Proplast Genioplasty: A Retrospective Study with Treatment Recommendations

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The contour deficient chin represents a commonly encountered clinical entity. The number of currently used methods for chin augmentation indicates that no single technique affords uniformly predictable, stable, and esthetically acceptable treatment results. Thus, there is a continuing concern with the development of more adaptable methods of augmentation genioplasty.

Literature Review

Treatment planning for augmentation genioplasty has classically stressed profile evaluation and efforts have been directed toward the development of methods to augment the anteroposterior dimension of the mandibular symphysis.[1-5]

Sliding osteotomy of the inferior border of the mandible was first reported in 1942.[6] Since that time several variations of sliding osteotomy have been described.[4,7-11] This technique appears to provide a predictable augmentation with fair stability which seems related to the magnitude of augmentation.[11-13] However, this technique is limited by the anatomy of a given mandible. In particular, lateral augmentation is limited, and it is rarely possible to perform sliding genioplasty in conjunction with an anterior subapical osteotomy of the mandible.

Another basic approach to chin augmentation involves the implantation of various materials over the mandibular symphysis. Autograft, allograft and xenograft materials have been used as well as alloplastic materials for chin augmentation.[13-27]

Theoretically, implant genioplasty presents several advantages over sliding genioplasty. More precise dimensional control, both anteroposteriorly and laterally, is possible. In addition, an implant can be placed at the time of subapical mandibular osteotomy. There have been few scientific studies to document the complications, predictability, and stability of alloplastic implant genioplasty. Complications cited, but not statistically documented, with the use of silicone rubber and methyl methacrylate chin implants include: infection, migration, extrusion, mandibular resorption and loss of contour augmentation.[1,18,28,29,36] No study of Proplast, a relatively new alloplastic implant, has appeared in the literature.

We now report on our results with 31 consecutive Proplast chin implants for correction of the contour deficient chin. A retrospective study of treatment results with the use of Proplast for genioplasty follows. Our clinical experience including surgical technique, frequency and management of complications, and predictability of treatment results is presented and discussed. An approach to diagnosis and treatment planning for chin augmentation is outlined and illustrated with case presentations.

Materials and Methods

Implant Material

Proplast is a composite of polytetrafluoroethylene and vitreous carbon fibers. It is produced as a sponge in blocks of various sizes. The blocks can be autoclaved, stored, and contoured at the time of surgery. The physical properties

of Proplast, as well as the results of laboratory, animal, and preliminary clinical trials are described elsewhere.[30-33] The material is highly biocompatible. A variable pore size lends a unique capacity for tissue ingrowth and self-stabilization, which is reportedly complete within four weeks. Preliminary reports describing its use for facial augmentation have been promising.[34-36]

Patient Population

All patients studied were treated at the Center for Correction of Dentofacial Deformities at John Peter Smith Hospital, Fort Worth, Texas. All patients who had received Proplast chin implants as of September 1975 were recalled for detailed clinical, radiographic, and cephalometric examinations. Pretreatment clinical, radiographic, and cephalometric records were available for comparison on all patients studied. A minimum postoperative period of three months was established for inclusion in this study. Thirty-one patients met the criteria.

All patients who responded to recall underwent thorough clinical examinations and were questioned about problems related to their chin implants. Subjective and objective evaluation of mental nerve function was recorded. The status of all teeth in the area of the implants was evaluated. Periodontal status was assessed. Palpation was performed to evaluate the clinical stability of the implant. Facial expression was observed to note any tendency for overlying skin to be tethered to the implant.

Radiographic Evaluation

Panoramic and cephalometric radiographs were taken on all patients. The former were used to evaluate implant related changes of the bone, periodontal structures, and tooth root resorption. The cephalometric films were used to
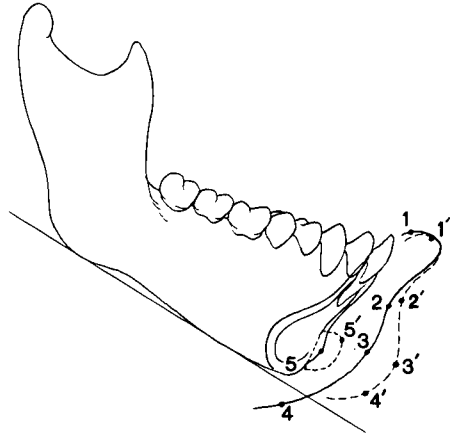

Fig. 1 Preoperative and postoperative films were superimposed on the cortical outlines of the mandible with registration on the inner cortical aspect of the symphysis. All measurements were made relative to the mandibular plane (see text), 1) "stomion" for lower lip; 2) mentolabial fold; 3) soft tissue "pogonion" (Pgs); 4) soft tissue "menton"; 5) osseous/implant pogonion; 2'-2) change in position mentolabial fold; 3'-3) change in position soft tissue "pogonion"; 5'-5) change in position osseous/implant "pogonion"; (1' to 4')-(1 to 4) change in length of lower lip; and (5' to 3')-(5 to 3) change in chin thickness.

study bone resorption associated with the implants and soft tissue changes. The implant was visualized on cephalometric films with the use of a soft-tissue shield. All films were taken with the lips in repose or at rest.*[37]

Landmarks and measurements for cephalometric study are diagrammed in Figure 1. The preoperative and most recent postoperative films were super-

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*This is important in studying soft tissue changes associated with various procedures to correct dentofacial and craniofacial deformities. The senior author has observed that in individuals with lip incompetence or excessive interlabial gaps that the soft tissue thickness of the chin will vary to 100% from when the lips are at rest to when the lips are pursed together. This fact will introduce a large potential error in studies such as this if it is not taken into account.

imposed on the outline of the mandible with registration on the outline of the inner cortex of the symphysis according to the technique of McNeill et al.[38] Anteroposterior measurements were made along the mandibular plane with change in an anterior direction recorded as a positive value. Vertical change was measured perpendicular to the mandibular plane with change in an inferior direction recorded as a positive value. All changes were measured to the nearest 0.5 mm. Standard errors of measurement ranged from 0.18 to 0.41 mm.

Statistical Evaluation of Data

Variables which we deemed of clinical importance were identified. They were: implant related bone resorption, stability, and predictability of soft tissue augmentation. Twenty-seven variables were recorded for each patient (Table I). Means and standard deviations for each variable were calculated. Multiple correlation coefficients among all variables were computed. The strengths of association between variables are described below in terms of their correlation coefficients (R) and the significance level (SL) of the observed correlation. Selected variables under study were made dependent variables in statistical techniques of backward elimination and multiple regression. A mathematic model was derived which associated relevant independent variables to the variable under study and provided a measure of strength of association between variables.*

Surgical Technique

Implant beds were prepared through an intraoral degloving approach. In most instances the incision was made in the lip and carried in a step-wise fashion down to the periosteum (Fig. 2).

TABLE I
VARIABLES RECORDED IN PROPLAST GENIOPLASTY

V1 : hPg(s) anteroposterior soft tissue chin augmentation (mm)

V2 : hPg anteroposterior osseous chin augmentation (mm - implant thickness)

V3 : Ratio hPg(s) / hPg.

V4 : Follow up (months)

V5 : Anteroposterior change chin thickness (mm)

V6 : Anteroposterior change at mentolabial fold (mm)

V7 : Age (years)

*V8 : Preop labial competence (+/—)

*V9 : Postop labial competence (+/—)

*V10 : Anterior segmental osteotomy (+/—)

*V11 : Postop complications (+/—)

V12 : Vertical change at Pg(s) (mm)

V13 : Vertical change at Pg (mm)

V14 : Vertical change at mentolabial fold (mm)

V15 : Change in lip length (mm)

V16 : Preop symphysis width (mm)

V17 : mm symphysis resorption

V18 : % symphysis resorbed

V19 : Time postop resorption recorded (months)

*V20 : Predominant superior resorption (+/—)

*V21 : Bone apposition or growth (+/—)

*V22 : Mental nerve paresthesia (+/—)

V23 : Time postop implant radiographically evident (mos)

V24 : Postop interlabial distance (mm)

V25 : Time postop resorption noted (months)·

*V26 : Sex (M = +)

V27 : % symphysis resorption/month

* Notes dichotomous variables

This makes possible layered closure, reducing problems with wound dehiscence. The mental nerves were identified, dissected free, and retracted. Periosteum over the symphysis was elevated and released. After insertion implants were injected with a small gauge needle and syringe to saturation with an antibiotic (usually penicillin). All implants, with the exception of one, were placed in a subperiosteal pocket and fixed to bone with wire or suture.
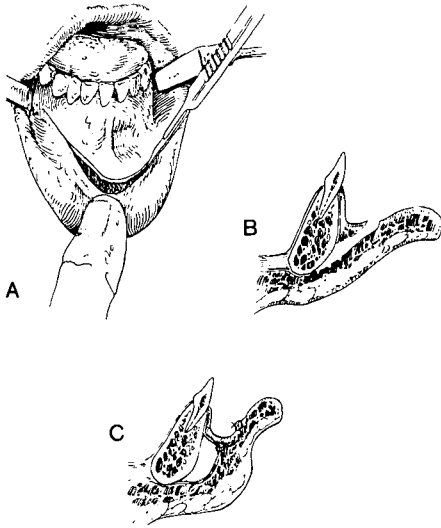
Fig. 2 A) Degloving incision performed onto the base of the lower lip. B) Stepwise dissection through lip and mentalis with incision and reflection of periosteum. Note relaxing incisions in periosteum. C) Double layered closure after placement and stabilization of implant.

All patients received a seven to ten day course of antibiotics postoperatively.

RESULTS

Thirty-one patients were studied, 13 men and 18 women, with an average age of 19.2 years at the time of surgery. The majority of patients studied underwent other procedures simultaneously for the correction of various dentofacial and craniofacial deformities. Eighteen patients had anterior subapical osteotomy of the mandible at the time of genioplasty.

Clinical Evaluation

Twenty-two patients appeared for recall evaluation. Mean follow up for this group was 15.8 months. Over-all follow up, dated from the last available cephalometric radiograph, was 15.5 months for the 31 patients studied.

Eight patients experienced implant related complications. Four suture lines dehisced with clinically uninfected adjacent tissues. Two other cases of dehiscence with purulence occurred and there were two soft tissue infections without wound dehiscence.

Dehiscence was managed with vigorous local irrigation and injection of exposed implant with antibiotic (penicillin unless the patient was allergic to it). After collection of material for culture and sensitivity, all patients were placed on systemic antibiotics, usually penicillin. The initial regimen was changed as indicated by the antibiotic sensitivity. Of the 31 implants inserted, two required removal. One was associated with an infected dehiscence refractory to treatment, and the other was associated with submental and sublingual infection. The latter infection was associated with a circummandibular wire stabilizing a dentoalveolar segment.

At recall no patients had specific complaints which could be associated with their implants. Four of 22 patients examined clinically demonstrated objective signs of residual mental nerve anesthesia or paresthesia. Of these patients, three had simultaneous mandibular ramus or anterior subapical osteotomy performed. The majority of patients noted a transient paresthesia after their surgery with resolution within two to six postoperative months.

No tooth or periodontal disease was noted which could be related to implant genioplasty. Importantly, we did not note lack of attached gingiva or pathologic decrease in sulcus depth. In fact, the zone of functionally attached tissue was sometimes increased.

Only one implant was mobile to palpation. This implant was placed in a supraperiosteal pocket and not stabilized to bone. This was also the only implant tethered to overlying skin.

TABLE II

SOFT TISSUE VARIABLES IN PROPLAST GENIOPLASTY

		Mean	Range
V1	Anteropost. soft tissue chin augmentation	4.5 mm	2 - 9
V2	Anteropost. osseous chin augmentation (implant thickness)	5.4 mm	2 - 10
V3	Ratio V1/V2	0.9	0.4 - 2.0
V5	Anteropost. change chin thickness	—0.6 mm	— 4 - +3
V6	Anteropost. change in position of mentolabial fold	0.5 mm	— 5 - + 5
V12	Vertical change at Pg(s)	—0.3 mm	—11 - + 7
V13	Vertical change at Pg	—4.1 mm	—16 - +3
V14	Vertical change at mentolabial fold	0.2 mm	—11 - + 10
V15	Change in lip length	—0.1 mm	— 5 - + 5

CEPHALOMETRIC EVALUATION

Soft Tissue Augmentation

Suitable records for soft tissue study were available for 23 patients. The range and mean values for variables reflecting soft tissue and implant changes are presented in Table II. The mean ratio of soft tissue to anteroposterior alloplastic chin augmentation was 0.9 with a standard deviation of 0.37. The correlation coefficient relating soft tissue chin and alloplast augmentation was 0.48 with a significance level of 0.018. Other measured variables which demonstrated a significant relationship to the anteroposterior soft tissue augmentation include: V5, change in chin thickness (R = —0.43 SL = 0.039); V13, vertical change of Proplast chin at Pg (R = 0.44 SL = 0.03); V20, implant resorption predominant at superior edge of the implant (R = 0.54 SL = 0.009).

Vertical changes in the position of soft tissue pogonion (V12) and osseous/implant pogonion (V13) demonstrated greater variability than those in the anteroposterior plane. There was no significant correlation between the vertical positioning of the implant and the resultant position of the soft tissue pogonion (R = —0.03 SL = 0.95). In fact, no strong correlation could be demonstrated between V12 and any of the other variables studied with the exception of a relationship between V12 and anteroposterior change in position in the mentolabial fold (R = 0.41 SL = 0.048).

Changes in chin thickness demonstrated significant correlations with several variables: V2 anteroposterior augmentation osseous chin, R = —0.55 SL = 0.007; V3 ratio anteroposterior soft tissue / implant augmentation, R = 0.87 SL = 0.0001; V8 preoperative labial competence, R = 0.48 SL = 0.02; V9 postoperative labial competence, R = 0.51 SL = 0.01; V24 postoperative intralabial gap, R = 0.47 SL = 0.02. The mean ratio for mm change in chin thickness to anteroposterior implant thickness was —0.1.

Anteroposterior change in position of the mentolabial fold (V6) was related only to vertical change in position of soft tissue pogonion (V12), R = 0.41 SL = 0.048; and change in lower lip length (V15), R = 0.68 SL = 0.006. No significant relationships to vertical repositioning of the mentolabial fold were demonstrated.

Effective lip length demonstrated a wide range of change after augmentation genioplasty —5 mm to + 5 mm and was without significant correlation with other variables.

TABLE III

VARIABLES ASSOCIATED WITH RESORPTION IN PROPLAST GENIOPLASTY

		Mean	Range
V4	Follow up (months)	15.5 mos	3 - 28
V7	Age	19.2 yrs	13 - 35
V8	Preop labial competence		+13 / —10
V9	Postop labial competence		+19 / —4
V10	Anterior segmental osteotomy		+13 / —10
V11	Postop complications		+ 4 / —19
V16	Preop symphysis width	16.1 mm	9 - 21
V17	mm symphysis resorbed	4.6 mm	0 - 15
V18	% symphysis resorbed	26.2 %	0 - 60
V20	Predominant superior resorption		+14 / —8
V24	Postop interlabial distance (mm)	3.1 mm	0 - 14
V26	Sex (+ Male, — Female)		+10 / —13
V27	% symphysis resorbed / month	2.3% / mo	0 - 9.7

Implant Associated Resorption

Resorption of the mandibular symphysis under the chin implant was observed in 22 of 24 patients with adequate documentation for study of this phenomenon. No resorption occurred in a patient with Moebius syndrome after almost three years. The other patient without resorption was under treatment for an extreme Class II, Division 1 occlusal deformity and had redundant lips relative to his skeletal facial height.

Mean values and ranges for variables used to study implant related resorption are presented in Table III. Over the 15.5 month follow up a mean of 4.6 mm of bone resorption occurred. This resorption represented approximately 26% of measured mean preoperative symphysis width. The degree of resorption tended to be greatest at the superior edge of the implant (Fig. 3).

Multiple measures of resorption were selected and related to other variables under study in an effort to describe implant related resorption and to identify which factors were most strongly related to resorption under the implant. Table IV presents correlation coefficients and significance levels for associations between measures of resorption and other related variables under study.

Age and Sex Related Phenomena

Age range for this group of patients was from 13 to 35 years with a mean of 19 years. Only one significant association was found between the age of the patient and other variables. Seven patients demonstrated a variable degree of symphyseal growth and/or bone ap-
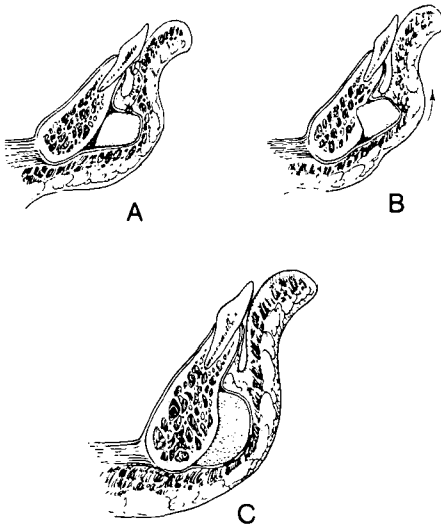

Fig. 3   A) Oblong implant placed for correction of contour-deficient chin. B) Chin-lip muscle activity resulting in a "tipping" of the implant with resulting superiorly based bone resorption. C) Suggested implant shape to minimize resorption; implant is well below tooth roots with broad base superoinferiorly and well-rounded margins.

TABLE IV

PROPLAST IMPLANT RELATED RESORPTION: CORRELATIONS

Variables Measuring Resorption

Dependent Variables		mm Symphysis Resorbed V17		% Symphysis Resorbed V18		Predominant Superior Resorption V20		% Symphysis Resorbed/Mo V27	
		R	SL	R	SL	R	SL	R	SL
AP augmentation soft tissue chin	V1	0.31	0.15	0.28	0.20	0.54	0.009*	0.07	0.75
AP osseous chin augmentation (implant thickness)	V2	−0.18	0.56	−0.16	0.53	0.58	0.005*	−0.05	0.81
Followup	V4	−0.05	0.80	0.04	0.85	0.28	0.21	−0.65	0.001*
Age	V7	0.01	0.95	0.05	0.82	0.23	0.30	−0.22	0.31
Preop labial competence	V8	0.31	0.16	0.26	0.25	0.13	0.54	−0.05	0.81
Postop labial competence	V9	0.46	0.03*	0.50	0.017*	−0.11	0.62	0.11	0.64
Anterior segmental osteotomy	V10	0.21	0.65	0.26	0.23	0.14	0.54	−0.05	0.81
Postop complications	V11	0.21	0.66	0.11	0.64	0.11	0.62	0.20	0.62
Postop interlabial distance	V24	−0.42	0.05*	−0.40	0.06	0.06	0.78	0.03	0.91
Sex (+ = Male)	V26	0.04	0.85	0.11	0.63	−0.14	0.54	0.20	0.63

position at the margins of the implant. The correlation between patient age and the growth apposition phenomena was −0.47 with significance level of 0.026. The magnitude of observed growth or apposition over the period of study was usually less than 1 mm.

A total of 13 men and 18 women were treated. For the 23 patients studied radiographically the ratio was 9 men / 14 women. Only one association tended to be sex related; wound dehiscence occurred somewhat more frequently in women with borderline statistical significance (R = −0.40 SL = 0.054). No study of possible factors involved in this correlation was carried out.

DISCUSSION

Unpublished early experience with Proplast placed transorally for genioplasty documented a failure rate of less than 10% (8 of 89 implants) over an unspecified period of follow up. By 1974 a 97% success rate was quoted by the manufacturer in their clinical evaluation of Proplast.[34] The majority of implant failure was attributed to infection. Our experience with Proplast genioplasty as of September 1975 (2 of 31 implants unsuccessful) constituted a failure rate of 6%. Since September of 1975 we have inserted an additional 17 chin implants without having to remove any. At present our success rate is 96%.

Implant loss or removal was associated with intractable infection, generally preceded by wound dehiscence. Loss was not observed into the late postoperative period after primary incisional soft tissue healing had occurred.

Six patients in this series experienced incision dehiscence. Dehiscence generally occurred in the region of the thin tissues about the canine eminence. Meticulous attention to tension free, double-layered wound closure has since

eliminated the incidence of incision de-
hiscence (Fig. 2).

Despite wound dehiscence over the
implant, failure was avoided in five of
the six cases. Systemic antibiotics, me-
ticulous oral hygiene, and injection of
the exposed implant (often repeated
several times a week) with antibiotic
led to secondary healing. We did not
attempt secondary closure on these
cases.

Significant implant migration, other
than into the underlying bone, was not
observed in this series. It should be
noted, however, that 30 of 31 implants
were fixed directly to bone with wire
or suture. The only implant with any
degree of mobility, or tethering to skin
was not placed subperiosteally or fixed
to bone. Implant fixation to bone is
recommended to achieve tissue in-
growth and optimum implant stabiliza-
tion.

Implant Related Resorption of Underlying Bone

Resorption of bone underlying the
implant was the rule rather than the
exception. The absolute measured val-
ues of resorption were affected by the
geometry of our technique of measure-
ment. Measurement relative to the
mandibular plane increased the mag-
nitude of measured resorption, and
therefore the mean 4.6 mm resorption
over 16 months is somewhat overstated.
Despite the fact that resorption of un-
derlying bone has been cited as a "com-
plication" associated with the use of
alloplasts for genioplasty, definition of
the clinical significance of this phe-
nomenon is unclear. No patient in this
series demonstrated clinical symptoms
which would be associated with resorp-
tion, specifically, root resorption, patho-
logic fracture, or compression neuro-
pathy of the mental nerves. Lack of
uniform longitudinal records and the
cross-sectional nature of this study do
not allow definitive statements about

the stability of soft tissue augmentation
while resorption is occurring. Clinical-
ly, the chin augmentation appears to
be fairly stable.

Bone resorption beneath the implants
correlated best with lack of postopera-
tive labial competence and the magni-
tude of the postoperative interlabial
distance. These variables indirectly re-
flect the clinically dynamic concepts of
tonicity and activity of the mentalis
and lower lip. One of the patients
without bone resorption had facial
nerve paralysis, and the other redun-
dant lips, further suggesting that mus-
cle tension on the implant was directly
related to the amount of underlying
bone resorption. A weak correlation
was observed between bone resorption
and time postoperative. Interestingly,
the implant thickness and magnitude
of soft tissue augmentation correlated
only with predominance of resorption
at the superior edge of the implant.

The shape of the chin implant also
seems to play a role in what represents
a superior tipping of the implant, sec-
ondary to muscle activity, with result-
ant resorption at the superior edge of
the implant (Fig. 3). We recommend
that the base of the implant be as
broad superoinferiorly as possible. The
principal limitations in the height one
can achieve at the base of the implant
include: height and concavity of the
symphysis and location of tooth roots.
It is believed best to avoid placement
of the implant superiorly over tooth
roots should significant resorption oc-
cur. Attention should be directed to as-
sessment of labial competence preop-
eratively, with appropriate procedures
planned for the correction of labial in-
competence.

Soft Tissue Changes Associated With Osseous Augmentation

Genioplasty effects multiple subtle
changes in contour of the lower third
of the face in both profile and frontal

view. These subtle changes in contour constitute the clinically perceptible result of chin augmentation. Most contour changes are incompletely measured by cephalometric analysis alone. One needs, however, certain guidelines for treatment planning which can be derived from cephalometric study and integrated with over-all evaluation of the patient.

The mean ratio of anteroposterior augmentation of soft tissue chin and anteroposterior implant thickness measured at cephalometric pogonion was 0.9 (S. D. 0.37) for this series of 31 Proplast genioplasties. Implant projection versus soft tissue augmentation correlated significantly (R = 0.48 SL = 0.018). Other significant correlations with the amount of chin augmentation included: change in chin thickness; vertical change at pogonion (implant); predominant resorption at the superior edge of the implant. There was no significant correlation between anteroposterior soft tissue augmentation and the occurrence of wound dehiscence or the performance of simultaneous mandibular subapical osteotomy.

With the exception of anteroposterior augmentation and change in soft-tissue chin thickness, no measurable soft-tissue changes demonstrated sufficiently predictable behavior to be of use in treatment planning. Change in chin thickness correlated with thickness of the implant (R = —0.55 SL = 0.0068). The mean ratio of change in soft-tissue chin thickness to implant thickness was —0.1.

Multiple variable models derived from techniques of backward elimination and multiple regression did little to refine the clinical predictability of soft tissue augmentation because of the variability exhibited by the sample population and the sample size.

Diagnostic and Treatment Planning Considerations

The term contour deficient chin is not diagnostic in an anatomical sense. Diagnosis and correction of the contour deficient chin involves an appreciation of normal balance among clinically and radiographically appreciable facial structures. Osseous and soft tissue dysplasias in all three planes of space should be accurately identified and described prior to formulation of treatment goals.[39]

Our systematic approach to clinical and radiographic examination has been described elsewhere.[40] In this context it should be noted that frontal face esthetics have historically been less emphasized than profile esthetics. Yet, since patients visualize themselves and others primarily from the frontal aspect, more emphasis on frontal esthetics is indicated.

Two points which may be appreciated on initial clinical examination are of particular importance. Lip incompetence should be noted and, if possible, corrected where Proplast genioplasty is anticipated. The morphology of the lower third of the face should be carefully scrutinized. A "V-shaped" lower third, or pointed chin, with contour deficiency and an otherwise square upper and middle third face will often present an indication for lateral as well as anteroposterior mandibular augmentations. Sliding genioplasty in these cases corrects the profile deficiency, but makes the chin appear more pointed from the frontal aspect (Fig. 4). This is due to the fact that lateral augmentation did not occur; such augmentation can be nicely accomplished with a properly shaped alloplastic implant (Fig. 5).

Cephalometric analysis will help confirm the clinical patient evaluation.

Fig. 4   A pointed chin made more pointed by horizontal osteotomy.

Fig. 5   Lateral as well as anteroposterior augmentation with Proplast chin improved lateral bulk and over-all frontal esthetics.

Normal dimensions for the mandibular symphysis and overlying soft tissues are available.[41-43] It has been demonstrated that osseous and soft tissue chin morphology vary independently. A seemingly contour-deficient chin may be secondary to maxillary vertical excess or horizontal mandibular deficiency (Fig. 6). Systematic clinical and cephalometric analysis would confirm these diagnoses. In many instances genioplasty would not be indicated after correction of the maxillary or mandibular deformity.

Systematic evaluation will allow the clinician to determine whether the contour-deficient chin is due to: 1) osse-ous microgenia, 2) soft tissue microgenia, 3) mandibular horizontal deficiency, or 4) maxillary vertical excess (Fig. 6).

Given an anatomic diagnosis, one can then determine those elements of the patient's skeletal structure to be changed with surgery. Chin, lip, nose balance is sought with genioplasty in frontal and profile views. Any of several cephalometric guidelines can be employed to determine where the soft tissue chin and osseous chin should be in relation to other facial structures.[5,45-47] With Proplast genioplasty, where the ratio of soft tissue to osseous augmentation approaches 1/1, we have found two guidelines to be particularly helpful (Fig. 7). The distance of the lower incisor to the NB line and the distance between pogonion and the same line should give a ratio between 1/1 and 2/1 for adequate tooth/lip/chin balance in an otherwise balanced face. A profile line formed by the tangent between the upper lip and skin should bisect the nasal philtrum for appropriate chin/lip/nose balance.

SUMMARY

The treatment results in 31 consecutive patients treated with Proplast for chin augmentation show good clinical success with the implant. A critical analysis of treatment results reveals that attention to certain details of the preoperative evaluation, surgical technique, and postoperative care can make for impressive results. These facts are discussed.

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Osseous Microgenia

Normal Mandible -15mm.
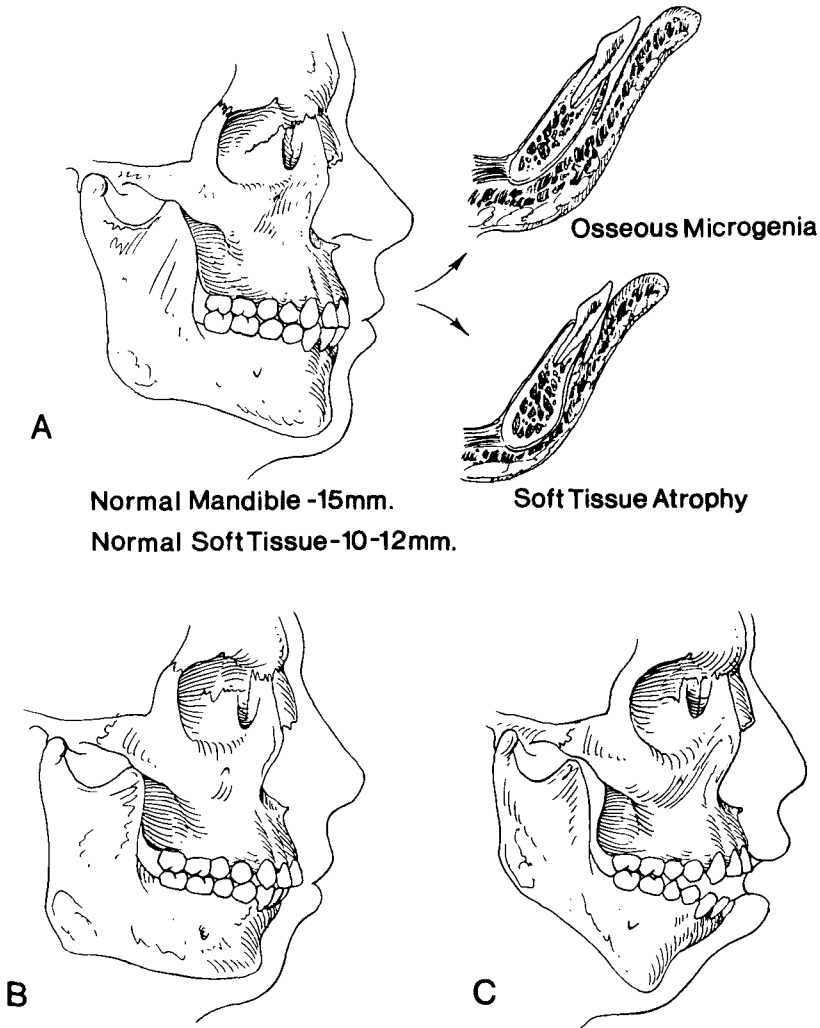**Normal Soft Tissue-10-12mm.**

Soft Tissue Atrophy

Fig. 6   A) Normal skeletal and soft tissue anatomy with good nose/lip/chin balance. "Osseous Microgenia," small symphysis width (< 15 mm and/or retropositioned symphysis. "Soft Tissue Atrophy," normal size and position of symphysis with thin (< 10-12 mm) overlying soft tissues. B) Horizontal mandibular deficiency (retrognathic mandible). Mandibular symphysis and overlying soft tissue are anatomically normal with contour deficiency from retropositioned mandible. C) Vertical maxillary excess (Long Face Syndrome). Grossly normal symphysis and overlying soft tissues with contour deficiency from inferior and posterior displacement of mandible by the maxilla.
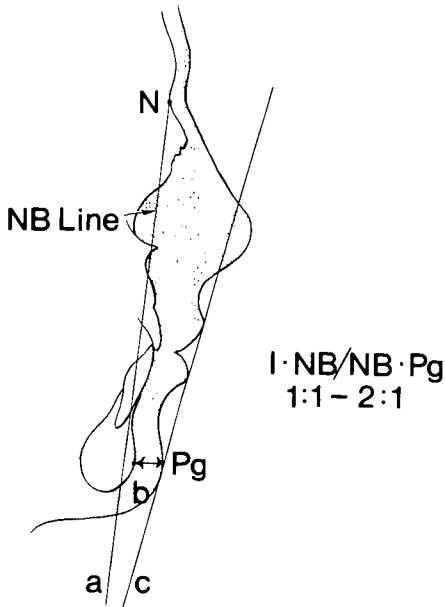
N

NB Line

I·NB/NB·Pg
1:1 — 2:1

Pg

b

a   c

Fig. 7 (a) NB line: lower incisor to NB/NB to pogonion should give a 1:1 to 2:1 ratio for normal tooth/lip/chin balance. (b) Thickness of overlying soft tissue chin should be 10-12 mm. (c) Profile line, formed as a tangent between soft tissue chin and upper lip should bisect the nasal philtrum for normal nose/lip/chin balance.

REFERENCES

1. Hinds, E. C., and Kent, J. N.: *Surgical Correction of Developmental Jaw Deformities*, St. Louis, 1972, C. V. Mosby.
2. Hambleton, R. S.: Soft tissue covering of the skeletal face as related to orthodontic problems. *Am. J. Orthodont.* 50:405, 1964.
3. Gonzales-Ulloa, M., and Stevens, E.: Role of chin correction in profileplasty. *Plast. Reconstr. Surg.* 41: 477, 1968.
4. Fitzpatrick, B.: Reconstruction of the chin in cosmetic surgery (genioplasty). *Oral Surg.* 39:522, 1975.
5. Merrifield, L. L.: Profile-line as an aid in critically evaluating facial esthetics. *Am. J. Orthodont.* 52:804, 1966.
6. Hofer, O.: Die Osteoplastiche Verlaengerung des Unterkiefers nach von Eiselberg bei Mikrogenie, *Dtsch Zahn Mund Kieferheilkd.* 27:81, 1957.
7. Neuner, O.: Correction of mandibular deformities. *Oral Surg.* 36:779, 1973.
8. Hinds, E. C., and Kent, J. N.: Genioplasty: the versatility of horizontal osteotomy. *J. Oral Surg.* 27:690, 1969.
9. Obwegeser, H.: The surgical correction of mandibular prognathism and retrognathia with consideration of genioplasty. *J. Oral Surg.* 10:677, 1957.
10. Converse, J. M., and Wood-Smith, D.: Horizontal osteotomy of the mandible. *Plast. Reconstr. Surg.* 34: 464, 1964.
11. Fitzpatrick, B. N.: Genioplasty with reference to resorption and the hinge sliding osteotomy. *J. Oral Surg.* 3: 247, 1974.
12. Bell, W. H., and Dann, J. J.: Correction of dentofacial deformities in the anterior part of the jaws. *Am. J. Orthodont.* 53:262-284, 1967.
13. Carlin, G. A.: Personally fabricated chin implants. *Plast. Reconstr. Surg.* 51:121, 1973.
14. Dingman, R., and Grabb, W. C.: Costal cartilage homografts preserved by irradiation. *Plast. Reconstr. Surg.* 28:562, 1961.
15. ———: Follow-up on the use of costal homografts, preserved by radiation. *Plast. Reconstr. Surg.* 50:516, 1972.
16. Penn, J.: Use of bovine grafts to the chin to restore facial balance. *Trans. Third International Congress of Plastic Surgery.* Amsterdam, Excerpta Medica Foundation, 1963, p. 533.
17. ———: Kiel-bone implants to the chin and nose. *Plast. Reconstr. Surg.* 42:303, 1968.
18. Bell, W.: Correction of the contour deficient chin. *J. Oral Surg.* 27:110, 1969.
19. Wray, R. C.: The use of silicone chin implants in plastic surgery: a method of chin augmentation. *Southern Medicine J.* 67:456, 1974.
20. Mullison, E. G.: Silicones in head and neck surgery. *Arch. Otolaryngol.* 5:481, 1972.
21. Limberg, A.: Use of diced cartilage by injection with a needle. *Plast. Reconstr. Surg.* 28:523, 1961.
22. Converse, J. M.: Restoration of facial contour by bone grafts introduced through the oral cavity. *Plast. Reconstr. Surg.* 6:295, 1950.
23. Marzoni, F. et al.: An experimental study of silicone as a soft-tissue substitute. *Plast. Reconstr. Surg.* 24: 600, 1959.
24. Aufricht, G.: Combined plastic surgery of the nose and chin: résumé of 27 years experience. *Am. J. Surg.* 95:231, 1958.

25. Gonzales-Ulloa, M., and Stevens, E.: Implants in the face. *Plast. Reconstr. Surg.* 6:295, 1950.

26. Freeman, B. S., et al.: Experiments with injectable plastics use of silicone and silastic rubber in animals and its clinical use in deformities of the head and neck. *Am. J. Surg.* 112:534, 1966.

27. Harris, H. I.: The use of silicones in maxillofacial abnormalities. *Plast. Reconstr. Surg.* 43:419, 1964.

28. Robinson, M., and Shuhen, R.: Bone resorption under plastic chin implants. *J. Oral Surg.* 27:116, 1969.

29. Irby, W. H.: *Current Advances in Oral Surgery.* C. V. Mosby Co., 1974.

30. Homsy, C. A., et al.: Dynamic stabilization of implant prosthesis. *J. Bone and Joint Surg.* 52A:604, 1970.

31. Janeke, J. B., et al.: Proplast in cavity obliteration and soft-tissue augmentation. *Arch. Otolaryngol.* 100:25, 1974.

32. Homsy, C. A.: Implant stabilization: chemical and bromechanical consideration. *Orthop. Clin. North. Am.* 4:295, 1974.

33. Homsy, C. A., et al.: Porous implant system for prosthesis stabilization. *Clin. Orthop.* 89:220, 1972.

34. Clinical Evaluation Report—Proplast Dentofacial Applications, *Smith, Kline and French,* 1975.

35. Kent, J. N., et al.: Proplast in dental facial reconstruction. *Oral Surg.* 39:347, 1975.

36. Proplast: A New Porous Composite Material for Dentofacial Prosthesis. *Smith, Kline and French.*

37. Burstone, C. V.: Lip posture and its significance to treatment planning. *Am. J. Orthodont.* 53:262-284, 1967.

38. McNeill, R. W., et al.: Skeletal relapse during intermaxillary fixation. *J. Oral Surg.* 31:212-227, 1973.

39. Hohl, T. H., and Epker, B. N.: Macrogenia: a study of treatment results with surgical recommendations. *Oral Surg. Oral Med. Oral Path.* 41:545-567, 1976.

40. Epker, B. N., and Wolford, L. M.: Middle third facial osteotomies: their use in the correction of acquired and developmental dentofacial and craniofacial deformities. *J. Oral Surg.* 33:491, 1975.

41. Fromm, B., and Lundberg: The soft tissue facial profile before and after surgical correction of mandibular protrusion. *Acta Orthodont. Scand.* 28:157, 1972.

42. Burstone, C. J.: The integumental profile. *Am. J. Orthodont.* 44:1-25, 1958.

43. ———: Integumental contour and extension patterns. *Angle Orthodont.* 29:93-104, 1959.

44. Nanda, S. K.: Morphology of the human chin from cephalometric measurements. *J. Dent. Res.* 44:828, 1965.

45. Ricketts, R. M.: Planning treatment on the basis of the facial pattern and an estimate of its growth. *Angle Orthodont.* 14:37, 1957.

46. Hambleton, R. S.: Soft tissue covering of the skeletal face as related to orthodontic problems. *Am. J. Orthodont.* 50:405-420. 1964.

47. Gonzales-Ulloa, M., and Stevens, E.: Role of chin correction in profileplasty. *Plast. Reconstr. Surg.* 41:477-486, 1968.