

HISTORY CORNER

Gradenigo's syndrome and Dorello's canal

La sindrome di Gradenigo ed il canale di Dorello

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Several years have gone by since extra- and endo-cranial complications of suppuration of the ear and para-nasal sinuses were commonplace: indeed, since the introduction of antibiotics which, overcoming the initial infection, led to almost complete disappearance of the complications. At that time - the second world war was only just over - we were still medical students but, immediately afterwards, when we started to frequent the ENT Units, our Professors spoke to us of mastoiditis, petrositis, cerebral abscess, meningitis, cerebral and jugular thrombo-phlebitis, as if they were monsters that they encountered almost daily, in their professional practice, and which they had fought by means of aggressive and demolitive surgery. Some of these cases, we too were actually in time to see and to follow ourselves, during the long course of our professional lives but these complications had gradually become more and more rare.

Diagnostics, at that time, were based primarily upon subjective and objective semeiology and upon instrumental investigations, X-rays and laboratory tests which were still somewhat primitive. Thereafter, efforts of clinicians were focused on detecting and defining symptoms and signs in order to reach a diagnosis, as precisely and rapidly as possible. One great Italian Otologist, Giuseppe Gradenigo (1859-1926) – one of the few Heads of an ENT Chair, at that time, operating in Turin – in 1904, described a syndrome which carries his name, related to suppurations of the ear¹⁻³. This comprised a triad with diagnostic significance of infection, more or less severe, of the apex of the *pars petrosa temporalis* and of the adjacent meninx, derived from the middle or internal ear:

- acute or chronic suppuration of the ear;
- paresis or paralysis of the homolateral abducent nerve;
- homolateral trigeminal neuralgia.

Nobody contested the value of this syndrome, but fierce discussions arose concerning the pathogenesis of the involvement of the VI cranial nerve.

In Gradenigo's opinion, this was due to the limited areas of leptomeningitis both purulent and serous, triggered by the inflammatory process of the *cavum tympani*. According to Mongardi⁴, involvement of the VI occurred in the more distal endocranial portion, i.e., the intra-cavernosal area, due to the spread of the phlogosis from the tympanic

cavity across the tegmen. A meningitic process had arisen, limited to the median cranial fossa, with infection of the inside of the cavernosal sinus or in the tissue surrounding the *abducens*. Citelli⁵ suggested a more proximal pachymeningitis, i.e., limited in correspondence to the tip of the *pars petrosa temporalis*. Others suggested a central origin of the lesion: Moos, Urbantschitsch, Loubet-Barbon and others⁶, based upon the relationships between the nuclei of the VIII and VI. Geronzi⁷, not excluding the possibility that, in some cases, the disorder was due to a lesion resulting from leptomeningitis, hypothesized that, in most cases, the origin was of a reflex nature. He attempted to explain the long-standing cases of paralysis, referring to the presence of trophic lesions of the cells of the central nuclei not being immediately repaired.

These interpretations did not convince the anatomist Primo Dorello who undertook a meticulous study, focusing on dissection, regarding the course of the abducent and, in 1905, published his outstanding findings.

Who was Primo Dorello?

At the time when the facts described here took place, Dorello was a young Assistant in the Department of Normal Human Anatomy, at the University of Rome, where he had become well known for his ability not only to face, but also to resolve, problems related to Anatomy, Histology and Embryology, also focusing on the physiological and pathological aspects related to the topics under investigation.

He was born in 1872, in Narni, Italy, and gained his degree, with maximum results, in Medicine and Surgery, in Rome, in 1897. Indeed, his thesis was included to compete for a prize awarded by the Girolami Foundation. Immediately after gaining his degree, he was nominated as an Assistant in the Department of Normal Human Anatomy where he remained until 1922, when he obtained a post as Professor of Human Anatomy in Sassari (Italy). In 1926, he was awarded the Chair, in this particular discipline, in Perugia, where he remained until the end of his academic career in 1946. From the academic year 1939-40, he was also Dean of the Faculty of Medicine and Surgery. At the end of his teaching years, he was nominated *Professor Emeritus*. He was an active member of several cultural institutions: *Accademia Medica*

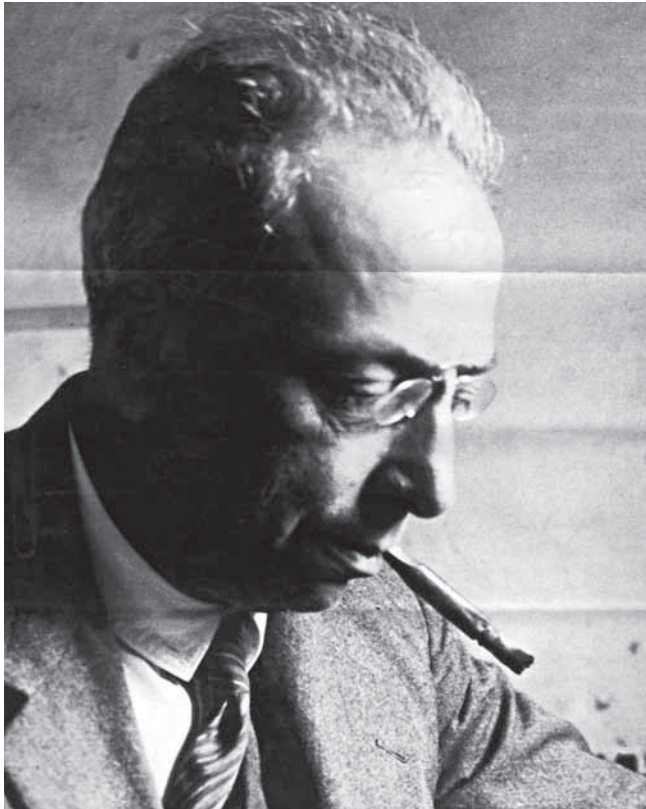


Fig. 1. Primo Dorello (1872-1963).

di Roma, Accademia Anatomica Chirurgica di Perugia, Società Italiana di Biologia Sperimentale, as well as many others. In 1937, he acted as President of the VII Congress of the Italian Society of Anatomy and Histology (S.I.A.I.), held in Perugia. He was also a collaborator of the Treccani Encyclopaedia with reference to Human Anatomy. In his *Curriculum* as a Research Worker, we can find a list of 83 scientific publications on topics related to Anatomy and Biology. Several titles, in that list, attracted our attention, on account of the particular historical interest; for example “*Le ossa del Perugino*” (Firenze, *La Nuova Italia*, 1940), or “*Una necropoli Umbra entro la città di Narni*” (*Rivista di Antropologia*, Roma: Istituto Italiano di Antropologia, 1950, vol. 38, p. 193-196). Obviously, this was a person with a variety of interests and with a passion, not only for history, but also for anthropology. Also for this reason, we felt a certain closeness.

Dorello was also a passionate and highly esteemed photographer; his collection, left in his will to his daughter, contains 1674 negatives on glass, all stereoscopic, related to towns in Umbria and other Italian areas, views, famous people and scenes from everyday life during the first half of the 20th Century. These archives have been declared as of “particularly outstanding historical interest”.

Dorello’s research on the canal that carries his name

Dorello, in 1905, published his findings entitled “*Considerations concerning the cause of temporary paralysis of the*

abducent in middle ear inflammation”⁸. After having carried out systematic morphological research on the intra-cranial course of the abducent, he stated that he had confirmed the presence, moreover not constant, at the tip of the *pars petrosa temporalis*, of a narrowing of the inferior *petrous sulcus*, that was often transformed into a complete canal when the superior wall was closed by a thickening of Gruber’s spheno-petrous ligament. This non-extensible canal, within which the inferior petrous sinus and the abducent nerve, were running, represented, according to Dorello, the only area in which the nerve might be compressed by phlogistic post-otitic oedema of the adjacent vascular structures and this compression fully accounted for the relative functional damage.

Dorello’s work was highly appreciated. Baldenweck⁹ (who did not make reference to Dorello’s findings), in one of his articles, two years later, describing many anatomical details which confirmed the observations of Dorello. Baratoux¹⁰, in one of his critical reviews on this topic, arrived at the same conclusions as those reached by Dorello. On the other hand, Gradenigo¹¹ adamantly criticized Dorello’s work, maintaining that his idea was not based on fact, neither clinical nor anatomical. Dorello replied with another note¹² challenging Gradenigo’s criticism and alleged convincing topics. *As far as concerns the clinical aspects* – he said – *I could do nothing else but repeat to Prof. Gradenigo the objections which had already been raised by several authors, specialists in this field ... However, I feel obliged to reply to Gradenigo’s statements that my hypothesis is not based upon anatomical facts because, he says, the veins of the tympanic cavity belong to the district of the pharyngeal plexus, of the meningeal media vein, of the internal and external jugular vein and, therefore, have no direct relationship with the inferior petrous sinus.* The veins of the middle ear, instead, are strictly related to the two petrous sinuses, Dorello insisted, as can be found in the works of Politzer¹³ which focused on dissection of the human ear. Politzer, to inject into the veins of the labyrinth and the tympanic cavity, proposed using *the sinuses closest to the dura mater (petrosquamous, petrous superior, petrobasis and transverse): it is through these sinuses that one can inject, in the best way.* Then, as far as concerns the inferior petrous sinus – Dorello added – *I would ask those who are not in agreement to consult the volume on Human Anatomy by Poirier and Charpy and to read, on page 973, exactly what has been written: the inferior petrous sinus receives the internal auditory veins, two or three small veins, satellites of the artery, emerging from the labyrinth and from the floor of the tympanic cavity; sometimes, the veins of the aqueduct of the cochlea; ...*

At this point, Dorello remembered that, following his publication, Gradenigo had considerably modified his early ideas regarding the origin of paralysis of the VI, abandoning the hypothesis of the limited area of lepto- or pachymeningitis. The leptomeningitis was not, in fact, tenable for the negativity, one out of four times, of the lumbar puncture and



Fig. 2. Count Giuseppe Gradenigo (1859-1926), the most famous Italian Otologist of that era.

because it was hard to understand how it could damage the abducent which, at that level, has already penetrated into the *dura mater* at a distance of 5.5-9 mm from the apex of the petrous bone, and, finally, because it is difficult to understand why also the IV and III cranial nerves are not involved, which, at that level, are in full dominium of the *pia mater*. Then, as far as concerns the area of fairly well circumscribed pachimeningitis centered on the apex of the bone, that the *disorder has a particular positive chemotaxis for the abducent*, if it spares the III, the IV nerve and Gasser's ganglion which are situated at a very short distance from the apex. Gradenigo – according to Dorello – was finally convinced that the abducent must be attacked in correspondence to its passage through the osteofibrous canal. The area in which disagreement continued, between the two men, was the route taken by the infection or the reaction, to reach the fibrous canal, leaving the middle ear. Dorello had thought of a vascular route, i.e., transmission across the veins which from the *cavum tympani* arrive at inferior petrous sinus level. Gradenigo, on the other hand, sustained that: *the infectious process through peritubaric pneumatic cells or through those of the carotid canal extends as far as the tip of the pyramid. At this point, a morbid focus originates, which hits the abducent at the point in which it leaves the osteofibrous cavity.* In Dorello's opinion, this route appeared rather long and difficult. In fact, the focus, *proceeding*



Fig. 3. The two articles published by Dorello in 1906 and 1909, the first of which referred to a new interpretation of the pathogenesis of post-otitic paralysis of the abducent, the second was dedicated to the difference of opinion with Gradenigo on the same topic.

through the thickness of the bone, should override the angle of the carotid canal, it should pass under the cave of Meckel, close to the lower face of the gasserian ganglion; only after having covered a distance of approximately 2 centimetres, destroying the osseous structure of the petrous bone which prevents its passing through, could it reach the more medial part of the superior margins of the pars petrosa, the part of which is in relationship with the abducent. And all of which – Dorello asked himself – could often occur in a relatively short space of time and without severe disorders affecting the carotid plexus, the sympathetic and Gasser's ganglion. Based upon the exact anatomical relationships, it was, in his opinion, more exact to suggest a collateral oedema, which disappears once the inflammation has died down without leaving any trace of its presence, rather than such a widespread osteitis, which, without doubt, would have given rise to more severe consequences and have required a long period before returning to normal.

This is where the second works of Dorello finish; on these aspects, there do not appear to have been any further discussions. We have devoted ample space to the differences of opinion with Gradenigo as we felt that besides the scientific interest in the research, these differences, between these old *Maestri* would make interesting reading. Nothing has changed in the meantime. How often have we had differences with a colleague because he/she failed to quote our

theory or because they held a different opinion regarding a pathogenic hypothesis, or some other topic. This is not the point, but rather the attitude with which the two contended: theirs was a duel at foil-point.

Primo Dorello died in 1963.

Gradenigo and Dorello, two great figures who, with their research, contributed to a better understanding of Otolaryngology at the beginning of the 20th Century: the former for his physiological and clinical studies, the latter for having clarified some particular morphological and physio-pathological aspects. But if the memory of Gradenigo is still clearly alive today, together with the results of his research, his academic curriculum and biography, this is not the case with Dorello which, over time, have gradually faded. It is, therefore, not only useful, but also our duty to recall events from a time which is now very much in the past, in order not to lose witnesses to figures of great historical importance in our particular medical field. This is why we chose to prepare the present report.

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