AN HISTORIOGRAPHY OF PALATAL PROSTHESIS

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VOLUME II

DOCTOR OF DENTAL SURGERY
UNIVERSITY OF EDINBURGH
1974
ACKNOWLEDGEMENTS

The author gratefully acknowledges the co-operation of the following individuals and institutions in permitting reproduction of illustrations from works in their possession.

The British Dental Association (B.D.A.)
The British Museum (Brit. Mus.)
R. D. Gain Esq.
J. K. Glaysher Esq.
The Royal College of Surgeons of England (R.C.S.)
The Royal Society of Medicine (R.S.M.)
Bibliothèque Nationale Suisse (Bibl. Nat.)
Messrs. Weinreb and Douwma.
The Wellcome Institute of the History of Medicine

(Wellcome Inst.)

The source of each figure is indicated in brackets following the caption. Where no acknowledgement is given, the material is derived from the author's own clinical work or volumes in his possession.
Figure 1. A plate from Cullerier’s 1819 publication. The types of palatal obturators illustrated include:

Figs. 1,7,8,10,13; winged obturators.
Figs. 6,9; bolt obturators.
Figs. 2,4,5; sponge obturators.
Fig. 3; turnbuckle type.
Figs. 11,12; spring type.

(R.S.M.)
Figure 2. Maury's signature on a copy of his book presented to Koecker.

(R.S.M.)
Figure 3. Detail from the Sculpture of Demosthenes.
(Brit. Mus. No. 1840).
Figure 4. The travels of Amatus.

(The map, Patriarchatus Antiqui, made available by Weinreb and Douwma Ltd.)
Figure 5. Places visited by Paré in the course of his professional duties.

Key

- Battles.
- Places visited during the Royal Tour with Charles IX.
- Other places at which patients were treated.
Le moyen d'adapter un instrument au palais pour rendre la parole mieux formée. 

VELQYEFIS VNE portion de l'os du palais est brisée & emportée par coup de haquebutte ou autrement, où bien par vècre de verolle, & que pour cette cause les patients ne puissent bien prononcer leur parole, sinon avec grand' difficulté : ils pourront recouvrir la parole par l'aide & ministère de notre art. Ce qui se fera en appliquant un instrument un peu plus grand que le trou où l'os défaut. Et ledit instrument sera fait d'or ou d'argent, & de figure voutée, & delié, d'espefler comme d'un escu : auquel fera attaché vne esponge, par laquelle eftant mis ledit instrument au trou où manquera l'os, ladite esponge affez toit l'imibera & l'enflera par certaine humidité, & puis après tiendra ferme. Et par ce moyen la parole se formera mieux : ce que j'ay vue aduenir aux guerres quelquefois par coups de haquebutte & autres, & principalement (comme j'ay dit) par vècres provenus de la verolle. Or tu as icy le pourtraict des instruments dont il est mention.

Figure des instruments dits Obturateurs du palais.

Autre instrument sans esponge, lequel a une eminence par derrière qui se tourne avec un petit bec de Corbin (que tu vois en cette figure) lors qu'on le met dans le trou.

Figure 6. Paré's obturators from the 1575 edition of "Les Oeuvres".
DE LA TESTE.

Des playes & fractures des os de palais.

Les playes de palais sont faictes de playes pure & d'une in-
strhumet, comme nous avons par ce deusen dit. Parproxy & nous suivre le faire par-
separé dont palais peut se faire, Besoin 
comportant par coe de bagueuse ou autrement, sa bien parefrere de roy-
ble, on que pour cet cause les patients suprême bien prononcer leur parole, 
fin ain la grand difficult de pouvant 
renouer la parole par-de y bomini 
flere de notre air. Ce qui se fer en ap-
pliquant un instrument un peu plus 
grand que le trou ou le defauts. Et 
etant instrument fier fait d'un ou d'aut-

Figure 7. Paré's original description of his obturators. Three pages from his work of 1561.

(Brit. Mus.)
Figure 8. Guillemeau's concept of Paré's obturator. The lettering is explained in section 3.7.3.

(R.S.M.)
Figure 9. Pledgets used by Fabry to pack a palatal defect. Fifteen were used in the case described in section 3.9.3. The illustrations are the same size as in the editions cited.

(Wellcome Instit.)
Figure 10. Fabry's sponge obturator.

(Wellcome Instit.)
Figure 11. The palatal obturator as illustrated in various editions of Schultes' work. Discussion of these engravings appears in section 3.13.2. (Cf. vi with figure 10 depicting Fabry's obturator).
Figure 12. Richard Wiseman, a portrait from Sir Thomas Longmore's work.

(Wellcome Inst.)
Figure 13. Garengeot's obturator, without sponge attached. The lettering is explained in section 4.2.2

(Wellcome Instit.)
Figure 14. An illustration from James' "Medicinal Dictionary". fig. 4 reproduced Fabry's plate to which a sponge might be sewn (cf. figures 10 and 11). fig. 5 was re-engraved from Heister's work with a slightly varied perspective.

(Wellcome Instit.)
Figure 15. A plate from Weiss' catalogue illustrating an obturator of the rotating wing type. The mechanism is described in section 4.8.2. (cf. Fauchard's design figure 18).

(R.S.M.)
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(R.S.M.)

Figure 17. Snell's palatal prosthesis and the mouth for which it was prepared.

(R.S.M.)
Figure 18. f.1 - f.9, f.11 and f.12; the individual and assembled components of Fauchard's first obturator: f.10; the key to operate the wing mechanism. f.13 - f.16; the components and assembled form of the second obturator retained by a rotating wing.

(B.D.A.)
Figure 19. Fauchard's third appliance, a combined obturator/denture retained by a wing mechanism. F.16 represents the key for operating the mechanism.

(B.D.A.)
Figure 20.  f.1 - f.17; aspects of Fauchard's fifth appliance, a further obturator/denture. f.18; a partial denture with sponge obturator and ligatures (the fourth appliance).

(B.D.A.)
Figure 21. A plate from Bourdet's work illustrating a simple cover (Fig. 4) and a mechanical obturator (F.1, F.2, F.3 and Fig. 5). The components of the latter are described in section 5.3.1, observation 5.

(B.D.A.)
Figure 22. A palatal obturator described by Bourdet in his fourth observation. The mechanism is described in section 5.3.1.

(B.D.A.)
Figure 23. Jourdain's palatal prosthesis. The explanation of the lettering appears in section 5.4.1.

(B.D.A.)
Figure 24. Illustrations from de Chémant's work. F.13 and F.5 represent combined obturators and partial dentures; F.7 a form of soft palate prosthesis of unknown material.

(B.D.A.)
Figure 25. A second plate from Cullerier's 1819 publication. (See also Figure 1). The types of palatal obturator illustrated include:

Figs. 1, 3, 4 and 5; elevating wing obturators.
Fig. 2; du Bois-Foucou's obturator with zig-zag arms to the retaining teeth.
Fig. 9; rotating wing obturator.
Figs. 6 and 7; keys for operating the retaining mechanisms.

(R.S.M.)
Figure 26. A plate from la Forgue's work. The various types of obturator are described in section 5.6.1.

(R.S.M.)
Figure 27. A plate from Cullerier's 1804 publication. Compare with figures 1 and 25.

(R.S.M.)
Figure 28. The components of a reproduction model (x 2) made from Cullerier's description of Codan's obturator. (cf. figure 27 XI - XIII).

(J. K. Glaysher Esq.)
Figure 29. Touchard's combined obturator and denture. The annotation is explained in section 5.6.4.

(R.S.M.)
Figure 30. de la Barre’s palatal obturators. Fig. 118 illustrates aspects of a juxtaposed obturator with “elastic springs” and Fig. 118 bis, an obturator à chapeau with a replacement section of the vomer.

(B.D.A.)
Figure 31. A combined complete denture and palatal prosthesis, with movable soft palate, designed by de la Barre.

(B.D.A.)
Figure 32. Types of palatal obturator illustrated by Maury and described in section 5.6.7.

(B.D.A.)
Figure 33. A combined palatal and nasal prosthesis by Schange.

(B.D.A.)
Figure 34. Palatal prostheses by Schange. Note the use of occlusal rests to support the appliances.

(B.D.A.)
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(B.D.A.)
Figure 36. A juxtaposed obturator which le Foulon designed to be supported from the lower dental arch by springs.

(R.S.M.)
Figure 37. A child's bonnet, used to support a combined orthodontic and prosthetic appliance, similar to the reference made by Jourdain (See section 5.6.10 ii).

(R. D. Gain Esq.)
Figure 38. Charrièré's obturator as illustrated by Gaujot and Spillman.

Upper left; the palatal defect.
Lower left; palatal view of the obturator.
Right; views of the obturator and the appliance for operating the flap mechanism.
Figure 39. A modern mechanical obturator. The wings or flaps are operated by wires attached to a molar tooth. The upper illustration shows the flaps elevated and the lower, the flaps depressed.

(R. D. Gain Esq.)
Figure 40. A further plate from Maury's work. 3 represents a juxtaposed obturator for positioning over a palatal defect following the loss of a sequestrum, 2. (See also figure 32). The remaining representations illustrate aspects of springs and swivels used to maintain prostheses in position.

(B.D.A.)
Figure 41. Preterre's method of attaching a retaining spring to a band placed around a lower, natural tooth.

(R.C.S.)
Figure 42. Springs and swivels used to retain a combined obturator/denture from a removable overlay on the lower teeth.

(R. D. Gain Esq.)
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Figure 44. A flap velum designed by Preterre. The flap, E, is supported by the spring loaded cantilever, D. The cast of the mouth, on which the appliance rests, appears to be identical to that in figure 45. The latter design was taken from a different publication.

(R.C.S.)
Figure 45. A further flap velum designed by Preterre. The prosthesis is described in section 6.2.5. (cf. figure 44).

(R.S.M.)
Figure 46. Sercombe's flap velum.

(B.D.A.)
Figure 47. Williams' flap velum.

(B.D.A.)

Figure 48. Parkinson's flap velum. The view of the oral surface is on the left, the nasal surface appears on the right.

(B.D.A.)
Figure 49. Guérini's flap velum.
Figure 50. Delair's flap velum. The hinged flap is supported by an elastic band, c.

(B.D.A.)

Figure 51. The Ruppes' flap velum viewed from the superior aspect. CC represent two hooks around which a rubber band is applied.

(B.D.A.)
Figure 52. A simple flap velum of soft vulcanite mounted on a struck gold plate. Early 20th century.

(R. D. Gain Esq.)
Figure 53. A hard vulcanite partial denture carrying a soft vulcanite flap velum. The anterior part of the velum is grooved laterally to accommodate the margins of the cleft palate: an extended flap carries inferiorly and posteriorly to contact the posterior wall of the pharynx deep in the oropharynx.

(R. D. Gain Esq.)
Figure 54. Payne's flap velum. The left-hand illustration demonstrates the velum hinged to a partial denture. The right-hand illustration represents a posterior view of the flap, demonstrating the vertical flanges of soft vulcanite.

(R.S.M.)

Figure 55. Mitchell's hinged flap velum of hard vulcanite.

(B.D.A.)
Charles Woodward Stearns, son of W. Charles
Stearns & M. Julia Stearns, born Sept 12, 1857.

Figure 56. The register entry of Charles Stearns' birth.
Figure 57. Stearns' artificial velum as interpreted by Tucker.

a. Base plate with clasps.
b. Helical springs.
c,d. Aspects of the lateral wings.
e. Central portion, or body, of the velum.

(B.D.A.)
Figure 58. Diagrams of the palate to illustrate Stearns' first classification.
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(B.D.A.)
Figure 60. Stearn's revised classification of palatal defect.
Figure 61. The defect of Kingsley's first palatal prosthesis patient.

(B.D.A.)
Figure 62. Kingsley's first palatal prosthesis.
(B.D.A.)
Figure 63. The prosthesis which Kingsley and Stearns produced in co-operation.
Figure 64. Kingsley's four part mould for processing the artificial velum.

(B.D.A.)
Figure 65. A plaster master mould for processing artificial vela.

(B.D.A.)
Figure 66. A permanent mould of type-metal for processing artificial vela.

(B.D.A.)
Figure 67. The artificial velum which Kingsley finally made for his first palatal defect patient.

(B.D.A.)
Figure 68. Details of the artificial velum of soft rubber, with integral springs, prepared by Kingsley.

A, B. Aspects of the lateral wings.
C. The central body.
D. Pivot hole for attachment to denture.
G. Integral rubber springs.

(cf. figures 57 and 59)

(B.D.A.)
Figure 69. Kingsley's definitive artificial velum.
(B.D.A.)
Figure 70. Rottenstein's artificial velum. The features are explained in section 6.3.3.6.

(B.D.A.)
Figure 71. An artificial velum by Preterre. Note the integral rubber spring.

(R.S.M.)
Figure 72. A further artificial velum by Preterre.
(R.S.M.)
Figure 73. The form of Kingsley's artificial vela. These are same-size reproductions illustrating the range of deformity treated by Kingsley.

(B.D.A.)
Figure 74. Coles' artificial velum demonstrating the method of pivot attachment to the denture base. Compare the form of the appliance with figure 73.

(B.D.A.)
Figure 75. Claude Martin's winged velum.
(B.D.A.)

Figure 76. Kolliker's artificial velum.
(Bibl. Nat.)
Figure 77. Gion's bulb obturator. The apertures to facilitate respiration are guarded by valves.

(R.S.M.)
Figure 78. Ramsay's modification of Kingsley's artificial velum. The oral aspect is depicted on the left, the nasal on the right.

(B.D.A.)
Figure 79. A Suersen bulb fully extended to the cartilaginous tubes of the inner ear.

(B.D.A.)
Figure 80. A modern velar bulb finished in clear acrylic, but moulded in situ as a gutta percha model according to Suersen's method.
Figure 81. Diagrams by Warnekros demonstrating the possible reduction of bulb size in the Suersen prosthesis. (See also figure 95).

(B.D.A.)
Figure 82. A Suersen bulb modified to permit drainage of mucous.

(B.D.A.)
Figure 83. Baker's hinged bulb.

(B.D.A.)
Figure 84. Brugger's hinged bulb.

(B.D.A.)
Figure 85. Juterbock's Cofferdam (B.D.A.).

Figure 86. Case's bulb.
Figure 87. The Ruppes' bulb.

1 and 2; illustrate the airway.
3; the components of the universal joint.
4; a section of the assembled appliance.

(R.S.M.)
Figure 88. Brandt's inflatable bulb mounted on a partial denture.

(B.D.A.)
Figure 89. Martin's water pocket prosthesis.
(B.D.A.)

Figure 90. Martin's hinged bulb prosthesis.
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Figure 91. Hullihen's prosthesis. The domes to occlude the posterior nares are mounted on a slide.

(B.D.A.)
Figure 92. Blandy's prosthesis. The nasal aspect is depicted on the left and the oral aspect on the right.

(B.D.A.)

Figure 93. The meatus obturator as described by Fröschels and Schalit.

(R.S.M.)
Figure 94. A further clinical interpretation of the meatus obturator.

(R. D. Gain Esq.)
Figure 95. Lateral skull radiographs illustrating the contrasting positioning of a Wärnekros style bulb obturator (above) and a meatus obturator (below).
Figure 96. The pharyngeal obturator as illustrated by Wolff.

(R.S.M.)

Figure 97. Shiltsky's pharyngeal obturator.

(B.D.A.)
Figure 98. Brugger's pharyngeal obturator.
(B.D.A.)

Figure 99. Brandt's inflatable pharyngeal obturator.
a. the bulb; b. the connecting tube; c. the valve for inflation.
(B.D.A.)
Figure 100. Warnekros' design of pharyngeal obturator.

(B.D.A.)
Figure 101. The Gillies-Fry procedure. The illustrations of the upper row demonstrate the incisions, lengthening technique and instrument to maintain the repaired soft palate in a distally placed position during suture. The illustrations of the lower row demonstrate the appliance placed in the mouth during the post operative period and the final result obtained.

(Wills).
Figure 102. A partial denture with a hinge velum according to Pickerill's concept. Note the hook on the velum to engage the surgically created muscular bar, the replacement vomer and the pins to engage the root canals of the upper central incisors.

(R.S.M.)

Figure 103. A complete denture with a Pickerill style velum.

(R.S.M.)
APPENDIX
Concepts of soft-palate prosthesis

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ABSTRACT
Since the initiation of soft-palate prosthesis in the eighteenth century, design has been governed by a number of theories concerning the role of the appliance. Six concepts are presented with the aim of demonstrating the evolution of the prosthesis and dispelling the belief that all the appliances of a bygone age have been based on the whimsical notions of their creators.

INTRODUCTION
There have been some rather tenuous justifications made for the study of history. One of the most cogent recently enunciated was that by Patrick Gibbs (1972) in his review of the film Lady Caroline Lamb. Gibb's thesis was that historical fact is infinitely more entertaining than historical fiction. He illustrated his contention by comparing the documented aspects of the affair between Lord Byron and his mistress with the film director's interpretation of the same liaison. Of the two versions, that with the greater historical veracity would seem to have provided more poignancy and intrigue than the contrived account.

So it is, on a rather modified plane, with soft-palate prosthesis. Studies of the original concepts reveal that our predecessors had far greater insight and technical ability than they are, in general, given credit for. That their achievements have been allowed to pale is largely accounted for by the low standard of subsequent re-recordings. Historical notes, when included in a paper or an article on cleft-palate prosthesis, tend to accentuate quaintness rather than application. Indirectly derived and superficially informed, these introductions are designed to illustrate how far we've come since those distant times. The reality is worthy of deeper investigation.

Prostheses for soft-palate deficiency may be divided into six categories:
1. Flap velum.
2. Artificial velum.
4. Combined surgery and prosthesis.
5. Meatus obturator.
6. Palatal support prosthesis.

Flap velum
The prostheses comprising this category were the earliest to be described. Fig. 1 illustrates the design which Jourdain (1778) advocated.

The struck metal plate, A, is hinged at B. The posterior aspect is maintained in contact with the remnant tissues of the soft palate by the spring device, C. Primordial clasps, D, maintain the prosthesis in position. The concept embraced by this design persisted until the 1920's when Payne (1921) presented an essentially similar prosthesis to the Royal Society of Medicine. The passage of 143 years was
reflected only in the choice of material for the flap, which was of soft vulcanite.

There were many variations on this theme between 1778 and 1921. James Snell (1823), the archetypal British soft-palate prosthetist, contributed an article to the *London Medical Repository*. The text and illustration were perhaps purposefully undemonstrative but his appliance was remarkable for the use of rubber for the velar or soft-palate section. Remember that 1823 was in the pre-Goodyear era and therefore the rubber would be in the un-vulcanized form. Snell was giving private courses on the use of this appliance at a time when metal flaps were in general use and the 'crayfish tail' style of velum was coming into vogue. It is known from contemporary evidence (Stearns, 1860) that Nasmyth fitted these appliances which were fashioned of multi-hinged plates. He was wise enough, however, not to commit himself in print.

After the establishment of vulcanized rubber, Sercombe (1857) was amongst those who advocated a simple flap velum. A composite flap of two sheets of soft velar rubber was sewn to a conventional base; the soft-palate section could thus be readily replaced when it showed signs of perishing.

The ultimate in flap-velum technology was achieved, perhaps exceeded, by Preterre whose designs incorporated springs which permitted flexure of the flap in all planes. Preterre exhibited this style of prosthesis at the London International Exhibition of 1862, producing a special bilingual booklet for the occasion.

**Artificial velum**

The concept behind the flap velum was to cover the tissue defect with a mechanical seal; the artificial velum sought not only to replace missing tissue but also to simulate its physiological function. In its purest form it was derived by Charles Stearns, a young Massachusetts doctor who suffered from a congenital division of the soft palate. Surgeons had failed to cobble his palate together by the new operation of staphylorrhaphy and the attempts of dentists to provide an artificial substitute had proved derisory. Stearns carved a mahogany model for his velum, which was then processed in soft vulcanite as a complicated tri-part valve. The valve was attached to a supporting plate by helical gold springs. Stearns made a promotional tour of London and Paris in 1845-6, winning attestations for the effectiveness of his invention. In America, however, his achievement remained unheralded until Norman Kingsley lighted upon it accidentally in 1860. Kingsley was a man of boundless energy, coupled with considerable powers of self-projection and, fortunately, ability. He rationalized Stearns' artificial velum and devised a permanent type-metal mould in which it could be vulcanized. The wave of adulation which greeted Kingsley's contribution to dental science in America carried him across to London, where he was greeted with distant politeness and the doctrine of Sercombe's simple flap velum, and to Paris, where his audiences were already accustomed to the mechanical excesses of M. Preterre. A little chastened, Kingsley returned to New York to devise his definitive artificial velum on more straightforward lines. He remained unswervingly faithful to 'the only true principle, viz., the rendering available of the muscles of the natural palate to control the movement of the artificial palate' (Kingsley, 1871).

**Bulb obturator**

Suersen (1867) had alternative views on the only true principle. He recommended a fixed bulb obturator moulded of hard vulcanite in such a manner that the muscles of the palate and nasopharynx, when in function, could contract around the bulb to provide a nasopharyngeal seal (Fig. 2). Warnekros (1909) later demonstrated that, providing that the posterior margin of the bulb was positioned at the horizontal level of Passavant's pad, the bulb could be made of considerably less bulk than Suersen had originally advised.

The simplicity and effectiveness of Suersen's concept has made it durable to this day. It has survived the attentions of those who believed that it was too simple to work and attempted modifications and embellishments; these attempts were principally French-inspired at the turn of the century, and as their only remarkable features were high
quaintness ratings they will not be discussed further.

**Combined surgery and prosthesis**

Von Graefe is generally attributed with the introduction of the operation of staphylorehaphy or soft-palate suture in congenital cleft palate. His first operation was undertaken in 1816. Sir William Fergusson demonstrated how tension at the suture line could be reduced by section of the soft-palate musculature in 1844. However, with the introduction of uranoplasty (repair of the hard palate), an operation which was combined with staphylorehaphy, the problems of tissue deficiency and postoperative breakdown were still paramount. The Berlin surgeon Julius Wolff (1880) designed his operation in such a manner that available tissue was used to repair the hard palate and as much of the soft palate as possible, without creating tension. Nasopharyngeal seal could then be accomplished by the provision of a hollow-box obturator. This appliance was supported distal to the truncated velum and Wolff termed it a pharyngeal obturator, (Fig. 3). There was some form of co-operation between Wolff and the Berlin dentist Schilsky in the matter of the design and provision of these pharyngeal obturators; Wolff’s desire to maintain an ascendancy in this relationship makes it difficult to discern in retrospect the exact balance of their respective contributions.

In Switzerland the surgeon Kappeler and the dentist Brugger were co-operating on similar lines. The pharyngeal obturator which Brugger designed was a hollow box of cork impregnated with vulcanite for lightness. Pickerill (1912) had a unique approach. He described how the remnants of the cleft velum could be united to form a muscular bar across the defect. The hinged prosthesis which was provided postoperatively carried a hook on its nasal surface which engaged the muscular bar. The theory behind the design was that contraction of the bar in speech led to elevation of the hinged flap which contacted the posterior pharyngeal wall to produce nasopharyngeal seal.

Sir Harold Gillies was unconvinced of the benefits of full surgical repair of the hard and soft palates. He pointed to the narrow facial features, retained nasal speech, and poor occlusion of those who had undergone palatal surgery. Gillies therefore recommended sufficient detachment of remnant soft-palate tissue from the hard palate in order to permit suture as far back into the pharynx as possible. Kelsey Fry then prepared an appliance which occluded the enlarged defect of the hard palate and maintained the soft palate against the pharyngeal wall (Fry and Gillies, 1921).

**Meatus obturator**

All the four classes of prosthesis discussed so far had sought to seal the nasopharynx from the oropharynx at the level of the morphologically normal soft palate. The American dental surgeon Hullihen (1851) conceived the idea that rather than trying to simulate Nature it would be easier to control the quality of speech by governing the air flow through the posterior nares. He thus devised an appliance which was a conventional plate carrying two hemispheres on a slide. By adjustment of the slide...
forwards and backwards the air flow through the nares could be varied. Hullihen's concept attracted some comment in 'Harris' (1871) the standard American dental textbook of the last century, but in general the notion lay quiescent until re-launched by Fröschels and Schalit (1929). Fröschels, a speech therapist, had noticed many years earlier the similarity between cleft-palate speech and the speech defect of rhinolalia aperta. He demonstrated the control of cleft-palate speech characteristics by blocking the superior nasal meatus and cupola of the nasal cavity with pledgets of cotton-wool soaked in paraffin. Schalit then designed an obturator which performed the same function (Fig. 4). The method of manufacture was to model the obturator in gutta-percha, initially without an aperture. The result was immediate rhinolalia clausa, that is an adenoidal type of speech. The aperture was enlarged until balance between rhinolalia clausa and aperta was obtained. The appliance was then processed in hard vulcanite.

**Fig. 4.—A meatus obturator. (Clinical photograph by courtesy of R. D. Gain, Esq.)**

**Palatal support prosthesis**

The final class of soft-palate appliance is one which has come to the fore within the past 10 years. The palatal support appliance is used as an adjunct to speech therapy in cases of neuromuscular insufficiency leading to partial paresis of the soft palate. This may be of congenital origin or result from a stroke or traffic accident. The support is built of impression composition on a Hillerström loop. When the correct degree of support has been achieved the loop can be withdrawn from the base and the supporting bulb processed in acrylic. As therapy progresses it should be possible gradually to reduce the bulb in size.

With the continued increase in the efficiency of surgery it would seem that soft-palate prosthetics in the future will be dealing to a greater extent with acquired defects and the palatal support type of appliance.

**REFERENCES**


