

# Proplast in oral and maxillofacial surgery

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## **Abstract**

**Background:** Proplast is a material designed for tissue implantation commercially available through the Dow-corning Corporation. It is a gray black laminated felt of vitreous or glassy carbon and Teflon (polytetrafluoroethylene). The vitreous carbon also called hyperpure or elemental carbon or pyrolytic graphite, a pure molecular form of carbon that is pyrolytically derived from hydrocarbon such as rayon. Proplast was 1<sup>st</sup> prepared by Homsy in 1970, invented in 1968 especially for surgical implantation. It's manufactured as a tin felt sheet which is then layered and rolled under high heat and pressure to form the laminated block in common clinical use.

**Objective:** To evaluate the Proplast implant material in restoration of facial bony contour.

**Methods:** There were a total of 18 cases with proplast implant insertion. The mean age of the patients was 27.9 years. The range was 18-35 years. Data was obtained by prospective study and follow-up records of patients with the proplast implant at the department of maxillofacial surgery at Al-kadhymia Teaching Hospital for 6 years follow-up duration from 2000-2006.

**Result:** Proplast is a useful implant material for the restoration of facial bony contour (success rate was 88.9%). Sixteen implants were judged to be stable (88.8%), and 2 implants (11.2%) were judged to be unstable (removed) due to infection. In the two infected cases the fixation was done by wire fixation instead of suture fixation or spontaneous fixation with an intraoral approach. Of these 16 stable implants 3 were mobile (18.75%) and 13 implants were immobile (81.25%), and this is appeared to depend on the technique of proplast insertion.

**Conclusion:** Proplast is a useful implant material for the restoration of facial contour, There are some technical difficulties, when it is inserted over areas that are convex such as the malar prominence and orbital margins, in that it is difficult to eliminate the edge effect, but this can be overcome by proper feathering of the edges of the implant with a sharp scalpel.

**Key words:** Proplast, porous, alloplastic, implant.

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## **Introduction**

A number of alloplastic materials, which are an inert foreign substances implanted within living tissue, have been used in oral and maxillofacial surgery during the last century, none of which have proved to be entirely satisfactory. Physicians have been implanting non-viable substances into human body since 1565.

Heterogeneous transplants have a history dating from 1668 when Van Meekeran reported the successful transplantation of part of dog's skull to a cranial defect in Russian soldier.

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Proplast is microporous implant material, has a porosity of between 70 & 90 volume %, and has high surface energy. The actual surface area is approximately 1200x apparent surface area. The 100-500  $\mu$  pore size and the 200-250  $\mu$  dendritic interpore connection allow sufficient permeability of tissue for effective metabolic activity; tissue maturation is demonstrable to the point of osteoid or actual osseous tissue within the implant. The ultra porosity enabling as much as 80% of the implant volume to become tissue <sup>(5-12)</sup>.

Proplast does appear to match up closely with the criteria of scales (1953) laid down for implants, those they:

1. Should not be physically modified by tissue fluids.

2. Should not excite an inflammatory or foreign body cell response in the tissues.
3. be chemically inert.
4. be non-carcinogenic.
5. Do not produce a state of allergy or hypersensitivity
6. be capable of being fabricated in the form required with reasonable ease and relatively low cost.
7. be capable of being sterilized <sup>(13-16)</sup>.

Until 1981 there was only one type of proplast. In 1981 proplast II was introduced, it is a PTFE/aluminum oxide (which substitute the vitreous carbon), therefore, the conventional proplast was then called proplast I & the new one is proplast II, which is white, and, therefore, more suitable for superficial implants.

It's particularly indicated where the implant is placed under thin skin, such as the nasal ridge. Proplast II offers a number of advantages over other commonly used silicone & polymethylmethacrylate. It is light, porous, resilient, malleable and easy to shape. It can be readily sterilized after shaping. It has been found to integrate with the surrounding tissues, thereby minimizing the risk of subsequent implant migration and extrusion <sup>(17-22)</sup>.

#### **Patients and Methods**

Data was obtained by prospective study records of 18 patients with the proplast implant at the department of maxillofacial surgery at Al-kadhymia Teaching Hospital.

The mean age of the patients was 27.9 years. The range was 18-35 years.

The study protocol included the patient name, age, sex, site, cause and duration of the defect. Clinical examination, radiographs, investigations, photographs in anterior and profile view (preoperatively and postoperatively), preparation of proplast I and II, placement of the implant either suprapariosteally or subperiosteally. Fixation of the implant

either spontaneously, or with absorbable suture (daxon 3:0), or by wire fixation (0.35 gauge) by drilling small holes either side of the implant with straight hand piece and fissure bur with irrigation with normal saline, careful closure in two layers, pressure pack with gauze for 5 days and prescription of antibiotics and follow-up result for 6 years.

Parameters of evaluating the implant postoperatively as good, satisfactory and poor result was done. Good results mean the deformity was completely corrected to the satisfaction of both the surgeon and patient.

Satisfactory mean the defect was corrected but there was dissatisfaction of either the patient or the surgeon. Poor results, when the problems arose necessitating removal of the implant.

The defective area was examined and assessed clinically, and radiographically; these areas include the Orbit, Zygoma, Nose, Chin and mandible.

In case of defective orbital bones, we examined the entire orbital rim, if there is any scar and tethering in the area, the position of the eye lid as well as the presence or absence of the globe and compared to the sound area. We also examined if there is any associated diplopia and the level of the two orbital sockets. Ocular mobility was examined and facial nerve function was assessed by facial expression.

The Zygoma was examined for the degree of bone loss, any associated tissue loss, scarring and tethering of the tissues. The infraorbital nerve sensation was test by blunt object for any sign of paresthesia or anesthesia. Intraoral examination was done for the state of periodontium and teeth, and if there is any communication with the maxillary sinus. The nose was examined for the defect, if it is

associated with bone loss or with cartilage loss.

The chin area is assessed clinically depending on the true Meridian of the face according to the profile of the patient, and preoperative judgment was done to the size of the implant. Examination of the mental nerve sensation was done by a blunt object. Intraoral examination done for periodontitis, calculus, presence of non-vital teeth especially interiorly, the interdental papillae, as well as the gingival margins, and the presence of partial denture or bridge.

In case of defective orbit, the indications were for cosmetic as well as elimination of diplopia; in others due to blow-out fracture.

For the defective zygoma, nose and chin, the indication was absolutely cosmetic. For mandibular implant, the indication was for augmentation of mandible in conjunction with mandibular osteotomy (intraoral sagittal split) in order to obtain symmetry of the face as a result of unilateral hypoplasia of the mandible in a young female due to fracture sustained during childhood.

In case of orbital defects, the numbers of patients were 4. Two were operated on for the defective roof and 2 were operated on for the defective floor. For the roof a subperiosteal pocket was created to receive the implant by a traditional approach through the eye brow. The remaining 2 patients were operated on for the defective floor of the orbit by an infraorbital approach with the skin crease and insertion of the implant subperiosteally.

For nasal bone defect the numbers of the patients were 4. Two were approached through the skin by supranasal flying bird incision at the nasion, and 2 were approached intranasally by intercartilaginous approach.

For zygomatic bone defects, number of patients were 4, all were approached intraorally by a horizontal incision through the mucosa, a lightly below the depth of the vestibule on the lip side above the canine- premolar teeth. For chin implants, numbers of patients were 5. All approached intraorally by degloving incision, a horizontal incision one inch long through the mucosa midway between the depth of the vestibule and the wet line of the lower lip. Only one patient was operated on for mandibular augmentation. This proplast was used in conjunction with sagittal split of the mandible (intraoral approach, RT. Side), and the augmentation done to LT. side by intraoral approach through the mucosa, midway between the depth of the vestibule and the wet line of the lower lip, slightly to the left side.

### **Result**

There were a total of 18 cases with proplast implant insertion. Seventeen were males (94.4%) only one female (5.6%). The mean age of the patients was 27.9 years; the range was 18-35 years. We operated on the orbit (4 cases = 2.2%), nose (4 cases = 22.2%), chin (5 cases = 27.7%), zygoma (4 cases = 22.2%), and mandible (1 case = 5.5%). The higher number of proplast was inserted in chin area, and the least number of proplast was inserted in mandible.

The causes of the defects are war injuries, road traffic accidents, congenital (contour lack), civilian injuries and fracture mandible. The higher cause was due to war injuries (55.5%) = 10 cases.

We used proplast type I (black color) in one case only (mandible) and proplast type II (white color) in 17 cases (94.4%). All proplast II are preformed and did not require any carving, while proplast I required preoperative carving.

Two implants (11.1%) were impregnated preoperatively with blood, one for nose and the other for orbital floor. Two other implants were impregnated with antibiotic solution (penicillin), one for the roof of the orbit and the other for the nose. The 14 remaining implants (77.8%) were unimpregnated with any solution.

Fifteen implants (83.3%) were inserted subperiosteally, and 3 implants (16.7%) were inserted supraperiosteally. The supraperiosteal implants were inserted in cases of zygomatic implant (1 case), and chin implants (2 cases).

The implants were stabilized in their places by three methods; 8 implants (44.4%) stabilized spontaneously, and these include; roof of orbit (2), nose (2), chin(1) and mandible(1), 8 implants were fixed by sutures as follows: floor of orbit (2), both fixed with dextran suture 3:0 with the soft tissues, nose (2), with silk suture 4:0 transcutaneously and in one case; as well as suture fixation, it was fixed with a T-shaped gypsum on the nose for 14 days.

Zygomatic implants (3), with dextran suture 3:0 with the soft tissues, chin (1), with dextran suture 3:0 with soft tissues. Wire fixation (gauge 0.35) was used in 2 cases (11.2%), one for the chin and the other for the zygomatic implant.

Regarding the contour evaluation of the implant postoperatively, a good visible contour was one which was asymmetry in cases where there had been asymmetry or bony defect. We included here the nose and chin for proper contouring. There were 10 implants (55.6%) evaluated as a good contour, these include: orbit (3), 2 for the roof and 1 for the floor, nose (2), zygoma (2) and chin (3 cases). 8 implants evaluated as improved contour (44.4%), these include: orbit (1

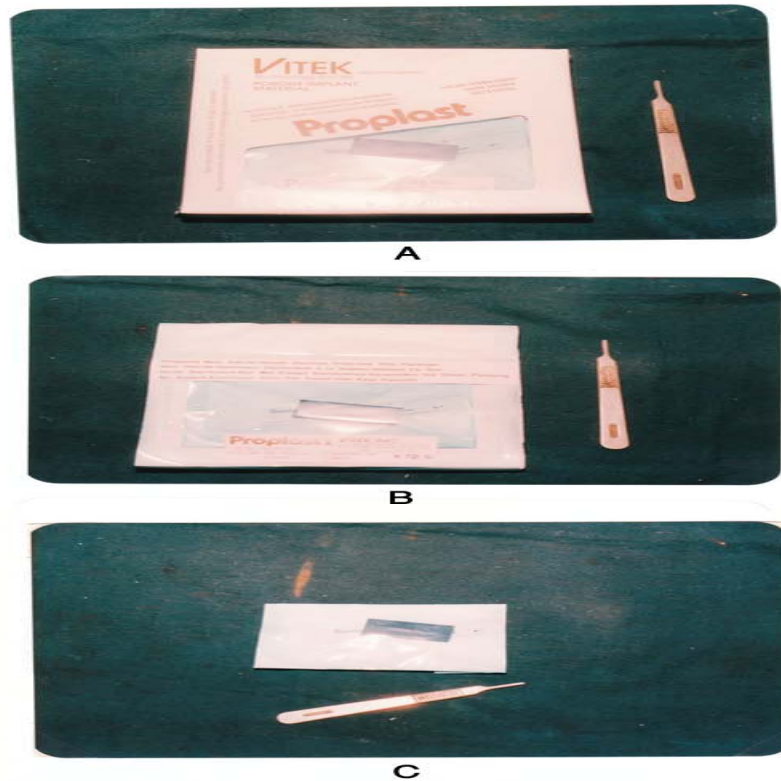
case) for the floor, nose (2 cases), zygoma (2), chin (2) and mandible (1).

There was no implant evaluated as worse, or no change occurs.

The colour change of the skin overlying the implant was regarded either satisfactory (no visible colour through the skin), or unsatisfactory (visible colour through the skin). Satisfactory colour was 100% postoperatively stable implants were 16 (88.9%), unstable (removed) were 2 (11.1%), one chin implant and one zygomatic implant, of these 16 stable proplast, 13 (81.25%) were immobile, and 3 (18.75%) were mobile (2 nasal & 1 chin implant). Mobile proplast here means not true mobility, but shifting of its position (migrated but still fixed). Of the 18 implants there were 8 (44.5%) palpable margins of the proplast (floor of the orbit 2, nose 2, zygoma 3 and chin 1. Regarding the visibility of the palpable margins, there were 3 visible margins (37.5%) and 5 not visible margins (62.5%). The visible margins were present in nasal implants (2 cases) and in zygomatic implants (1 case).

In evaluating the degree of satisfaction, good results obtained in 7 implants (38.9%), satisfactory results were 50% (9 implants) and poor results were 11.1% (2 implants). Good results obtained for the following areas: Mandible (1 case), Orbital floor (2 cases), Nose (2 cases) and Chin (2 cases). Satisfactory results obtained for the following areas: Roof of the orbit (2), Nose (2), Zygoma (3) and chin (2).

Poor results occurred with the chin implant (1 case) and zygomatic implant (1 case).



**Figure 1: A. Proplast 1. implant in a form of block, as it appears from it's box . B. The Proplast implant is supplied non-sterite in an autoclavable duble wrap package. This is the 1st wrap package. C. The 2nd warp package.**

### **Discussion**

Proplast is a useful implant for the restoration of facial contour. There are some technical difficulties when it is inserted over areas that are convex such as the malar prominence and orbital margins, in that it is difficult to eliminate the edge effect; in post-traumatic cases it seemed that slight under building of the contour gave a better appearance than the reverse. When it came to restore concave defects it was excellent. In 17 cases we inserted proplast II (white colour) and in a case we used proplast I (dark colour). The cause of this large difference is due to mandatory use of the proplast II in thin skin areas which include the orbit (4 cases), nose (4 cases) and zygoma (4 cases), and in 5

cases of the chin implants we also used proplast II due to its preformed shape availability in our department. Only in one case we used proplast I (dark colour) for the mandible, this is because here we can use proplast I due to presence of thick skin over the implant, and also we used it because we want a special thickness to get symmetry of the face in the patient we operated on, and this is achieved by careful carving of the implant and compared to the contralateral area until we get the desired shape and thickness. In this study, 2 implants were impregnated preoperatively with blood, and this is taken from the same patient by intravenous aspiration of 5cc with a needle and injected it directly to

the proplast. In another 2 implants we impregnated them by an antibiotic solution (penicillin) by using vacuum pressure in a 50cc syringe. In the remaining 14 implants we didn't impregnate them in any solution.

Reasons for impregnating only 2 implants with blood is due to the thought of some investigators who suggested that preimpregnating the proplast with blood might promote granulation tissue penetration into the sponge interstices. But this thought is intriguing and there has been no clear experimental evidence to support this concept. In addition, because it does not rapidly "soak up" fluid like a sponge, blood must either be injected directly into it or forced into it by vacuum impregnation. The former technique may not give uniform perfusion and it may be laborious; the latter technique is cumbersome in an operating room. If these maneuvers were shown to have no effect on the fibrous ingrowths and fixation, then the additional operating time and risk of contamination would constitute contraindications to such pretreatment of proplast implant. In addition all the investigations did not confirm any advantages of pretreatment of the proplast with blood; therefore, we chose only 2 implants for pretreatment with blood, to be compared with the dry implants. Only 2 implants were infused preoperatively with antibiotic (penicillin) for the thought that these measures might decrease the risk of infection, but this is not clear cut, as well as some investigators advocated no pretreatment and confirmed that the dry implants were superior than others which impregnated with antibiotics or blood. The stability of the implant was judged both with regard to mobility on palpation and for any tendency for it to slip completely. Only 2 implants (11.1%) had to be removed (poor stability) because of infection. We

agree with Whitaker, 1987 (11.3% poor stability), and Epstein, 1979 (9.9%). Our results were less than that of Moss, 1979 (19.2% poor stability), the cause was due to different indications. Moss, 1979 used proplast for augmentation of the temporal regions in cases of hypertelorism, also he used the proplast for patients with secondary cleft lip and palate, hypoplastic maxillae, and used once in a post- Le Fort II osteotomy of the anterior maxillae and infranasal area.

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