Aesth. Plast. Surg. 29:222–229, 2005
DOI: 10.1007/s00266-004-1023-3

Aesthetic Plastic Surgery

Contour of the Lower Third of the Face Using an Intramusculary Injectable Implant

Almir Moojen Nácul

Porto Alegre, Brazil

Abstract.
Background: The mandible contour plays a major role in the beauty and youthful look of the face. Few methods are available to create or recover facial contours. The author advocates the use of injectable polymethylmethacrylate microspheres suspended in a solution of sodium hyluronate 2%, D-1 propanodiol 10%, and apyrogenous solution 2.5 ml, applied by means of a minimally invasive procedure into deep anatomic planes. The biomatertal is injected in the muscle using microcannulas.
Methods: A review of charts from January of 2001 to December of 2003 was undertaken to search the clinical outcomes from this therapy.
Results: This technique for contouring the lower third of the face has been used for 487 patients along 1,383 different sites. There were no significant complications.
Conclusions: Excellent results and a high degree of satisfaction were achieved among the patients and the medical staff.

Key words: Chin—Contour—Face—Implant—Intramuscular—Mandible

A well-defined mandibular line, a well-proportioned chin, and a demarcated mandibular angle that limits the lower third of the face are considered attractive aesthetic elements. These atributes characterize a youthful face, both in men and in women, and determine the aesthetic transition from the face to the neck.

Correspondence to Almir Moojen Nácul, Rua Quintino Bocaíuva 1086, Porto Alegre/RS, Brazil 90440-050; *email:* nacul@clinicanacul.com.br

The contour of the lower third of the face is determined by the lower edge of the mandible. Anatomically, the mandible is divided into ascending branch, horizontal branch, and chin (Fig. 1). The chin is the prominent part of the mandible with its overlying soft tissue parts. The meeting of the posterior edge of the ascending branch with the lower edge of the horizontal branch forms the mandibular angle. The space between the chin and the mandibular angle (Gonion) will here be called the mandibular line. The lower third of the face is limited by the posterior line of the ascending branch of the mandible and the mandibular line.

The purpose of this report is to describe the technical guidelines for the intramuscular use of injectable polymethylmethacrylate microspheres suspended in a solution of sodium hyluronate 2%$_s$ D-1 propanodiol 10%, and apyrogenous solution qsp 2.5 ml to improve the contour of the lower third of the face.

Materials and Methods

A review of charts from January of 2001 to December of 2003 was undertaken to search for clinical outcomes from the use of intramusculary injectable polymethylmethacrytate microspheres suspended in a solution of sodium hyluronate 2%, D-1 propanodiol 10%, and apyrogenous solution qsp 2.5 ml for contouring the lower third of the face.

Injections were performed using a microcannula with a blunt tip that does not injure vessels or nerves. With this microcannula, it is safe to work in deep anatomic, planes in a closed field, thus reducing the pain during the procedure. (Fig. 2).

To Introduce the microcannula through the skin, it was necessary first to perforate the skin with an

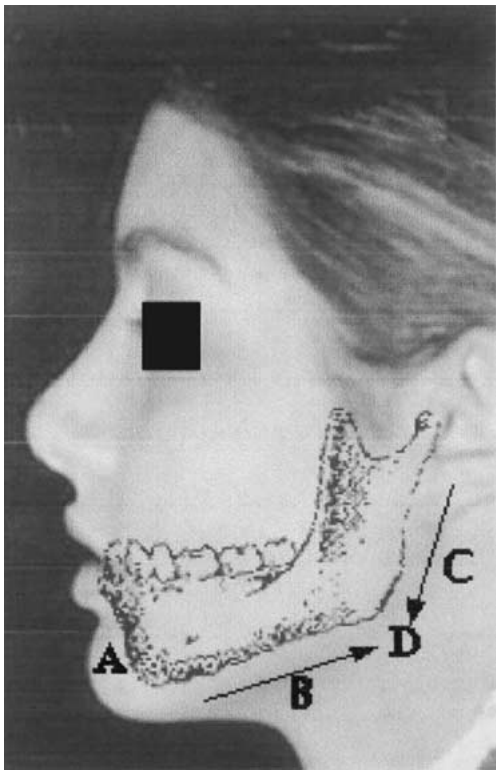

Fig. 1. Scheme representing the position of the mandible on the face. (**A**) Chin. (**B**) Horizontal branch. (**C**) Ascending branch. (**D**) Mandibular angle (Gonion).

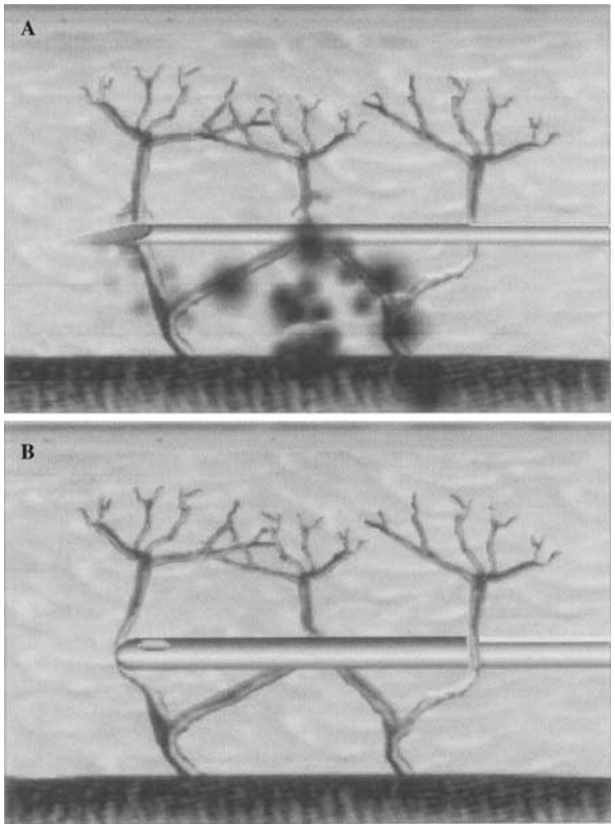

Fig. 2. Diagram showing the use of a needle (*above*) and microcannula (*below*).

18-G1½ (40 × 12) needle. The needle then was changed to a microcannula, which was inserted into the subcutaneous layer.

For these procedures, anesthesia usually is not necessary, except for the dermis where perforation with the needle is performed. The microcaanula is attached to a syringe connected to an injection pistol. With this pistol, a known quantity of the product is gradually released, allowing safe control over the amount of implant applied.

In the chin and mandible line, the implant was injected right above the periosteus, within the muscles and in the deep subcutaneous plane. At the mandibular angle, the application penetrated the fascia of the masseter muscle, parallel to the parotid gland in the lower portion. The biomaterial was injected at a deep level, within the muscle plane of the masseter. No dressings or micropore were applied.

Results

During the 4-year period, 487 patients underwent 1,383 procedures involving biomaterial implant. No cases of extrusion of material or other complications caused by the implant were observed among the patients in this series during the median follow-up period of 17 months (range, 5–41 months).

Case Reports

Case 1

A 62-year-old white woman had undergone excessive subplatismal fat removal and submental skin removal previously elsewhere. (Fig. 3A and 3C). The facial deformity was corrected with injectable polymelhylmethacrylate microspheres suspended in a solution of sodium hyluronate 2%, D-1 propanodiol 10%, and apyrogenous solution qsp 2.5 ml using a microcannula. Altogether, 7 ml of the material was injected in the muscle and the subcutaneous layer. The upper and lower lips also were corrected with implant injections. Figure 3B and D show this patient 14 months after the procedure.

Case 2

A 19-year-old white boy presented with a hypotrophic chin and an ill-defined mandibular line (Fig. 4A, and C, E). The patient underwent an injection of injectable polymethylmethacrylate microspheres suspended in a solution, of sodium hyluronate 2%, D-1 propanodiol 10%, and apyrogenous solution qsp 2.5 ml by a microcannula inside the muscles. Altogether, 4 ml was injected in the chin,

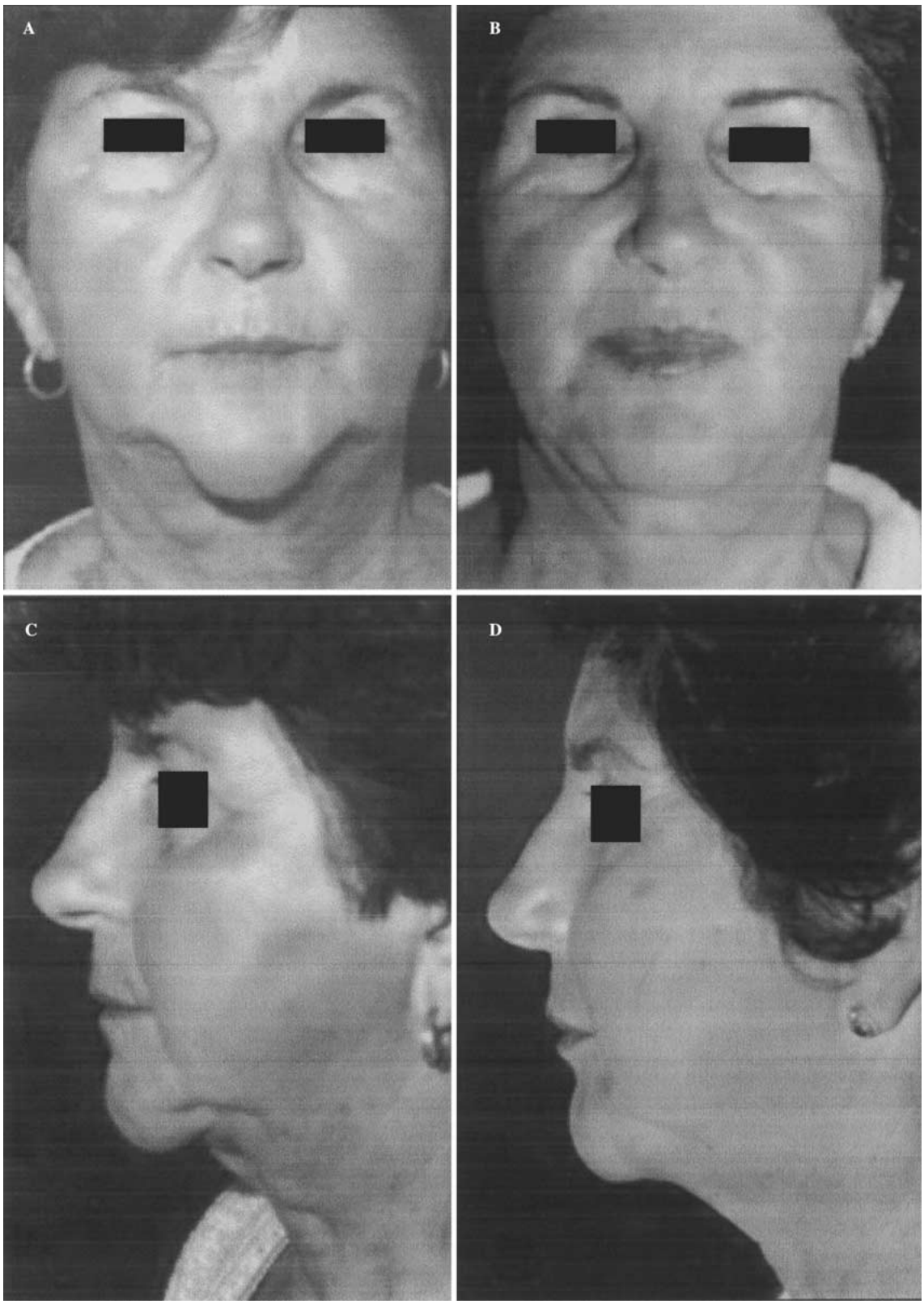

Fig. 3. (**A, C**) Frontal and lateral views before injection. (**B, D**) At 14 months the patient shows good contour of the lower third of the face (mandibular contour and chin). The upper and lower lips also were augmented.

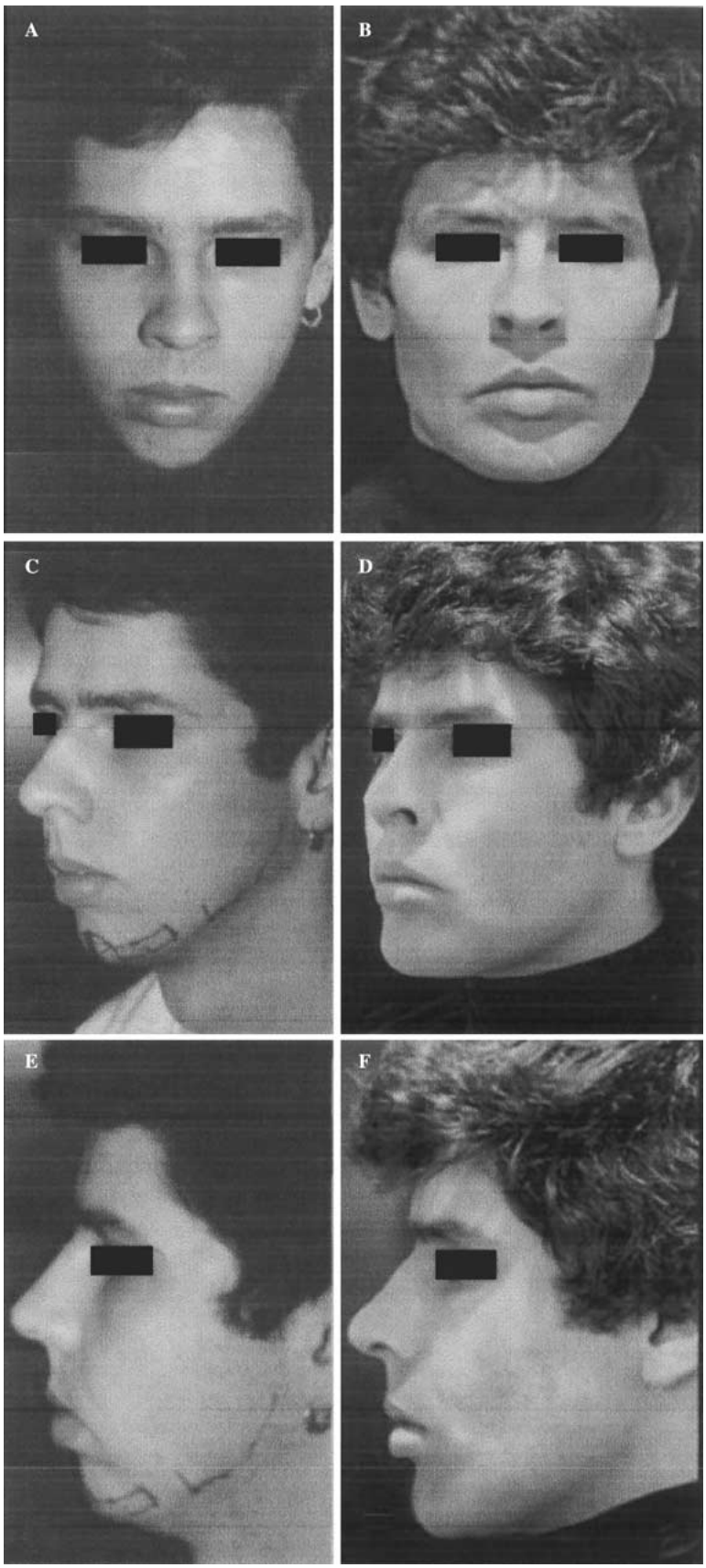

Fig. 4. (**A, C, E**) Frontal, oblique, and viewd before injection. (**B, D, F**) This 3-year result shows an important improvement along the mandibular line, mandibular angle, and chin. Malar and zygomatic areas also were augmented.

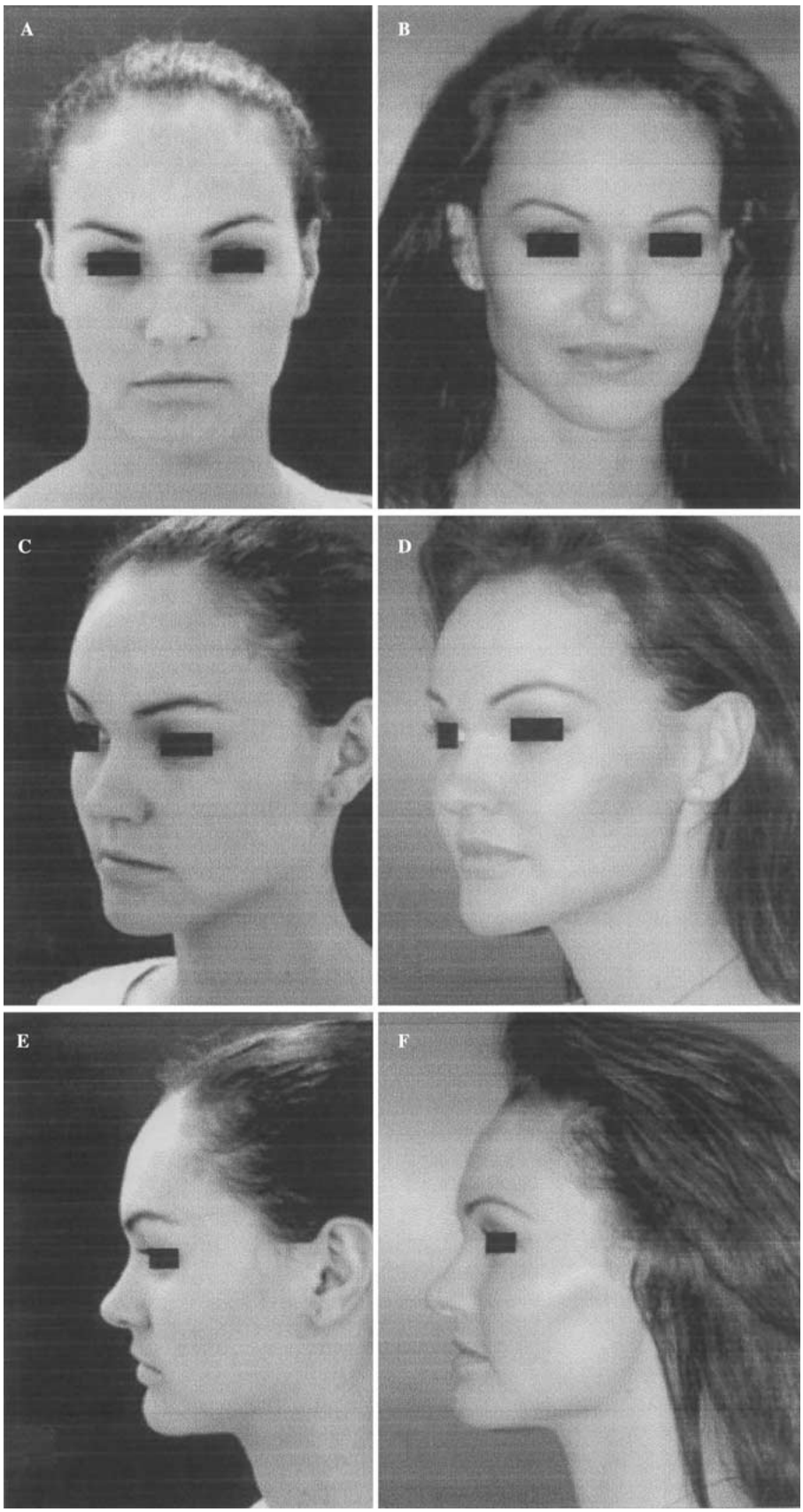

Fig. 5. (**A, C, E**) Frontal, oblique, and lateral views before implant injection. (**B, D, F**) At 6 months the patient shows pleasant lines along the mandibular line and mandibular angle. The malar, zygomatic area, and upper lip also were augmented.

7 ml on each side of the mandible line, and 8 ml inside each masseter muscle. The malar and zygomatic areas also were augmented. Figure 4B, D, and F show this patient 36 months after the procedure.

Case 3

A 22-year-old white woman presented with a hypotrophic line and chin (Fig. 5A, C, and E). The patient underwent an injection of injectable polymethylmethacrylate microspheres suspended in a solution of sodium hyluronate 2%, D-1 propanodiol 10%, and apyrogenous solution qsp 2.5 ml by a microcannula inside the muscles. Altogether, 1.3 ml was injected on each side of the mandible line and 3.5 ml within each masseter muscle. The upper lip and the zygomatic and malar areas also were augmented. Figure 5B, D, and F show this patient 6 months after the procedure.

Discussion

A small mandible can be a racial or structural characteristic. However, it also may occur as the result of changes in. the growth of the lower third of the face. Facial trauma may result in mandible deformities or asymmetries [3]. These abnormalities may become even more obvious as the face ages.

Bones grow by the deposition of bony tissue on one surface and absorption on the opposite surface. This combines to produce growth movement or "drift" in a specific direction. Bones of the face are covered on the outside by periosteum and on the inside by endosteum. These osteoactive membranes cover the bone in a jigsaw-like pattern of growth fields that are responsible for both bone deposition and resorption. This growth is not thought to be programmed within the bone itself, but in its covering osteogenic membranes and functioning soft tissues such as tendons, muscle, mucosa, and brain.

The rate of activity in differential growth fields vary according to the specific function and growth of the surrounding soft tissues. Certain growth fields, such as the mandibular condyle, have special significance in the growth process. Nevertheless, it is a misconception to view them as isolated "growth centers" because all the surrounding bone participates in the remodeling and enlargement that produces the mature facial form.

The process of remodeling and results in the relocation of the component parts to allow for overall growth and to provide structure for the changing physiologic conditions of the encapsulating soft tissues. It also results in each component bone being carried away from its adjacent neighbors, a process called primary displacement. Primary displacement occurs as a result of a bone's own. growth, and its direction generally is in the direction opposite that of bone deposition. For example, as the mandible is carried forward by its growing soft tissues, it is displaced anteriorly and inferiorly from, the temporal mandibular joint. In response, the condyle and the ramus grow by deposition in a posterosuperior direction, in effect filling the space caused by the displacement. Similarly, as the nasomaxillary complex is displaced anteriorly and inferiorly, bone deposition occurs at the multiple sutural interfaces between the maxilla and the adjacent bones of the face. In other words, bone growth at the sutures is not responsible for the projection of the maxilla, but rather is the result of it. Furthermore, the bones of the face also are secondarily displaced by the enlargement of the adjacent bones, such as occurs with the downward and forward displacement of the maxilla as a result, of cranial enlargement.

The mandible undergoes significant changes during the aging process. As teeth are lost, the alveoli are reabsorbed, causing a loss of vertical dimension as well as a retrusion of this area. With the lack of proportion between bone support and soft tissues, the skin, and fat accumulate in ptotic folds on the mandible line, forming gravity pouches. The only area in which the skin remains attached to the mandible is in the firm insertion of the superficial aponeurotic muscle system (SMAS) around the chin. The apex of the chin goes down to below the mandibular margin. Adept submental sulcus creates an aspect of a suspended mass, called "witch's chin." When associated with the prominence of the labialmental (genian) sulci, this creates the appearance known as "marionette sulci." Also, as the patient ages, the lateral projection of the ascending branch of the mandible is effaced. The mandibular angle increases slowly. From values of 95° to 100°, it reaches values of 130° to 140° [3].

The purpose of the correction to the contour of the lower third of the face is to gain a harmonious and regular transition between the face and the neck, the demarcation of the transition on the lateral view of the face and the proportion between the lower third and the other regions of the face. Modifications to the contour of the lower third of the face can be performed by maxillofacial surgery and orthodontic treatment using conventional plastic surgery techniques and implant materials.

The use of solid implants to correct the lower margin of the mandible has involved various materials. According to Rubin et al. [12], who in 1948 reviewed the literature since antiquity, ivory, bovine bone, and many other materials have been used with variable results to increase the contour of the chin.

Several authors have already described the treatment of the mandible contour using prostheses of alloplastic materials [2,15] such as porous hydroxyapatite [1], titanium [5], silicone [14], and porous polyethylene [13]. For several years, authors have mentioned and insisted that the muscular layer is the ideal tissue layer for the placement of grafts infiltrated to increase facial and body contour and volume [14,18,20,21].

The use of Bioplastique [4] and polyacrylamide gel [5] injectable implants for contouring the lower third of the face has been reported, but the techniques describe only the approach for the subdermal or deep subcutaneous plane.

The search to discover nonsurgical options for facial treatment has increased considerably because many patients are reluctant to undergo a surgical procedure, or even an orthodontic correction. Because most patients desire a cosmetic improvement with a short recovery period, the use of minimally invasive methods has become significant in plastic surgery.

Historically, implants have been inserted subperiosteally [14,16], and complications usually occur with subcutaneous implantation [17,19]. The use of implants injected into the masseter muscle to increase its volume has not been reported previously in literature. The injection into the intramuscular layer provides a more natural result because the consistency achieved, even if more dense, cannot be palpated. Also, if small irregularities occur, they are not visible. The author termed this technique "bioplasty," contouring with the use of injectable implants.

Bioplasty was described in 1992. Initially, the material used was injectable implant with solid particles of dimethylpolyxyloxane in a nonproteic fluid [5–10]. Since 1996, an injectable implant with polymethylmethacrylate microspheres suspended in a solution of sodium hyluronate 2%, D-1 propanodiol 10%, and apyrogenous solution qsp 2.5 ml has been used. It can be used as a pure technique or as a technique to complement conventional plastic surgery, maxillofacial surgery, or oxthodontics for cases in which the functional result obtained was satisfactory, but the aesthetics can be further improved [11].

Injections of the implant are very safe because the microcannulas have a blunt tip. Accidents that could be caused by intravascular injection or by injury to the major structures were avoided, thus diminishing the amount of ecchymoses (Fig. 5), although no procedure is entirely without complications. Adverse reactions after injection of these materials are rare, although there are a few reported cases attributable to bad technique or anomalous granulomatous reactions. These reactions usually are foreign body granulpmas, extrusion, dislocation, or infection. None of these complications were observed in this series.

For selected patients with moderate flaccidity, facial contour may be corrected using this technique with good results, postponing facial surgery. Increasing the volume of the area involving the maxillary angle and the lateral expansion of the mandibular line supplies sufficient distension of the submental skin, and the neck to diminish the flaccidity of the skin in this region. For patients with excessive flaccidity who manifest an indication for treatment of the cervical region or submentum where fat has accumulated, bioplasty may be useful as a complement to conventional plastic surgery to improve the result.

This powerful combination of lifting and filling together allows the surgeon a better opportunity to obtain the goals of facial rejuvenation by adding the missing dimension. All the patients in this series and those described by the case reports have an evolution without: complication and remain very satisfied with the results achieved during the follow-up period.

The use of an injectable implant next to the parotid gland or the submandibular region requires knowledge concerning the anatomy of this region, practice, and skilled hands.

Bioplasty is very effective for correcting localized areas, making it possible to improve facial contour in cases for which surgery alone would not be effective, and for correcting deformities that are difficult to correct by conventional methods. The procedure is well controlled, predictable, and reproducible.

Conclusion

The use of injectable implant using a minimally invasive technique for the chin and for the mandibular line and angle is a good alternative for treating these regions. They also may be used both during surgery and postoperatively to improve the result of conventional plastic surgery. Moreover, they may be used as a complementary technique for maxillofacial surgery or orthodontics when the functional result achieved has been satisfactory, but can be further improved aesthetically.

References

1. Astoh K, Nakatsuka K: Simplified procedure for aesthetic improvement of facial contour by maxillary deformity. *Plast Reconstr Surg* **97:**338–344, 1996
2. Constantino PD: Sinthetic biomaterials for soft tissue augmentation and replacement in the head and neck. *Otolaryngol Clin North Am* **27:**223–262, 1994
3. Enlow DH: *Facial growth* 3rd ed. WB Saunders, Philadelphia, 1990
4. Ersek RA, Stoval RB, Salisbury AV: Chin augmentation using minimally invasive technique and Bioplastique. *Plast Reconstr Surg* **95:**985–992, 1995
5. Filatov AV, Miroliubov SN: Soft Tissue contour plastic repair of the maxillofacial area using a biologically compatible polyacrylamide gel. *Stomatology (Mosk)* **77:**45–47, 1998
6. Nácul AM, Born AG: Bioplastique na Correção de contornos da face e do nariz: In: Horibe EK (ed) *Estética clinica e cirúrgica*, 1999, 167–170
7. Nácul AM, Nácul AP: Correção de narizes primários e secundários por processo minimamente invasivo (Bioplastique) In: Tornieux AAB, Curi MM (eds) II *Atualização em cirurgia plastica—SBCP* Robe: Brasília, pp 625–632, 1996
8. Nácul AM, Nácul AP, Born AG: Bioplastique as a complement in conventional plastic surgery. *Aesth Plast Surg* **22:**444–450, 1998

9. Nácul AM, Nácul. AP, Born AG: Uso de Bioplastique nas Perfiloplastias. In: Tornieux AAB (ed). *Atualizagao Cirugia Plástica SBCP* Robe: Brasilia, 1999
10. Nácul AM, Nácul MP: Uso de microparticulas sólidas injetáveis na correção de tecidos moles. *Arq Catarinenses Med* **23:**114, 1994
11. Nácul AM, Nácul MP, Nácul AP: Correção dos contornos dos tecidos moles com microparticulas sólidas injetáveis (Bioplastique): Dots anos de experiência. *Ver Soc Bras Cir Plast Estet Reconstr* **10:**15, 1995
12. Rubin LR, Robettson GW, Shapiro RN: Polyethylene in reconstructive surgery. *Plast Reconstr Surg* **3:**586, 1948
13. Scaflani AP, Romo T: Injectable fillers for facial soft tissue enhancement. *Facial Plast Surg* **16:**29–34, 2000
14. Spadafora A, De los Rios E, Toledo Rios R: Flat cheeks: Polyethylene endoprostheses inserted subperiosteally along the zygomatic arch. *Prensa Med Argent* **58:**1946–1950, 1971
15. Terino EO: Implants for male aesthetic surgery. *Clin Plast Surg* **18:**731–749, 1991
16. Thinderer UT: Nasal base, maxillary, and infraorbital implants—alloplastic. *Clin Plast Surg* **18:**87–105, 1991
17. Travis WD, Balogh K, Abraham JL: Sillcone granulomas: report of three and review of the literature. *Hum Pathol* **16:**19–27, 1985
18. Tromovitch TA, Stegman SJ, Glogau RG: Zyderm collagen: Implantation technics. *J Am Acad Dermatol* **10(**2 Pt 1**):**273–278, 1984
19. Watanabe Y, Nishijima K, Morita T, Ueda H, Takanashi Y: Three cases of facial disfigurement due to injection of unknown material in the buccal region for the cosmetic purpose. *Keisei Geka*. **12:**356–362, 1969
20. Webster RC, Gaunt JM, Hamdan US, Fuleihan NS, Smith RC: Injectable silicone for facial soft tissue augmentation. *Arch Otolaryngol Head Neck Surg* **112:**290–296, 1986
21. Webster RC, Kattner MD, Smith RC: Injectable collagen for augmentation of facial areas. *Arch Otolaryngol* **110:**652–656, 1984