

Arthrostereophonendoscope: A New Diagnostic Device with an Electronic Recording of TMJ Auscultation Phenomena

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Abstract

The authors present an arthrostereophonendoscope - a new diagnostic device and set of knowledge obtained by practical experience and complemented by theoretical knowledge from the available literature. The work describes the arthrostereophonendoscope, its history and even the basic division and the way of auscultation of the TMJ sound phenomena. In conclusion they point out to the use and advantages of the orthrostereophonendoscope and the need of an examination of the auscultation along with TMJ mobility as the basic diagnostic methods in a dental clinic.

Keywords: arthrostereophonendoscope; auscultation phenomena; temporomandibular joint.

1. Introduction

The stethoscope is a tube-like tool that transmits sound from the patient directly to the doctor's ear. By then, a similar operation was done by simply attaching the ear to the chest of the examined patient [8]. This is the first medical diagnostic tool, which is still even after many years an important tool. The stethoscope was developed by French physician René Laënnec in 1816. Laënnec found it difficult and troublesome when he needed to hear the heartbeat of a young woman.

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Laënnec had got an idea to roll the sheets of paper into a rigid cylinder. One end was attached to the patient's chest and the other to his ear. After three years of observation and the amount of patient's autopsies (he was able to relate the auscultated sounds and pathology in the body), he published a book, to which there was a possibility to buy a stethoscope [9].



Figure 1: The First Medical Diagnostic Device - Laënnec's Stethoscope and its Illustrative Use [7]

Laënnec's wooden mono "model" was used by physicians until 1850. Its shape and materials changed during the time.

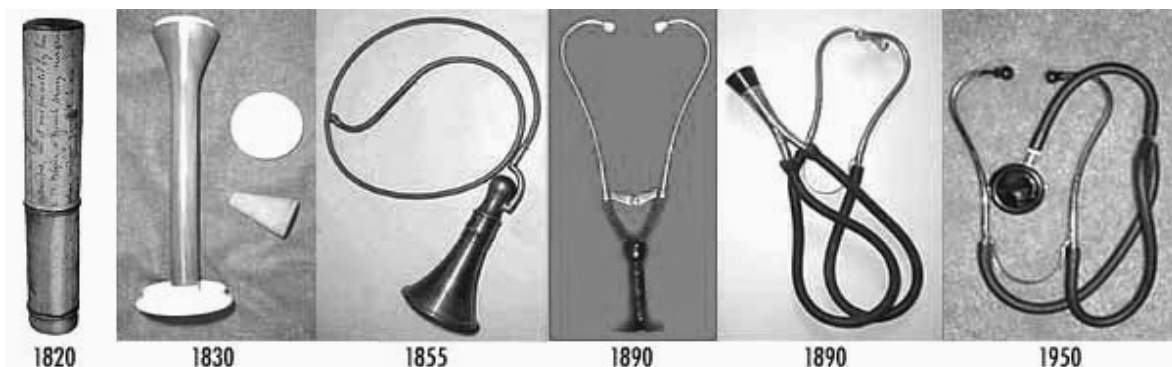


Figure 2: Evolution of the stethoscope to the phonendoscope [2]

Phonendoscope is a medical instrument (with resonator) that serves to investigate patients by auscultation. The stethoscope consists of a resonance membrane that is funnel-shaped and attached to the body and two rubber or plastic tubing, which continues with metal tubes into the so - olives (earplugs) that the investigator puts into the ear [2].

Its purpose is to capture and amplify sounds that accompany the physiological or pathophysiological activity of some apparatuses. There are no sound phenomena in the physiological movement of a healthy temporomandibular joint. Sound phenomena have recently been reported with the stereo-stethoscope which was first described by Watt in the TMJ auscultation. The stereo-stethoscope is a double phonendoscope, its use was described in our literature by [4].

2. Arthrostereophonendoscope: A new diagnostic device

Today, for a TMJ auscultation, we used the arthrostereophonendoscope with an electronic mp3 recording with the ability to amplify or mute the audio to make the subsequent sound playable and not overexposed.

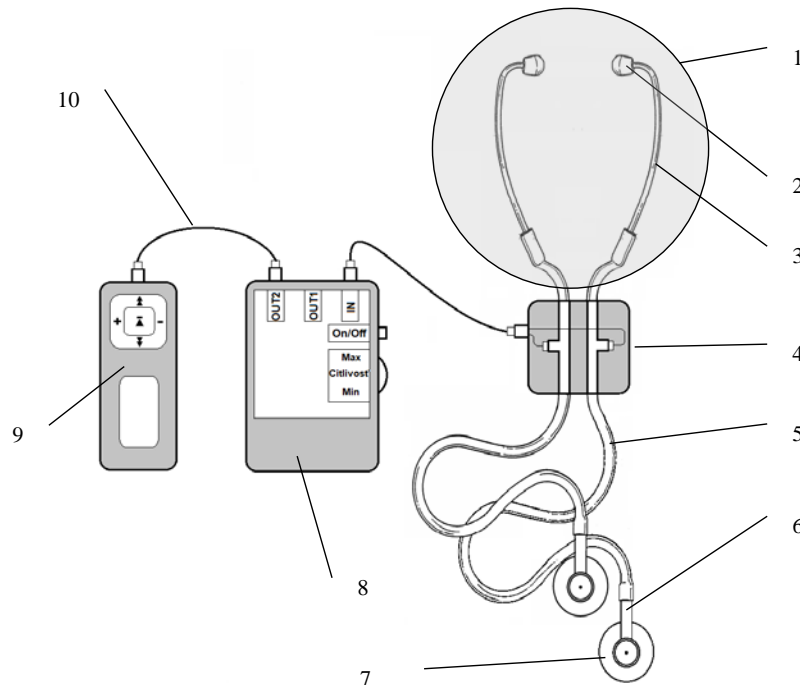


Figure 3: Arthrostereophonendoscope with an electronic recording in MP3 format - individual parts



Figure 4: Arthrostereophonendoscope with an electronic recording in MP3 format - our own design

We will do our own examinations by placing the resonance sensors pretrageously over the caput od TMJ and by inviting the patient to open and close the mouth. To accurately determine the prevalence of sound phenomena on one of the sides, we have the ability to alternate the listening of the right and left side, by moving one resonant box away from the face [1].

- 1 Main set - it is the metal part of the arthrostereophonendoscope made up of paired ear tubes and paired earplugs
- 2 Earplugs - of either plastic or rubber of different hardness
- 3 Ear Tube - Allows the transmission of auscultation phenomena from the tubing into the earplugs
- 4 Microphone box - Frequency range 20 Hz - 20 kHz, microphones are integrated into the tubes independently for the left and right sides. The acoustic outputs from the left and right sides are not affected by each other. There is a built-in preamplifier directly in each of the microphones
- 5 Hose - Arthrostereophonendoscope has double hoses for an acoustic signal transmission
- 6 Shank - The Arthrostereophonendoscope has two legs that connect the tubes of the arthrostereophonendoscope with sensors
- 7 Sensor - contains a membrane that can be tuneable and can be on both sides of the sensor
- 8 Acoustic Signal Conditioning Box - Provides filtering of the input acoustic signal, amplification of max. about 200x. The boost level (OUT2) can be set by the potentiometer. Considering the fact, that it is possible to connect to different dictaphones, PC sound cards, receivers, etc., which have different input sensitivity, this potentiometer serves to set the appropriate boost level for the other device. In case of a strong signal, the signal may be altered and degraded. If no pre-amplification is required, it is also possible to remove the original signal directly (output OUT1)
- 9 Device for recording and storing of audio signals - the audio recording can be further edited and evaluated

3. Conclusion

The arthrostereophonendoscope allows us to compare the sound phenomena in the examined patient before and after treatment. An irreplaceable and very useful one seems to be the possibility to upload the audio recording of a sound phenomenon, to amplify it if necessary, and then import it into an audio file. Not less important is also the ability to compare right and left TMJ. In some patients we have seen the change of loud sound phenomenon to a moderate, silent, or audible phenomenon completely disappears after treatment. In other examined patients, on the contrary, the sound phenomenon adds to the volume. After transferring the sound recording of the sound phenomenon to the audio application, this relatively subjective characteristic can be changed to an objective and measurable one. Auscultation of the sound phenomena together with the TMJ mobility examination should become a common diagnostic method in the dental clinic.

4. Discussion

Various stethoscope modifications are intended to help improve the auscultation of TMJ's auscultatory phenomena, but many do not respect the different characteristics of the sound phenomena. In foreign literature, we encounter a stethoscope that has a different modification to the diaphragm sensor, consisting of a metallic cylinder with a membrane, and the sound is transmitted from one tube to the speaker [3]. This modification does not ensure the transmission of phenomena from both joints stereophonically, and it is also not possible to record the sound stereophonically. Another alternative is the stethoscope, where the sensor is replaced with the modified end of the suction cup [6]. Both of these stethoscopes capture a tiny TMJ motion zone, which does not

allow the TMJ to accumulate during the entire opening-closing movement. An advantage may be the degradation of possible scarring caused by the movement of the skin in auscultation on the surface of the sensor. In some countries, Doppler is used for auscultation [11] In the United States there is well known diagnostic using device in the shape of headphones and it is being used to analyse TMJ vibration and sounds [10]. In this case, the digitalisation of auscultation phenomena is an advantage. The disadvantage is a hard technical equipment and thus the time-consuming examination.

The closest to the arthrostereophonendoscope is the stereosteoscope, which is a twin phonendoscope without the ability to further adjustment of the sound [5]. A major difference is even the use of omnidirectional microphones and a box for acoustic signal adjustment.

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