"Pantoscopy" — Electronic TMJ-Recording, the Answer to Problems in Functional Diagnosis

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INTRODUCTION

Functional diagnosis is one of the most important steps towards helping stomatognathic disturbed patients. All the known methods sharpen the operator’s eyes and help to bring dentistry up to its actual high standard. However, all systems represent only the technical possibilities of their time in perfect and, in some cases, large scaled mechanics. Electronics will definitely bring great advantages in dental diagnosis, but let’s not forget — the living patient is the centre of all our activities.

A REVIEW OF PROBLEMS IN FUNCTIONAL DIAGNOSIS

Patients with real, not subjective or objective pain, muscle or TMJ-problems in the stomatognathic system, are rare. In these special cases one finds incisal-canine-guided occlusion as well as unilateral or full balance. Even class II or III cases can work troublefree as a natural occlusion. Either the adaptability of organism covers latent problems or there are no hidden problems. Willy Krogh-Poulsen¹ states “these patients are in a functional harmony and need perhaps their special kind of occlusion”. If these patients have no or nearly no destroyed teeth, therapy has to preserve their functional harmony. Fillings or single restorations have to fit harmoniously into their system.

If patients have broken or lost teeth and need large restorations, a first diagnosis must detect even hidden problems of this stomatognathic system. A clinical-functional-diagnosis (muscle-palpation, test of the mandible’s mobility, etc.) according to Krogh-Poulsen² makes this possible. TMJ-X-rays, electromyography or acoustic methods may be of certain value. The detection of axis deviation, electronically or mechanically by the Bunergraph, the SAMMPI and the Denar-Verichek or by the use of the graphic instrumentations (e.g. pantography, axiography) as a diagnostic procedure only (!), gives helpful hints in these cases.

Even a technically perfect reconstruction done in a nonpretreated, disarranged stomatognathic system, will never give a stable and longlasting result. It may have the same effects as a biteplate, alter centric position and cause in some cases the acute outbreak of hidden pathology.
The most problematic, but also most interesting patients are those with real heavy stomatognathic problems, as headache, muscle-pain, reduced jaw mobility and massively destroyed teeth. These patients badly want and need help. That is one of the problems; in these cases it is very difficult to recognize, if the cause of the patient's trouble is really located in the dentist's special field of interest, or if the latent stomatognathic problems are only brought into the foreground by certain disturbances of the entire organism. Psychological stress may be the cause of the patient's problem. Psychosomatic medicine might help to diagnose these cases.

Krogh-Poulsen, the leading teacher in anamnestic talks with problem-patients, showed how to look for trouble-inducing problems. A patient with decreased working power, frequent sleeplessness, using a lot of sleeping pills or analgetics might be in a psychologically difficult situation.

In more than 80% of the cases, the reasons for psychological stress are found in problems in the patient's personal life, e.g. the financial situation, the job, the education of his children or the relation to his partner. Especially in this group of patients it can be seen how gently and careful the diagnosis must be, in order not to influence the patient and through him the results of the procedure and the heavy mechanic used.

The major effort in the future must be, to get the diagnostic information as accurately and with the least stress possible for the patient. Adjustments and handling of the functional-diagnostic-method must be quick and easy in order to get the best possible pretreatment.

The electronic registration methods, introduced to dentistry by several authors may help to eliminate some of the disadvantages of the mechanical systems. In this sense the author wants the reader to appreciate his own method of touchless, electronic recording of TMJ-movements.

REGISTRATION METHOD

The terminal hinge-axis is worldwide accepted as reference for high reproducibility. The tracings which this imaginary axis describes when the mandible moves, are well known. The axis is needed to transfer therapeutic models to an articulator at the end of the pretreatment.

The idea of this registration-concept is, to watch and record without touching, in the three dimensions, the movements of two defined axis-points, placed symmetrically to the patient's head. This is done electronically.

The system consists of two identical emitter-receiver-units working with infra-red light. The measuring units are adjusted coaxially and symmetrically to the patient's head using two rigid bows, an emitter and a receiver bow (Fig. 1). The patient only has to wear and
move the lightweight (70 gr) emitter-bow, fixed to the mandible with a common or a para-occlusal clutch. The second bow, carrying the receivers, is adjustably mounted to the headrest of a dentalchair (Fig. 2), the office wall or a special kind of an eyeglass-frame. The patient lies relaxed in the headrest, wearing the axial mounted emitter-bow. In some cases the head may be additionally fixed with a belt. The receiver-bow is then coaxially adjusted to the head and parallel to the reference-plane (Fig. 3). The system is now prepared for recordings. The patient is asked to move the mandible in the desired direction (straight, protrusive, mediotrusive, etc.). The signals of the moving axis are transmitted into an evaluation box and visualized on a screen (Fig. 4). The movements shown are about three times magnified, selectable for the left or right side and as an axial, frontal or downward view to the registrated axis-point for the diagnostic evaluation.

Angles and distances may be measured by a concentric-turnable rastermask in front of the screen. A simple way to store the pic-
tures is, to draw them on a transparent foil using a pen. It is possible to connect an XY-writer to the unit for easier storage. Several switches for dark-control, special magnification, etc. complete this equipment as an analog, low-cost version of the registration system.

Additionally the measuring units are connectable to a computer for a more comfortable evaluation (Fig. 5) and storage (Fig. 6), to shorten the time of registration at the patient and for the automatic correction of geometric errors, which are found in all the movements and all registration systems.

Fig. 4. Analog evaluation box of the “Pantoscop” to visualise TMJ-movement in several projective planes.

Fig. 5. Evaluation of protrusive or Bennett movement on the monitor of the computer. Position and angle of the tangent is variable and shows inclination to the reference plane in steps of one degree.

Fig. 6. Hardcopy of a patient’s recording. a) = Axial view; b) = Sagittal view (bennett); c) = Frontal view in a rotated reproduction.
TMJ-RECORDINGS AND CRITICAL INTERPRETATION

The "Pantoscop" enables the dentist to visualize movements of defined hinge-axis-points in analogy to the working condyles. Several lines of sight are selectable for a diagnostic evaluation. The system works with high linearity (Fig. 7). Being at the beginning of an evolution in functional diagnosis, we have to ask where can we expect progress. Contactless recording and light-weight instrumentation minimizes without any doubt the "apparative stress" to the patient.

Easy magnification and high solution of the tracings (Fig. 8) and the possibility to watch movements of an exact axis-point out to each wanted direction of view is an advantage of the electronic diagnostic knowledge. The most interesting centric-near movements are better to interpret.

An example: The only way to diagnose a Bennett-shift as an axial, bodily movement of the mandible starting at its actual centric position is to visualize simultaneously axial components of motion from at least two different points of view (Fig. 9). It seems to be possible to compare well stored diagnostic pictures taken on the same patient and the same equipment at different steps of therapy. Even errors of projection must not be corrected to do that. In spite of errors, such tracings are of high value for the diagnosis. All extra-condylar registrations, mechanical or electronic, contain geometrical errors which may have effect on the recording. Several
authors\textsuperscript{10,11,12} showed this fact of mediotrusion and its mathematical way of correction. Other publications will follow. Computers, as the periphery of registration systems, simplify that correction. Magnification is one of the advantages. But errors are also magnified.

The condyle, measuring system? Fig. 10 shows some recordings of protrusive movements at the same patient. The adjustment was not changed. The tendency on all the pictures is the same, but what about the little variations especially near centric? Is that an effect of individuality in condylar guidance, or an effect of the

![Diagram](https://example.com/diagram1.png)

**Fig. 8.** High magnification of touchless taken, electronical recordings in comparison to those of natural size.

![Diagram](https://example.com/diagram2.png)

**Fig. 9.** Bennett shift as an axial movement seen out of two different sights. a) and a') means axial components in sagittal and frontal view. The frontal view is turned around for a better comparison.
Fig. 10. Several protrusiv recordings from the same patient without variation of the adjustment.

measuring system? It looks like we are on the right track. However, we need more basic information on the long way to perfect functional diagnosis.

REFERENCES

2. Krogh-Poulsen, W. see 1.
3. Krogh-Poulsen, W.: personal information as the result of a study done by the Institut for Sociopsychology, Copenhagen.

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Mechanical Jaw May Help Save Your Teeth

BY WILLIAM S. BARTON

A mechanical jaw and other precision instruments perfected by a Los Angeles dentist promise to revolutionize dentistry by preventing the loss of innumerable molars.

Invented by Dr. Beverly McCollum, the apparatus is said to be the first that is capable of faithfully measuring and reproducing jaw motions of individual patients. As a result of these measurements, dentists are able to reduce, wear and tear on teeth by bringing them together evenly in chewing.

Dr. Robert W. McNulty, dean of the SC School of Dentistry, announced at a press conference that the mechanical jaw, the gnathoscope, and similar apparatus designed by Dr. McCollum, have proved themselves to such an extent that a new course in their uses has been started by the school.

The metal jaw isn't placed inside patients' mouths. It is used to make measurements of the occlusion between models of upper and lower teeth placed inside the instrument. Other apparatus made by Dr. McCollum, a 1907 SC graduate, is employed in making these models.

More teeth, it was asserted, are lost because of being out of line than because of decay, in the long run. The machine tells where alignment is out and how it can be restored.

"True dentistry," asserted Dean McNulty, "is not alone looking into a patient's mouth, counting the cavities, or evaluating the extent of unrelated deficiencies. True dentistry must concern itself with diagnosing the ills of the mouth as a whole and restoring the functions of the mouth as an organ of chewing.

Saving Mouths

"An entire mouth can be crippled by the removal of one tooth, if that removal destroys the unity of the mouth. The new idea is to save mouths to save teeth."

Dr. Francis J. Conley, director of postgraduate dental instruction at SC, pointed out that unusual stresses placed on the jaw can result in the loss of bone foundations around teeth, inflammation of gum tissue, and eventually loss of teeth, sometimes through pyorrhea.

"The real purpose, and function of the mouth," Dr. McNulty declared, "enters directly into life processes. The mouth is a part of the digestive tract and as such is much more than just a hopper to receive food that goes into the stomach."

From Los Angeles Times, early, '40s.