

# A Spiral History of the Development of Ways to Identify the Correct Position of the Injection Needle in Relation to the Peripheral Nerve: A Brief Historical Essay

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## Abstract

The first way to identify the needle in relation to the peripheral nerve W. Halsted and R. Hall in 1884 performed the first regional blockade (using direct visualization). However, Vassily von Anrep was a few months earlier described the blockade of the peripheral nerve by anatomical landmarks. In 1912, the blockade of the brachial plexus was first performed using electrical stimulation, but this technique has been widely used only since 1962. The most popular way to identify the needle relative to the nerve at the moment remains US guidance. A promising direction may be optical coherence tomography. But this method is under development. In the last decade, a method for determining the pressure of a local anesthetic has been introduced into practice to determine the position of the needle relative to the nerve.

## Keywords

Regional Anesthesia, Electrical Nerve Stimulation, Ultrasound Guidance, Optical Coherence Tomography, Local Anesthetic Pressure, Injection Pressure

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## 1. Introduction

Like the entire science of anesthesiology, methods of identifying the position of the injection needle in relation to the peripheral nerve have a history of development. And like all history, the stages can be mixed up and intertwined in space and time. Sometimes known methods and techniques of anesthesia were applied

or developed earlier than is commonly believed. There can be various reasons for such situations: from difficult to find sources (due to the lack of databases many years ago), writing scientific articles in different languages, etc. In the modern world, the availability of extensive databases and the ubiquitous development of the Internet should have minimized the presence of such situations. In our small essay we try to tell about the historical development of the ways of identification of the injection needle in relation to the peripheral nerve, taking into account some historical nuances. Also in this paper we will mention another way of visualizing the position of the injecting needle in relation to the peripheral nerve. This method is almost never mentioned as a separate method in regional anesthesia, and has not been used in classification in recent years.

For regional anesthesia, the work of W. Halsted and R. Hall (blockade of the mandibular nerve and brachial plexus) in 1884 was of the greatest importance [1]. And what is interesting for us!? Based on this information, the first historical way to identify a needle, relative to a peripheral nerve was not based on anatomical landmarks (as strange as it sounds). W. Halsted and R. Hall identified the correct position of the needle in relation to the peripheral nerve by direct visualization as peripheral nerves were surgically isolated to perform these blockades [2].

Thus, the first way to identify the injection needle tip in relation to the peripheral nerve was direct imaging (including the control of anesthetic injection through direct imaging).

Note: Only after almost 100 years mankind will get indirect imaging (ultrasound control or US-guidance) to identify the needle relative to the peripheral nerve.

However, history would not be history if it were so unambiguous.

S. M. Yentis and K. V. Vlassacov published data that apparently Vassily von Anrep was the first (or could have been the first) to perform a peripheral nerve block (in this case an intercostal nerve block) [1]. Even though the article was indexed in the catalog of the chief surgical office in Washington [1], no one referred to it until recently (probably, it was not read because it was written in Russian) [1]. In the context of the question under consideration, this circumstance makes the method of needle position identification in relation to the nerve the first in history.

But according to Kerstin M. Lund *et al.* (published in 2007 in “The Anesthesiology annual meeting ASA” abstract A1183) in 1855 Rynd injected morphine around the peripheral nerve [3]. Unfortunately, the method of identifying the needle in relation to the nerve is not specified. This is the only source in which we were able to find a reference to 1855.

In 1912, Perthes performed a brachial plexus block using electrostimulation [4]. But until 1962, surgeons and then anesthesiologists used anatomical landmarks to identify the needle position with a search for paresthesia. 1962 can be considered the beginning of the superiority of electroneurostimulation in combination with anatomical landmarks for nerve search [4]. It was in 1962 that

Greenblat and Dexon began to determine the position of the injection needle in relation to peripheral nerves and plexuses using an electroneurostimulator [4].

Indirect imaging (ultrasound control, ultrasound guidance) was first used in 1989 for brachial plexus block by axillary access [5]. However, this technique became widespread much later.

Optical coherence tomography provides a high resolution image of tissue structures [6]. David T. Raphael and co-authors in 2004 published a study on anatomical structures of dead dogs and suggested that this technique could be useful to determine needle position in peripheral nerve blocks [6]. In 2007, they published work on the possible identification of the needle position relative to the nerve using spectroscopic contrasting (on animals) [7].

The first attempt (that we could find) to involve the local anesthetic pressure in determining the needle position relative to the nerve seems to have been published in 1978 by Selander D. and Sjöstrand J. [8]. The authors described the figures of local anesthetic pressure when injected into different parts of the rabbit sciatic nerve [8]. This was followed by a number of works by different authors who studied the change of local anesthetic pressure when injected into the paraneural space in animals as well as in cadavers in the anatomical theater.

In 2014, a publication by Jeff C. Gadsden *et al.*, in which the authors describe the measurement of local anesthetic pressure during peripheral nerve blockade in patients [9]. As the authors noted, they had not found a description of the use of this technique in humans prior to their study [9].

But the spiral of history would not be a spiral of history were it not for one “but”.

In 2013, four scientists from the little-known Mogilev Regional Hospital in Belarus (now the Mogilev Regional Clinical Hospital) published preliminary data from their new study. In this article, they described a method of identifying the position of an injection needle relative to a nerve by changes in local anesthetic pressure in various tissues (along the path of the needle to the nerve) in patients in the operating theater. This study was initiated in 2012. In the study we established what LA pressure figures should be at the correct needle position, how the pressure changes depending on the needle towel in different, how the pressure changes depending on the injected anesthetic volume in real time, we established the value of local anesthetic pressure at intraneural needle position. Blockades were performed under US-control using a peripheral nerve electrostimulator in the operating theater in patients for anesthesia during surgery [10].

The authors received a patent for this method of identifying the needle position relative to the nerve based on determining the local anesthetic pressure in various human tissues with patent priority dated March 25, 2013 (Patent of invention: “Method of regional anesthesia of the sciatic nerve” BY 20636 C1 2016.12.30—commencement date (application priority dated) 2013.03.25).

But the game of fate was such that we published our study in a scientific journal of Belarus in Russian. Although the journal has an English abstract and is

indexed in CrossRef, our article might not have been read (as in another story from 1884), probably because of the non-English writing.

Somewhat later, work in this direction was published in another journal, but already in the English-language journal of anesthesiology [11].

Much later, several articles on the subject were published that also did not cite our first study, although the authors obtained the same results as we did in our earlier study [12] [13] [14] [15]. More information about this is in the **Appendix** section.

## 2. Conclusion

It is most likely that the first and very accurate way to determine the injection needle in relation to the peripheral nerve was by direct imaging through surgical access. It is possible that in some time, thanks to advances in technology, direct visualization of the target nerve will again be the most accurate way to determine the position of the needle. But the visualization will be performed from the injection needle tip (and perhaps the local anesthetic pressure in the perineural space will be a secondary marker of peripheral nerve block safety).

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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## Appendix

Unfortunately, with the development of databases, which allow us to find accurate information about already existing data in minutes or hours, we are still faced with the fact that some research remains forgotten and unnoticed. Probably, to exclude such situations requires a very hard work of authors and editors.

PS. In this short work we could not name all the authors who have contributed through their work to the development of regional anesthesia in the world.

We want the reader of this letter to feel that the development of our specialty is due to enthusiasts who live in different parts of the world and speak different languages.

These works [12] [13] [14] [15] were published much later than our articles. The authors received the same data as in our articles, but these authors did not cite our articles as required by the journals in which they published their results. I have filed a plagiarism review for my article against these authors, I have also filed a plagiarism report with the publisher of these journals and have filed several applications with COPE, Hceres, EUREC, ORI, OFIS. Next, I applied with a statement to the employers of the authors (To the General Director of the Centre Hospitalier Universitaire de Montpellier M. Thomas Le Ludec) to initiate an investigation of scientific misconduct; To the Director of The Institute for Neurosciences of Montpellier (INM) Pr Sylvain LEHMAN). I also reported this problem to the National Institutes of Health (NIH)-Anonymous Reporting of Research Misconduct Concerns

(<https://oir.nih.gov/sourcebook/ethical-conduct/research-misconduct/anonymous-reporting-research-misconduct-concerns>). I also filed an application to investigate this case Pr. Marie-Christine Sordino, "Referent integrite scientifique University of Montpellier".

Regarding the article Jeff C. Gadsden, Jason J. Choi, Emily Lin, Allegra Robinson; Opening Injection Pressure Consistently Detects Needle-Nerve Contact during Ultrasound-guided Interscalene Brachial Plexus Block. *Anesthesiology* 2014; 120:1246-1253, I contacted the editors of the journal "Anesthesiology" (unfortunately no solution has been found).