

A History of Prosthetic Management of Cleft Palate: Paré to Suersen

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The rehabilitation of cleft palate and lip patients attracts the interest of various disciplines of the healing arts groups. There is no doubt that the surgical approach is preferable in the treatment of most patients with congenital cleft palates, whereas many acquired defects, both in the hard and soft palates, remain essentially a prosthetic problem. In reviewing the early history it is of interest to note that the obturators were devised mainly in the field of acquired defects and they were adapted later to serve in the area of congenital cleft. However, in the last two decades, as the number of congenital cleft palates to be handled prosthetically has decreased, there has been an ever increasing demand for the prosthetic rehabilitation of patients with surgically created palatal defects.

Literature on the subject does not reveal who was the first to employ a prosthetic device in treating cleft palate patients. As far back as the sixteenth century, every written report suggests that obturators were known before. In a very interesting letter to *Lancet's* editor, Saul Bien (1) suggested that Demosthenes, the famous Greek orator, was suffering from a congenital cleft lip and palate. He postulated that he used pebbles to obturate a possible cleft palate associated with his presumed developmental lip defect. Demosthenes (384–323 B.C.) was known to have gone to the seashore. There, filling his mouth with pebbles, he orated above the roar of the waves, presumably to overcome his stammering. Bien suggested that his repeated visits may have been to build up a store of suitable pebbles which would have been serviceable as obturators. On the other hand, Gariot (2) and Kingsley (3) believed that the first definite record suggesting mechanical closure of clefts was that of Alexander Petronius, whose work preceded by a few years that of French surgeon Ambroise Paré. Gariot set the date of Petronius' work ten years earlier than Paré's; however, Kingsley fails to mention either the date or the title of Petronius' work. In fact, both authors were referring to the "De Morbo Gallico" published in 1566, (4) in which Petronius stated:

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This paper was partially supported by N.I.H. Grant No. DE 01697

Attention is been called to the fact that an unpublished masters' thesis on the subject was written in 1946 by Mathilda Onachilla under the direction of Herbert Koepp-Baker, Ph.D., and is on file at Penn State University. The author was unaware of the existence of this thesis and hence did not have it for reference material.

"When there is only a hole in the palate, we can stop it up with cotton, with wax, with a gold plate or in any other way that the genius of the artist suggests, having come to give to these instruments the same concave form as the palatine vault."

However, Snell (5) mentioned that thirteen years earlier (in 1552), Hollerius, in his "Observ. ad Calam de Morbis Internis," proposed to stop the open cleft with wax or sponge. It also seems probable that Petronius was not the first to suggest the use of gold, since he did not offer any explanation concerning the methodology of its adaptation or retention.

The most significant earlier reports came from France. Ambroise Paré (6) (1510–1590), the great surgeon of the sixteenth century, used the word "Obturateurs" which is derived from the Latin word "Obturo" meaning to stop up. In 1634, Johnson (6) translated Paré's "Surgery" which was published in 1579, from Latin and compared it with the French. Paré dedicated the book to King Henri, the third, "the most Christian King of France and Poland." The text described an appliance to restore the palatal defect caused by venereal diseases or gunshot wounds.

"It must be done by filling the cavity of the pallat with a plate of gold or silver a little bigger than the cavity itself is. But it must be as thick as a French Crowne, and made like unto a dish in figure, and on the upper side, which shall be towards the brain, a little sponge must be fastened, which, when it is so moistened with the moisture distilling from the brain, will become more swollen and puffed up, so that it will fill the concavity of the pallat, that the artificial pallat cannot fall down." (6)

He added that he had observed the use of such "instruments" many times in the battle fought beyond the Alps. He had engravings for two different appliances, one with the sponge (Figure 1), and another with a button that passed through the aperture to be turned so as to engage the undercut in the nasal cavity (Figure 2).

While serving four kings as their surgeon, (7) Paré was constantly in

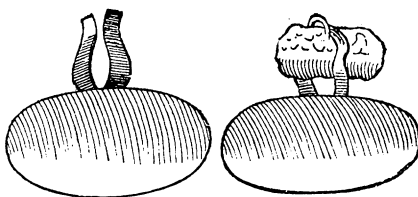


FIGURE 1. Paré's first "obturateur", held in position with a sponge.

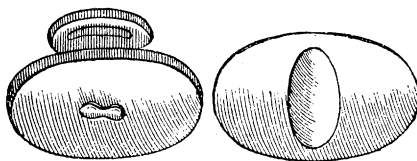


FIGURE 2. Paré's second appliance, meant to engage the nasal undercut with a button.

contact with war casualties. He was surgeon successively to the French Kings Henri II, Francois II, Charles IX and Henri III. Therefore, it is reasonable to assume that he used his "Obturateur" in acquired defects of the palate rather than in congenital deformities. The drawings of Paré's appliances in Johnson's translation support this assumption.

The period between Paré (1579) and Fauchard (1746) (8) witnessed few workers who were directly influenced by the former's work. Isaac Guillemeau (1649), one of Paré's students, published his "De Ouvres" which included a drawing of Paré's last appliance with no improvements. Kingsley was in disagreement regarding Guillemeau's first name and the date of publication. He called him Jacques and set the date at 1591. (3) Guillemeau criticized the fitness of such "instruments", however. An appliance similar to Paré's was described by Fabricus Hildanus in the year 1595. Amatus Lusitanus, in his "Curat. Medic. Centur" which was published in 1653, mentioned the case of a boy with a diseased cranium, and perforated palate who had his voice restored by means of a gold palate, to which a sponge was skillfully adapted. Moreover in 1672, Scultetus in his "Magazine of Surgery" (5) gave a brief description of an obturator utilizing the sponge and illustrating it with an engraving. He erroneously stated that Hildanus was the original designer of such appliances.

Paré's influence is still observed in Pistorae Albertus description of the "instruments" used in treatment of defects of the palate.

"In many cases it is requisite to have recourse to silver itself, in these kind of apertures with sponge annexed, as authors on surgery mention."⁹

Garangeot, in his "Treatise on Instruments" published in 1715, described a sponge "Obturateur" which differs in design from Paré's, but still makes use of the sponge. (5)

"This instrument has a stem in the form of a screw, upon which runs a nut. To make use of it, take a piece of sponge, cut in the shape of a hemisphere, with a flat surface; pass the stem of the obturateur through the sponge, and fix it by means of the nut; dip the sponge in water, squeeze it dry and introduce it through the aperture."

The first mention of congenital cleft palate patients is in the "Chirurgicis Operationibus," (10) written by Fabricii in 1723.

"The surgeon has to do with the palate when it is defective from erosion, or what happens in new-born infants when they are congenital, who are not able to suck, and at length die, as I have seen."

Then he describes the symptoms in these cases:

"But the different portions of the palate may become eroded through the bone, which injures the voice: the greatest part of food and drink passes through the nose."

Concerning the treatment:

"It is to be remedied by sponge, lint or silver plate, which is so attached to the palate that the aperture may be obturated."

The sergeant-Surgeon to King of England, Charles the Second (1660–1685), R. Wiseman, in his “Chirurgical Treatises” published in 1734, suggests the use of “Paste Palate” besides the other means already known. The formula of the paste was given (11).

“Rg. mastich pellucid pulv. emolliatur in spt. vin
Alibani Sandarac
Gum Guaica. nat.
Sang. Draconis. Rad. Iris. flor.
Myrrh 2. Cornu Cervi. uste
Luccini anna 3j M. ft.
Pasta ex qua formentur lamellae.”

This idea may have affected the closure of acquired clefts, since it can be adapted perfectly to the gap. But the question arises concerning the duration of its service to the patient.

The use of the sponge to retain the prosthesis must have created an oral hygiene problem and Heister in the “Institutions of Surgery” published in 1739, (12) suggested a solution.

“But he should be provided with two of these instruments, that after one has been worn a day, it may be extracted, washed, and dried, against the next day, to prevent the imbedded humours from putrefying and swelling.”

Astruc (13) discussed the “goal” of a prosthesis both accurately and inaccurately:

“it is not enough to stop the progress of the caries (of the palate) with proper medicines, but it will be necessary at the same time to remedy the defect of the speech, which is now uttered hoarsely and indistinctly through the nose.”

He then described the same line of treatment, suggesting the suspension of the appliance through a button rather than the use of sponge since, “This sponge by absorbing the mucuous will be corrupted.”

Pierre Fauchard’s (8) (1679–1761) authoritative work, “Le Chirurgien Dentiste” (Figure 3), accredited him with the title “Father of Denistry.” It marked a distinct era in the progress of dentistry. It is a two-volume work written in 1723 and first published in 1728. Snell stated (5) that the book was written in the year 1786. In fact he is referring to the third edition of the same book which was published after Fauchard’s death. The second edition appeared in 1746, whereas the original manuscript was written in 1723 and the first edition appeared in 1728. Since its publication it has been widely quoted. It served as a text and base for most of the subsequent writers. Fauchard stated that the greater part of the information contained in the book was already known before his time, but was seldom mentioned in works published by his predecessors. The knowledge was considered the closely guarded secret of the profession. Credit should be accorded to Fauchard for his valuable contributions and innovations particularly in the area of obturators.

He devoted four chapters of the second part of his book to a detailed discussion of five different obturators and the methods of their construc-

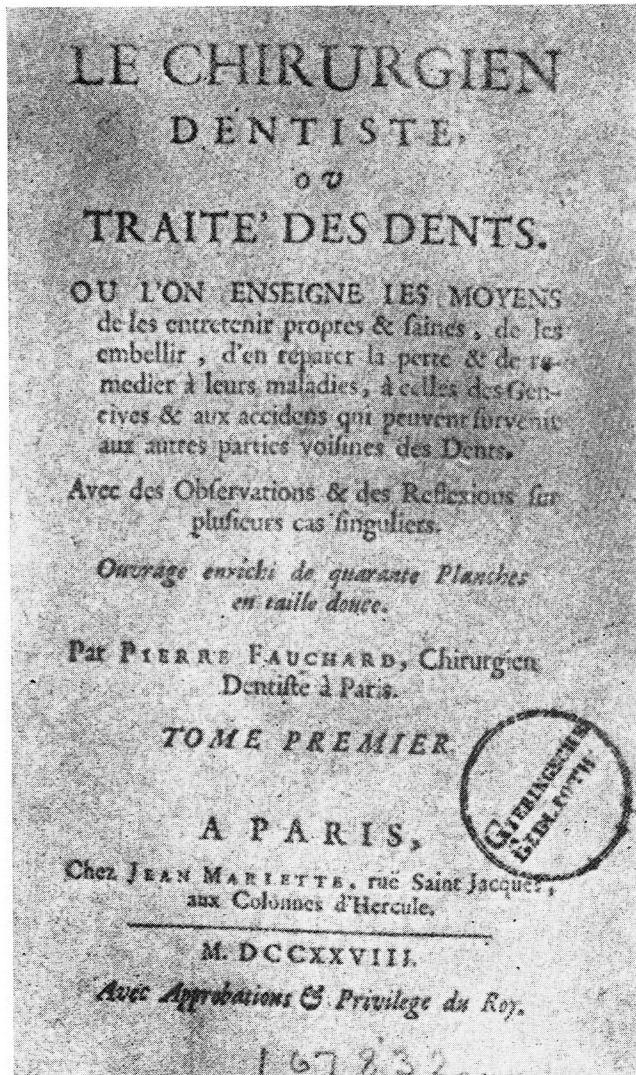


FIGURE 3. Front page of Fauchard's book, Vol. 1, Second edition 1746.

tion. (8) He included explanatory engravings (Figure 4). It seems that most of the ideas incorporated in the construction of these obturators were of his own innovation. He used a complicated mechanism for retaining the obturators in position. Basically, he used two wings attached to the superior surface of the plate. These wings were folded together and passed through the cleft. They were spread apart by a screw after seating of the appliances. The idea was to utilize the nasal undercuts. The following is a description of the five appliances.

The first was constructed of a convexo-concave plate covering the aperture, a hollow stem was fixed to the center of the convex side with two wings on its superior part, which were moved by means of a screw passing through the middle of the plate, the hollow stem having a nut which when screwed down, kept the wings across the cleft. The wings were covered with soft sponge. (Figure 4).

The second "obturateur" was composed of a similar plate and stem through which, from the concave side, passed a stem having a screw head. The other end was square in shape and passed through a square hole in a wing which moved around by turning the screw. The other wing was soldered to the upper part of the hollow stem. The movable wing in this "obturateur" differed from the first one by acting in a circular direction, whereas the former moved from a perpendicular to a horizontal position. When put into the aperture, the movable wing was placed over the fixed one; the screw was then turned, and the wing was carried to the opposite side to keep the obturator in position. This instrument, although ingeniously constructed, soon fell into disuse because the fixed wing was found to possess many disadvantages.

The third obturator consisted of two substances, bone and metal. It is believed to be the first appliance constructed in this manner. The plate was first fitted to the defective parts. The bone was to supply any portion of the maxillary bone and teeth which might be deficient and it was fastened to the plate. This obturator, too, was held in by wings turned down by a ball and screw.

The fourth obturator was composed of ivory, intended for the supply of four teeth, with a part of the palatine portion of the maxillary bone, and retained in its position partly by a sponge, and partly by ligatures around the canine teeth.

The fifth obturator was similar to the third. It differed only in the way of its retention, the wings being held by a screw that moved them closer to or away from the principal plate.

One hundred years elapsed after Fauchard until another revolutionary improvement on the practice of constructing the obturators occurred. Snell's publication in 1828 (5) marked a great advancement but it wasn't until 1867 that Suersen (14) (Berlin, Prussia, 1867) introduced the basic principles behind the design of the speech aid as it is presently known.

The period from Fauchard's onward is characterized by a flow of writing on the subject. The authors of this era, although greatly influenced by Fauchard's "Chirurgien Dentiste", disagreed among themselves. The most controversial subject was the practice of introducing extensions through the palatal defect and whether this had an effect on nature's attempt to close the palate.

In 1757, N. Bourdet, the French dental surgeon, expressed his ideas in his "Recherches et Observations." (15) He thought that openings in the palate, regardless of their cause, would close in time. Hence, he opposed

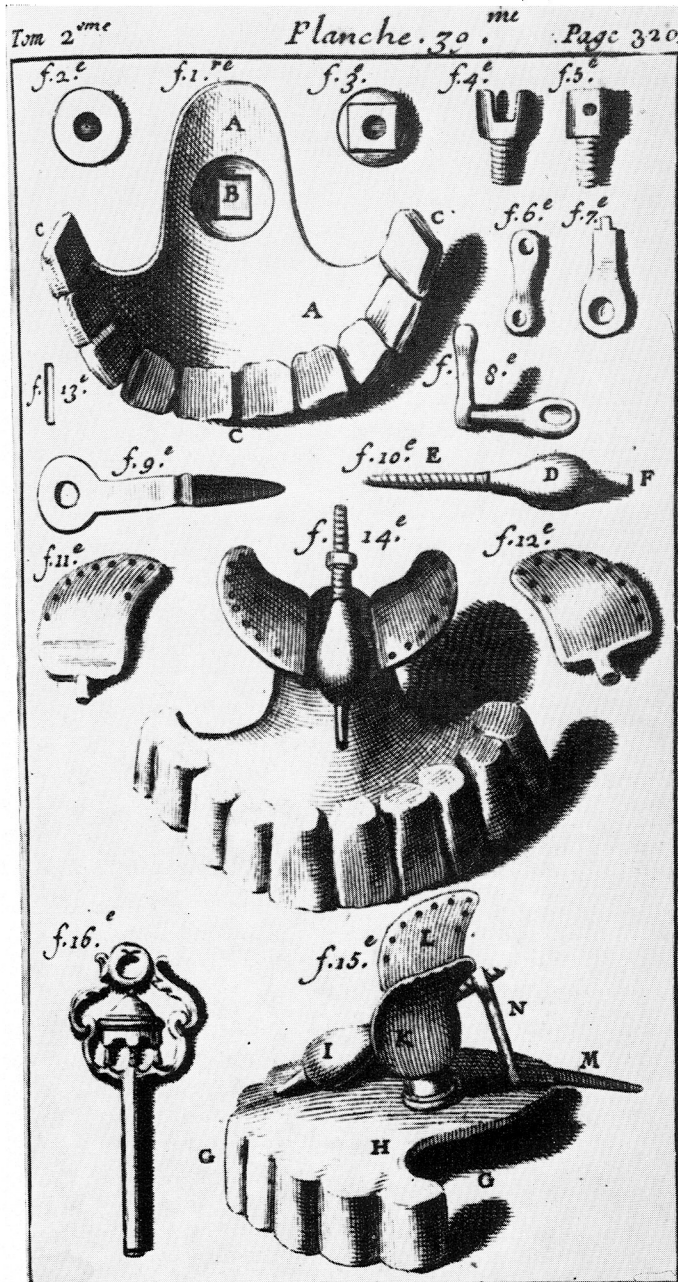


FIGURE 4. Fauchard's winged obturator, showing the different parts and the key used to operate the wings after insertion of the appliance.

the ideas of inserting parts of the appliance through the aperture. He described in the same text two obturators, made of a thin sheet of metal, in "Juxtaposition", which were attached around the teeth by means of ligature given off the plate. Delabarre (16) modified the design by using metal extensions around the teeth. These extensions, to a certain degree, resemble the contemporary partial denture clasps. Hence, Delabarre was the first one to use metallic bands (clasps) around the teeth. (Figure 5).

In 1776, M. Verdial constructed an appliance with a uvula made of sponge. The appliance itself was made of "Spanish leather" which was lined with a thin layer of sponge. The sponge uvula was attached with elastic silver wire. The gentle compression of the sponge lining was meant to seal the edges of the appliance. An article describing the appliance appeared in *The Journal of Medicine* in 1776. (5) In 1778 Jourdain, a French dentist who wrote extensively on the diseases of the mouth, suggested the introduction of a piece of sponge in the cleft to be retained with a thread passing through the nostrils. (17) Later, he modified the technique by using a plate of fine gold instead of the sponge which extended beyond the edges of the cleft. The plate carried a stem on the superior surface to which a thread was tied and passed through the nostrils. The thread was bent back to be attached to the cap of the child.

In 1780, M. Dubois Foucou (5) attempted to restore the defect in the velum by highly elastic bands or metallic plates. The plate extended from the palate backward covering the defective part of the soft palate. He incorporated springs in his design to permit the posterior extension to follow the motions of the remnant of the soft palate. Touchard improved on one of Fauchard's obturators. This appliance, which was presented to the Society of Medicine at Paris and later published in "*Journal Generale de Medicine*," (5) supplied the patient with five teeth along with the closure of the cleft. He used sea-horse teeth after shaping them into the form of human teeth. Two elastic gold bands were used to keep the appliance in place by pressing firmly against the remaining teeth.

Codan's obturator for a young girl, as described by Cullerier in 1803 in "*Dictionary Science de Medical*" (5) resembles Fouchard's winged obturator. However, it possessed three wings and covered a larger defect. In 1815, the mineral paste was used again; M. de Chamont (5) used it to cover an acquired defect. The appliance was retained by ligature around the bicuspid.

In 1820, Delabarre, (16) Doctor of Medicine of the Faculty of Paris and Surgeon-Dentist to the King published an excellent book on the mechanical phase of dentistry in two volumes. In his book, he gave credit to his predecessors, and he published engravings of Fauchard, Bourdet, and other workers. Also, he described some of his own, including a very complicated appliance covering the palate completely. This appliance was carved of metal, the superior surface had a depression to accommodate the nasal palatine process. Mineral teeth were attached to the palate by

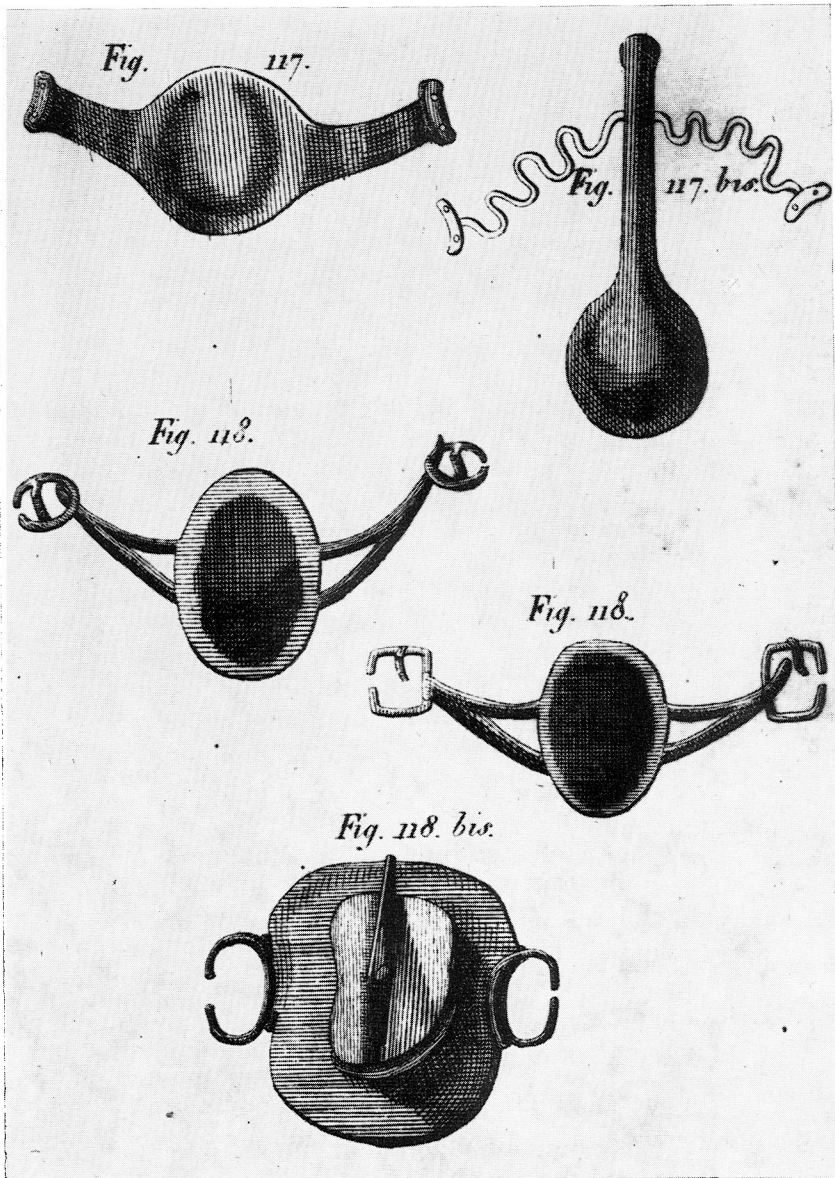


FIGURE 5. Fig. 117 shows Bourdet's appliance using the ligature around the teeth. Fig. 118 shows Delabarre's appliance with the (clasps), from Delabarre's book.

means of springs. He attached a moveable part made of elastic gum to restore the velum and uvula (Figure 6); hence he may be considered the first one to use a soft, flexible elastic valve to imitate the function of the velum. In the same appliance, he included a valve attached to the superior surface, which was activated by movement of the tongue, to separate the

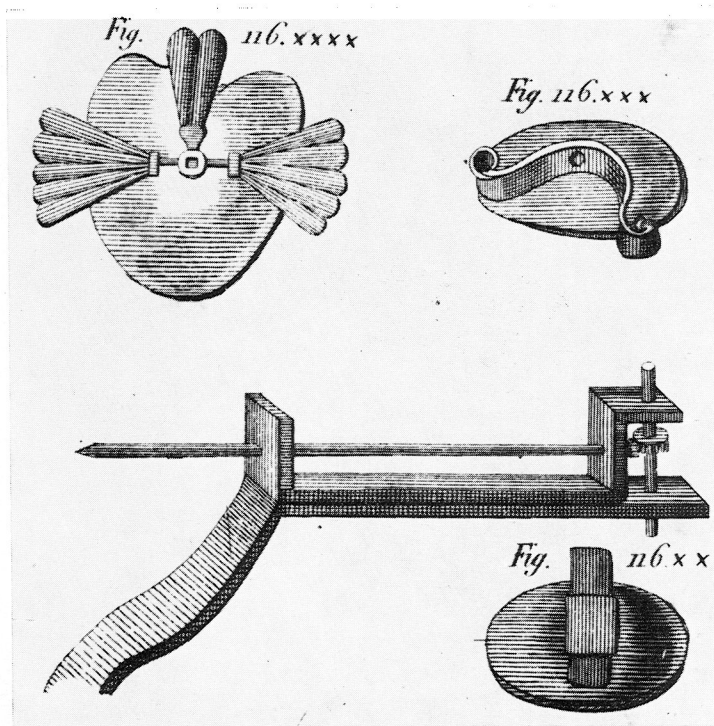


FIGURE 6. Delabarre's obturator with uvula made of elastic gum.

nasal cavity from the mouth during deglutition. The appliance was intended for an acquired cleft, which could have been treated with a much simpler appliance. Nevertheless his work laid the foundation for the future work of Snell's artificial velum.

Up to the nineteenth century, France had the lead in cultural and scientific fields which explains why most of the authors on the subject of cleft palate were French. The first important English author is James Snell, (5) who, in 1828, published his book on "Obturateurs." His book may be considered the first document dealing directly with the congenital cleft palate as a separate entity. Prior to him, there was no clear distinction in the manner of handling acquired and congenital palatal defects. He claimed that there was no successful way of treating congenital clefts before him. In the congenital cleft which he treated (9 reported in the book), he adapted Delabarre's artificial vela to restore the soft palate defect and used Bourdet "Juxtaposition" principle in retaining the appliances. He constructed a gold plate on a model obtained from the defective part, reaching as far back as the patient could tolerate. To the posterior part he attached two flaps of "India Rubber" to fill the deficiency in the soft palate. A small piece of the same material was attached by a gold wire to simulate the uvula. In some appliances he stretched the rubber on a

gold frame. Snell's prime objective of introducing the moveable velum, was to improve speech. While Snell, is not generally accredited for modifying the manner of feeding cleft palate infants, to my knowledge he is the first to suggest adding a flange to the nipple.

"On one side of the teat, which is to be the upper side, sew a piece of leather sufficiently large to be introduced into the mouth without difficulty, of a length and shape suited to cover the tissue in the palate."

In the same text, Snell criticizes Mr. Alcock's artificial palate which was described in "Medical Intelligencer," since it was cast in metal. He stated:

"He was probably not aware, that by a simpler process, a good artist would have made half a dozen of them (obturators) in the time it must have taken him (Alcock) to construct it according to his method."

In spite of Snell's criticism, Alcock's contribution cannot be denied. He was the first to suggest casting the appliances, a technique still in use at the present time.

In 1835, Leonard Koecher, (18) published two cleft palate case reports in his book, where he used obturators in their treatment. He advocated simple, palatal coverage with clasps on the most posterior molars. One of the patients was a "tragedian" who suffered from a cleft palate due to an active "anti-mercurial" treatment and the other female patient had a congenital cleft. The engraving of the latter case showed that she had an extensive cleft of the soft and hard palate only.

In 1850 Hullihen (Wheeling, W. Va.) pointed out the dramatic changes that occurred after the insertion of an obturator in acquired cleft. However, in congenital cases, he felt that they already had acquired peculiar habits of speech (19):

"they don't know how to make a correct articulator sound, and, indeed, they can scarcely ever be taught to do so, even when their palates have been perfectly restored, unless that restoration is effected at an early period of life"

He described in his article a speech appliance with a valve design to block the nares during function. The valve was attached to a slide by which the patient was enabled to adjust the quantity of air passing through the nares.

The revolutionary change in concept in the construction of appliances for patients with acquired cleft palates came about through the work of Stearn, an American physician, and Suersen, a German dentist. Their concept is still the basic principle behind the contemporary speech aid, and the credit should be awarded to these two pioneers.

In 1841, Dr. Stearn (20), a graduate in medicine who himself had a congenital cleft became acquainted with Goodyear's experiments in combining sulfur with rubber to improve it. Since he had had by that time a few unsuccessful operations in an attempt to close his own soft palate, he attempted to construct an appliance for himself. In spite of his limited

knowledge in prosthetic dentistry, he demonstrated that an extension could be introduced into the pharynx; that it could be worn with comfort; and that it could assist in the articulation of perfect speech. Because of his unfamiliarity with dental techniques, he used carved wood to make the molds for vulcanizing the rubber velum. In 1845 he made a trip to London and Paris and wrote an article in *Lancet* about his appliance. This is the reason that some authors have believed that he was an Englishman. The principle behind Stearn's artificial velum for congenital clefts was that the portion of the appliance designed to fill the defect was made flexible and was under the control of the muscles in the remaining parts of the soft palate. The appliance was made in three parts with the most posterior portion extending into the pharyngeal cavity. Hence it was termed "triple form appliance."

In 1860, Kingsley (3) worked in conjunction with Stearn to construct a speech appliance for a 20-year-old girl who had a "double fissure of the lip and extensive fissure of both hard and soft palate." (3) Afterwards, Kingsley improved on Stearn's appliance with a simpler design, but he adhered to the same principle of utilizing the levator muscles and bridging the upper pharynx behind the uvula to cut off nasal communication at will. Kingsley's modification consisted mainly of leaving off the triple forms and doing away with the central slit, the flap and the springs. His simplified form consisted of two leaves of soft vulcanized rubber connected in the median line, the palatal portion running down to the uvula and then bridging across the defect with the nasal portion reaching across the pharynx. Instead of making the appliances in sections so as to slide across each other as in Stearn's, the bifurcated uvula was made to slide between the two leaves, and the levator muscles lifted it up to meet the pharynx.

Kingsley was awarded a gold medal at the American Dental Convention held at Saratoga in 1863 for the improvement he introduced on Stearn's speech aid.

In 1867, at the 6th Annual Meeting of the Central Association of German Dentists, Wilhelm Suersen, Sr., (14) introduced his concept in a lecture titled "On the restoration of a distinct utterance by means of a new system of artificial palates to be employed in cases of congenital and acquired defects of the palatine organs." Later in the same year extractions from this report were published in the *American Journal of Dental Science*. Since then, the articles have been considered the most important reference in the field of speech aid construction. He explained the anatomy and physiology of the pharyngeal area, and he was the first to draw attention to the action of the superior constrictor of the pharynx in velopharyngeal closure.

"The constrictor muscle contracts the cavum pharyngo-palatinum, the pharynx-wall bulging out—and it is chiefly on the action of this muscle that I base the system of my artificial palates." (14)

He used hard caoutchouc to construct his one piece obturator which covered the tissue in the hard palate and extended into the pharyngeal space to terminate in an "Apophysis" broad enough to fill the defect. This apophysis (speech bulb) was meant to be thick enough to keep up a contact with the two halves of the velum when the levator palati was in activity. He pointed out that the bulb should not interfere with the passage of air when the superior constrictor muscle of the pharynx was relaxed. The article included illustrations for two appliances made for congenital cleft palate patients (Figure 7). It is of interest to note the similarities between Suersen's early speech aid and that used at the present time (Figures 8 and 9).

Discussion and Summary

The early writings on dental science contain many conflicting statements relative to its chronology and source. It is difficult to reach a decision regarding individual contributions, but it is logical to assume that the interest in the treatment of palatal defects started in the area of acquired rather than congenital defects. The various wars in the sixteenth century must have left many individuals with palatal defects who desperately needed some type of rehabilitation. This contention is further supported by the assumption that the life expectancy of infants with congenital clefts must have been very short. One can imagine how high the mortality rate was because of the difficulty in feeding and control of infection. Guillemeau in his "De Ouvres", as quoted by Snell in 1828, stated:

"I have seen new born infants have the palate split through the noses which prevented them from sucking. Nevertheless I have seen infants to be nourished by a biberon for two or three months; but at length they die, as the milk was thrown out through the nose."

Malleot reported a case of cleft palate infant who was kept alive for fifteen days by spoon feeding.

The first attempts were directed mainly at restoring the anatomical defect. Most of the inadequacies in the appliances were due to the primitive materials and techniques employed in their fabrication.

Snell is believed to be the first to attempt the treatment of congenital clefts with obturators in 1828, about 300 years after Paré wrote his "Surgery" describing the construction of an obturator for a congenital cleft. Before that time it was believed that congenital cleft palate patients were incurable. Snell's attempt to restore the soft palate stopped short of occupying the pharyngeal space.

The first attempt to extend the speech aid in the pharyngeal area was performed by Stearn on himself. His medical background gave him knowledge of anatomy and physiology, but he did not have the dental experience necessary to fabricate the appliance. It was Kingsley and Suersen who improved greatly on Stearn's appliance. The advancement made in the construction of the acquired cleft palate obturator laid the

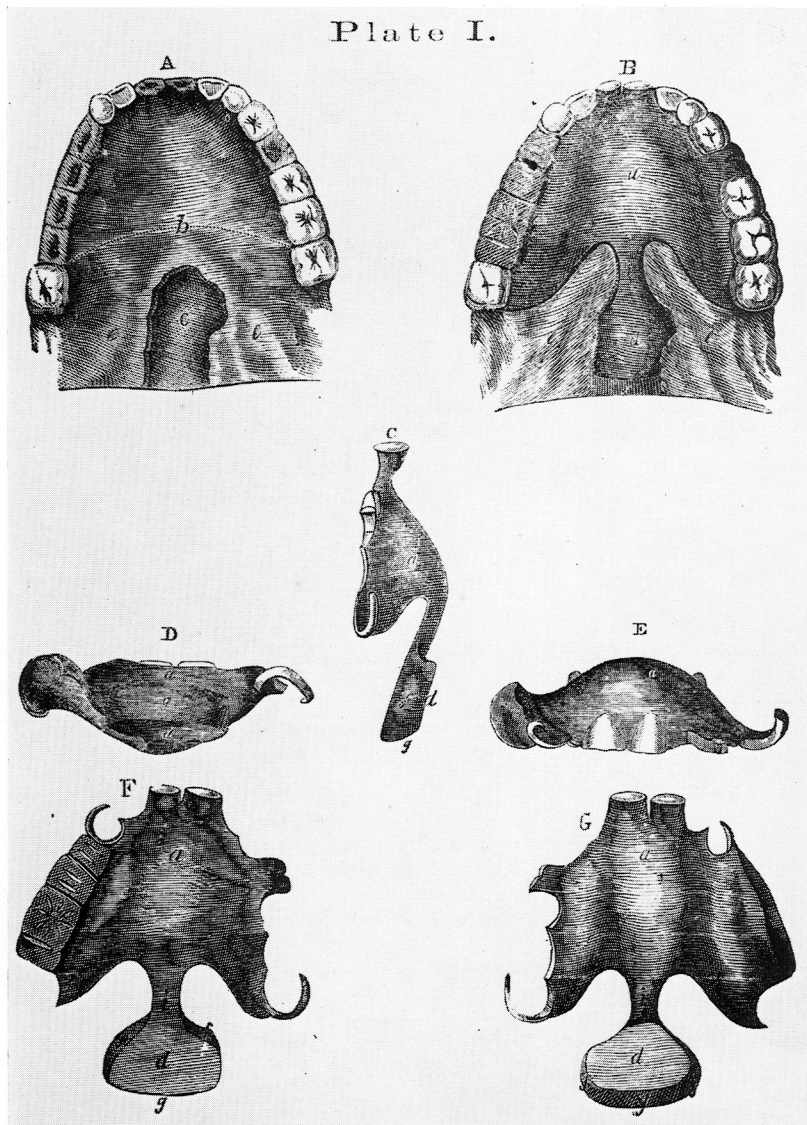


FIGURE 7. One of Sucrsen's "Speech Aid" employing the contemporary principles. Published in *Amer. J. Dentistry*, 1867.

foundation for the innovation of the speech aid which is now used in rehabilitation of cleft palate.

Needless to say, the significant advances in treatment resulting from these early efforts have enabled cleft palate patients to lead more normal and productive lives—and certainly more comfortable lives than could have been possible for the patients treated by Petronius.

Acknowledgements: The author wishes to express his gratitude to Dr.



FIGURE 8. Speech aid for a congenital cleft palate patient. The palatal and pharyngeal muscles are relaxed. Note space around the bulb portion.

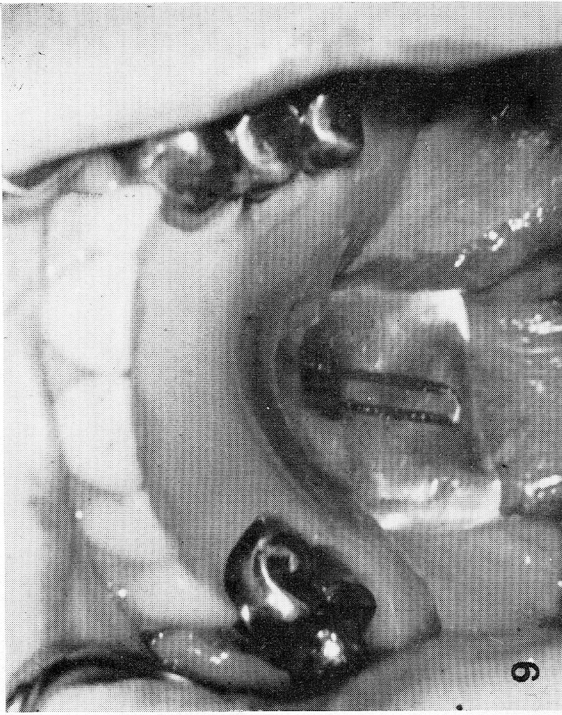


FIGURE 9. Same patient pronouncing strong "Ah". Note the contraction of the pharyngeal muscles and the elevation of the remnants of the palate.

Jack Matthews, Chairman, Department of Speech and Theatre Arts University of Pittsburgh; and Dr. Betty Jane McWilliams, Director, Cleft Palate Center and Professor, University of Pittsburgh, for their critical evaluation of this article. Thanks are also extended to Mr. Howard Sweitzer for the graphic reproductions.

References

1. BIEN, SAUL, M., Why Demosthenes Mouthes Pebbles? Letters to the Editor, *Lancet*, 25: 1152, 1967.
2. GARIOT, J. B., Treatise on the Diseases of the Mouth, Translated from French by Savier. Amer. Soc. of Dental Surgeons, Baltimore, 1843.
3. KINGSLEY, NORMAN, A Treatise on Oral Deformities. D. Appleton Century Co., New York, pp. 215-312, 1880.
4. PETRONII, A. T., De Morbo Gallico. Book 1, Chapter 19, p. 33 and 34, 1566.
5. SNELL, JAMES, Observations on the History, Use and Construction of Obturators or Artificial Palates. Callow and Wilson, London, pp. 1-106, 1828.
6. JOHNSON, THOMAS, The Works of Ambrose Parey, Translated out of Latin and compared with the French. T. Cotes and R. Young, London, p. 873. 1634.
7. PAKARD, F. R., Life and Times of Ambroise Paré. Paul B. Hoeber, p. 10, 1921.
8. FAUCHARD, M. PIERRE, "Le Chirurgien Dentiste, ou Traité des dents." Servieres, Paris. Part II, pp. 292-338, 1786.
9. TULPIUS, NIC., Observat. Medici. Book 1, Chap. 37, p. 70, 1685.
10. FABRICII, HIERONIMI, Chirurgicis Operationibus, under "Palati Chirurgia Chap. 25, p. 458, 1723.
11. WISEMAN, R., Chirurgical Treatises, Vol. II, book 7, p. 324, 1734.
12. HEISTER, L., Institutions of Surgery. Written in 1739 in Latin and translated into English. W. Innys, London, p. 469, 1743.
13. ASTRUC, J., Treatise on Syphilis, Book 4, Chap. 9, p. 128, 1754.
14. SUERSEN, WILHELM, SR., A New System of Artificial Palates, *Am. J. Dent. Sc.* 1: 373-379, 1867.
15. BOURDET, N., Recherches et Observations Sur Toutes Les Parties de L'art du Dentiste. Jean Thomas Herissant, 2nd Ed. Paris, 1786 (First ed. 1757).
16. DELABARRE, C. R., Traité de la Partie Mecanique de l'art du Chirurgien Dentiste. De L'Imprimerie de Couturier, Paris, 1820.
17. JOURDAIN, BERCILLET, Traite des Maladies et des Operations re-ellement Chirurgicales de la Bouche, Vol. 1: 442, 1778.
18. KOECHER, LEONARD, An Essay on Artificial Teeth, Obturators and Palates. S. Highley, London, pp. 167-194, 1835.
19. HULLIHEN, S. P., A New Kind of Artificial Palate. *Amer. J. Dent. Sc., Philadelphia*, 1: 245-252, 1850.
20. ANON., A History of Dental and Oral Science in America. American Academy of Dental Science. Samuel S. White, Philadelphia, 1876.