle, leading to restoration of a regular interface. The height and regularity of the interface was finally checked in maximal intercuspidation position. For edentulous patients, we used their dental prosthesis, if available.

The second step of surgery was to replace the disc with a silicon sheet (Silastic®) 1.0 or 1.5 mm thick and cut into a 2.5 mm square with rounded corners. It was secured using three trans-osseous non-resorbable sutures, as shown on Fig. 1. Suction drainage was inserted for 24 h after surgery before closing the wound in layers.

All patients received a prophylactic antibiotherapy and an antalgic protocol adjusted by the visual analogue scale. They were instructed to eat a non-chewy diet for 4 weeks after surgery. Mild physiotherapy was prescribed at one month after surgery when there was limited MO. All patients were seen for least at 6 months postoperatively, and then at various times depending on aspects of individual cases.

Overall, the following parameters were recorded: aetiological context, the model of the silicon sheet (depending on its thickness), the initial postoperative evolution plus any eventual complications, length of the follow-up in months, MO (corresponding to inter-incisal distance in mm) preoperatively and at the final follow-up, and pain score (PS), scaled from 0 to 3 (no pain, light pain, severe pain, very severe pain) preoperatively and at the last follow-up.

Fig. 1. The silicone sheet in position at the end of surgery and secured by three trans-osseous silk sutures to the zygomatic arch (right side).

This study was approved by the research scientific board (DRCI) at our institution, and was designed according to the WMA Declaration of Helsinki.

2.1. Analyses

All data were recorded on an Excel sheet (Microsoft©). Statistical study included mean, standard deviation, Student test and correlation coefficient, performed on a PC laptop (Hewlett Packard©).

3. Results

All recorded data are shown in Table 1. Of the 24 patients included (two males [8%], 22 females [92%]), mean age at surgery was 55 ± 13 years (range: 26–80). The overall mean follow-up was 26 ± 24 months (range: 6–80). The aetiological factors are shown in Table 2. Five of the seven patients previously operated have had a silicone sheet inserted at that time. Only one of these five patients had undergone surgery within our unit and using our technique; the other four had undergone previous surgery without fixation of the silicone sheet. This sheet had later become displaced and damaged.

During the first two days post-surgery, all patients considered pain to be less than it was preoperatively, except for three patients that needed level-2 antalgics for a week. No iatrogenic infections nor delayed healing were observed. A frontal paresia occurred in six patients with complete recovery by 6 months post-surgery.

The average preoperative MO was 24.7 ± 6.7 mm and was 32.8 ± 6.4 mm at the last follow-up. Thus, the mean improvement was 8.2 mm, which was highly significant in Student's *t*-test ($P < 0.0001$). However, four patients had no or only very limited improvement in MO, and one patient had a reduction of 2 mm.

The average PS was 2.5 preoperatively and 0.8 at the last follow-up. The mean improvement in this score was 1.7 units, which was highly significant in Student's *t*-test ($P < 0.0001$). No patient experienced worse pain after surgery.

In order to determine the role of the silicone thickness, we divided the series into two groups:

- group A (10 patients) where the patients received a 1.0-mm-thick silicone sheet;
- group B (14 patients) where they received a 1.5-mm-thick silicone sheet.

Table 1
Data for study patients.

No.	Gender	Age (years)	Survey (months)	Silastic® (mm)		MO			PS		
				Right	Left	Pre-surg	Post-surg	Difference	Pre-surg	Post-surg	Difference
1	F	50	70	1.0		25	25	0	3	2	−1
2	F	26	80		1.0	28	37	9	2	1	−1
3	F	42	80		1.0	23	26	3	3	1	−2
4	M	38	28	1.5	1.5	12	28	16	1	0	−1
5	F	57	60	1.5		38	44	6	3	1	−2
6	F	51	6	1.5	1.5	18	18	0	3	2	−1
7	F	59	16	1.5		31	37	6	3	1	−2
8	F	66	20	1.5		25	42	17	2	0	−2
9	F	41	50		1.5	32	30	−2	3	2	−1
10	F	61	45	1.5	1.5	15	31	16	3	0	−3
11	F	69	6	1.5		25	35	10	3	1	−2
12	F	55	22	1.5		10	25	15	2	1	−1
13	F	53	19		1.0	25	30	5	3	1	−2
14	F	73	21	1.0	1.0	15	38	23	2	0	−2
15	F	55	12	1.5		32	44	12	2	0	−2
16	F	71	22	1.0	1.0	25	32	7	2	1	−1
17	F	30	12	1.5	1.5	27	34	7	3	2	−1
18	F	66	10		1.5	30	32	2	2	0	−2
19	F	66	6		1.0	28	32	4	2	1	−1
20	F	55	10	1.0		25	30	5	3	1	−2
21	F	80	6	1.0		25	35	10	2	1	−1
22	M	63	6		1.5	30	40	10	2	0	−2
23	F	57	9	1.5		23	28	5	3	1	−2
24	F	40	6	1.0		25	35	10	3	0	−3

Age: age at the time of surgery; Survey: measured in months between surgery and the last clinical control; Silastic®: depth of the silicone sheet; MO: mouth opening in millimetres; PS: Pain Score (0 = no pain, 1 = light pain, 2 = severe pain, 3 = very severe pain).

Table 2
Distribution of the aetiological factors.

Main aetiological factor	No. of patients
Previous surgery on the TMJ	7
Isolated occlusal disturbance	5
Inflammatory disease	4
Intra-articular contusion	3
Idiopathic	5

Occlusal disturbance was sometimes observed combined with each one of the other aetiologies.

The choice of the thickness during surgery was not randomized but depended on several factors, including the size of the interface to be filled, the personal preference of the surgeon and sometimes the availability of the material at the time of surgery.

The two groups were similar regarding age (mean age was 55.6 years in group A and 54.8 years in group B), preoperative MO (24.4 mm in group A versus 24.9 mm in group B) and PS (2.4 in group A versus 2.5 in group B). The only difference between the two groups was the length of follow-up: i.e. 32.0 months for group A versus 21.6 months for group B (this point is discussed further below). At the end of follow-up, the mean improvement in MO was 7.6 mm in group A versus 8.6 mm in group B. The mean improvement in PS was 1.6 in group A and 1.7 in group B. There were no statistical differences between the two groups regarding these two parameters.

The lengths of follow-ups were compared with the clinical results by a correlation test. Results are shown on Fig. 2 (for MO) and Fig. 3 (for PS). No statistical relationship was found for MO ($P = 0.171$) or PS ($P = 0.122$). Nevertheless, there was trend towards deterioration of outcomes over time.

4. Discussion

In the past, autogenous tissues were generally considered to make good disc substitutes. For example, dermal grafts were proposed by Georgiade et al. many years ago [9] and more recently by Meyer et al. [10] and produced relatively good results after 50 months for 50% of patients. The use of auricular cartilage grafts has been proposed by several authors [6]. Svensson et al. reported on a series of 23 patients that underwent surgery using this technique [11]: however, the graft needed to be removed subsequently for 30% of these patients after a mean period of 26 months. These poor results occurred mainly in cases of degenerative lesions, including patients that had previous surgery. The best results seemed to be correlated with the integrity of the bony structures.

The most efficient autogenous material seems to be the temporalis muscle flap, as described by Feinberg et al. [12]. In a small series (13 patients), results for MO were good, but the follow-up period was less than 9 months. More recently, DeMerle compared the results for MO and PS with abdominal fat grafts versus temporalis myofascial flaps [13]. As expected, the results were better for the flap, but almost all patients presented initially with an isolated disc displacement without a degenerative lesion. Indeed, the long-term outcomes for this flap are unknown, as it is unlikely that they would remain intact for more than a few weeks [14]. Furthermore, it is known that it can be technically difficult to achieve a good silk suture within the inner part of the joint.

Alloplastic materials have logically been used for many years to avoid the problems encountered with autogenous techniques. Silicone implants were introduced in 1968 as an interpositional material for the reconstruction of arthritic or severely damaged joints after evidence had been obtained regarding its biocompatibility [15]. The tendency for a fibrous capsule to form around a silicone implant is well known but can be useful in specific conditions such as TMJ surgery. However, as reported by Mercuri [16], the American Association of Oral and Maxillofacial Surgeons' Society decided, in November 1992, that the use of permanent Silastic® implants should be discontinued, except when used to prevent recurrence of ankylosis. Since then, it appears that the use of a TMJ total prosthesis has become the gold-standard for many surgeons, not only for TMJ ankylosis, but also for cases of

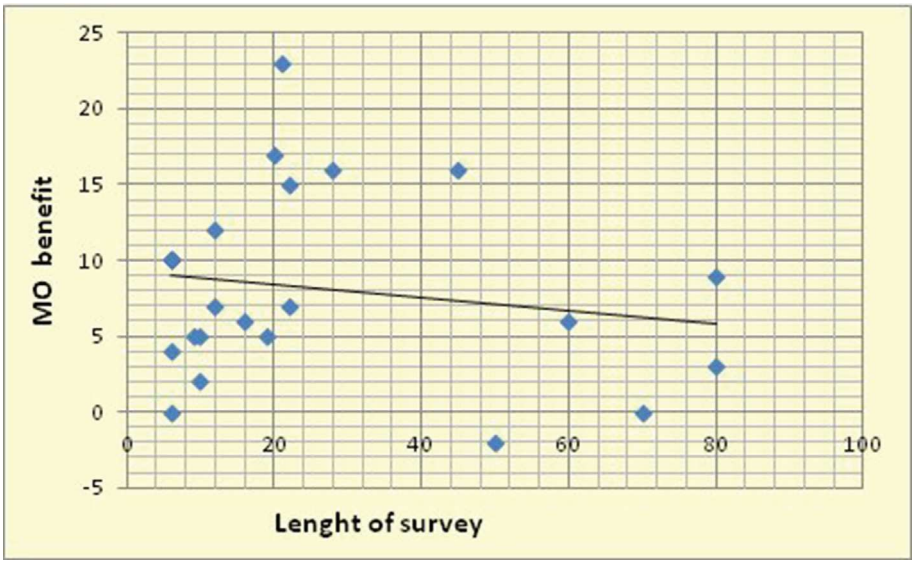

Fig. 2. Correlation diagram between MO and the time of the final examination. Each patient is represented by a blue square.

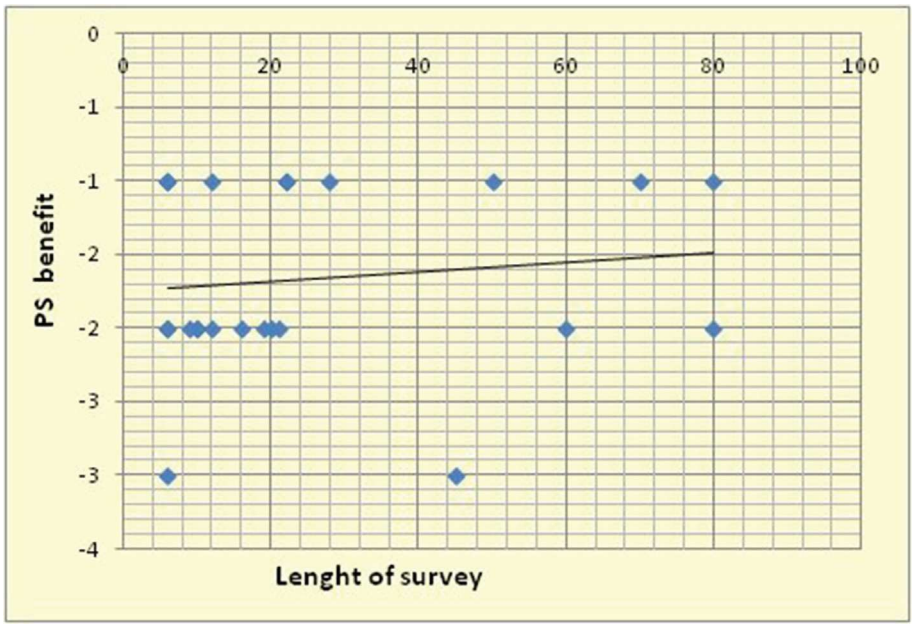

Fig. 3. Correlation diagram between PS and the time of the final examination. Each patient is represented by a blue square.

degenerative osteoarthritis [17]. Meanwhile, in our series, MO was improved by 33% and PS decreased by 68% at the final examination. These results correspond to the patient's request. These results seem to be better than those of Schliephake [3], but our mean follow-up time was much shorter (26 months vs. 7 years). They reported on morphological modifications to the condyle, as seen in later X-rays, with flattened condyle head and osteophytes. We have also noted such deformations in several of our cases. Even though there was no statistical significance in Figs. 2 and 3, the progressive degradation is probably ineluctable, though rather slow. Some authors reported the possibility of fragmentation of these sheets, which may then cause foreign-body giant-cell reactions in cervical lymph nodes [18]. They have identified the poor strength of silicone and its ability to be perforated and/or fragmented, as shown in Fig. 4. Meanwhile, in most of these cases, there were errors during surgery regarding the lack of fixation or insufficient coverage of the condyle head. In order to avoid this type of complication, we could expect better results with the thicker sheet (1.5 mm instead of 1.0 mm). However, surprisingly, we were unable to find any difference in success rate between the two thicknesses of silicone sheets. This means that the main problem was probably the biomechanical status inside the joint and not the strength of the material itself.

Because of the risk of degradation of clinical status over time, many authors now think that there is no satisfactory conservative treatment for cases of TMJ osteoarthrosis and propose total prosthetic replacement instead as is done for TMJ ankylosis with satisfactory long-term results [19]. O'Connor recently published a paper on a series of 24 patients that underwent TMJ prosthetic replacement for an inflammatory disease with good functional results [20]. Good results have been also reported by Gruber et al. [21] in a prospective analysis where the most common diagnosis

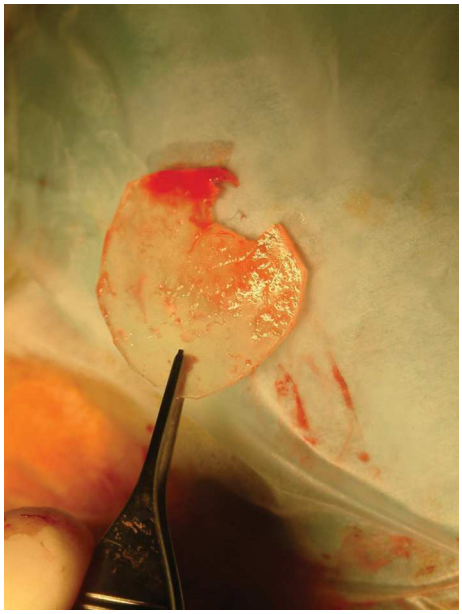

Fig. 4. Example of a deteriorated silicone sheet removed from a patient that had undergone previous surgery in another structure without fixation of the sheet. There is a perforation at its inner part.

was degenerative disease. However, they mention some disadvantages to the TMJ prosthesis: the intervention is longer and more aggressive with increased risks including morbidity, excessive bleeding leading to blood transfusion, infection, and definitive facial palsy. Even though it is rarely mentioned, the ability for mandibular protraction is lost. The real cost of the procedure is not fully known, but it is obviously much greater than for a conservative technique. Furthermore, it is not supported by the Health Insurance Service System in some countries, particularly in France where the TMJ prosthesis is reserved for cases of ankylosis.

In conclusion, the poor reputation of silicone-sheet implants did not seem to be as evident in our series. Even though an optimal method for disc replacement has not yet been found, silicone can be used with success, but using a rigorous technique and strict fixation. It is a simple, quick, and non-expansive method that has a low rate of complications. However, it seems that anatomical and functional results decrease with time, thus it should mostly be used for elderly or fragile patients that have severe pain and low mobility. For other cases, it is certainly better to perform a TMJ prosthetic total replacement. We hope that modifications to the French health-care system will be made and permit in the future better results in the management of TMJ osteoarthrosis.

Disclosure of interest

The authors declare that they have no competing interest.

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