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A Photographic Method of Recording Movement Trajectory to Evaluate the Effectiveness of Physiotherapy in Temporomandibular Joint Dysfunctions – A Preliminary Study

Fotograficzna ocena toru ruchu jako ocena skuteczności fizjoterapii w zaburzeniach czynności stawów skroniowo-żuchwowych – badania wstępne

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Abstract

Background. Dysfunctions of temporomandibular joint become a more frequent disorder of the stomatognathic system. Despite that masticatory organ performs very important role in nutrition of human, it's diseases and disorders are notoriously by society ignored and considered as minor.

Objectives. The aim of the study was to elaborate a method of assessment useful in physiotherapy practice to evaluate progress in temporomandibular dysfunctions therapy. In this paper effectiveness' evaluation of physiotherapeutic treatment in temporomandibular joint's dysfunctions is presented.

Material and Methods. Research was conducted in a group of students who complained about disorder of masticatory organ. Research comprises 15 people (12 women, 3 men) with confirmed temporomandibular joint dysfunctions. Functional evaluation of the temporomandibular joint was performed by measuring the jaw's range of motion (ROM) in the sagittal plane and by using a photographic method of recording the jaw movement trajectory.

Results. In 60% of the patients, the jaw's active ROM increased after therapy. The method used in the research was a simple, cheap and non-invasive form of evaluation of the masticatory organ's functional state: a photographic method of recording the jaw movement trajectory. Deviations from the normal jaw movement trajectory are evidence of temporomandibular joints dysfunctions observed in 100% of the patients in the study.

Conclusions. Physical therapy performed using readily available home-use apparatus can be an ideal supplement to stomatognathic treatment, and the outlined photographic method of recording the jaw movement trajectory can be a non-invasive, simple, cheap and fast diagnostic tool for practicing physiotherapists to use when dealing with temporomandibular joints dysfunctions. Further research on this method is warranted to confirm these results, with a larger study group and an appropriate control group (*Adv Clin Exp Med* 2011, 20, 1, 79–85).

Key words: physiotherapy, temporomandibular joint dysfunctions, photographic evaluation.

Streszczenie

Wprowadzenie. Zaburzenia czynności stawów skroniowo-żuchwowych stają się coraz częstszą dolegliwością ze strony układu stomatognatycznego. Mimo że narząd żucia pełni istotną rolę w odżywianiu człowieka, to choroby i zaburzenia, które go dotyczą są notorycznie ignorowane przez społeczeństwo i uznawane za mało ważne.

Cel pracy. Opracowanie metody badań przydatnej w praktyce fizjoterapeuty do oceny postępów terapii w zaburzeniach czynności stawów skroniowo-żuchwowych. W niniejszej pracy przedstawiono ocenę skuteczności postępowania fizjoterapeutycznego w zaburzeniach czynności stawu skroniowo-żuchwowego.

Materiał i metody. Badania przeprowadzono na grupie studentów skarżących się na dolegliwości narządu żucia. Badaniami objęto 15 osób (12 kobiet, 3 mężczyzn) ze stwierdzonymi dysfunkcjami stawów skroniowo-żuchwowych. Oceny czynnościowej stawów skroniowo-żuchwowych dokonano na podstawie badania zakresu ruchomości żuchwy w płaszczyźnie strzałkowej oraz fotograficznej metody rejestracji toru ruchu.

Wyniki. Mierzac zmianę zakresu ruchomości żuchwy w płaszczyźnie strzałkowej, odnotowano jego zwiększenie u 60% studentów. W badaniach zastosowano prostą, tanią i nieinwazyjną formę oceny czynnościowego stanu narządu żucia – fotograficzną ocenę toru ruchu żuchwy. Zaburzenie prawidłowego toru ruchu świadczy o dysfunkcji stawów skroniowo-żuchwowych, co stwierdzono u 100% badanych.

Wnioski. Fizjoterapia wykonywana z zastosowaniem ogólnodostępnych urządzeń domowego użytku może być doskonałym uzupełnieniem leczenia stomatognatycznego. Fotograficzna metoda oceny toru ruchu żuchwy może stanowić nieinwazyjne, proste, tanie i szybkie narzędzie diagnostyczne w praktyce fizjoterapeuty zajmującego się problematyką zaburzeń czynności stawów skroniowo-żuchwowych. Należy zwiększyć liczbę osób w grupie badanej oraz stworzyć odpowiednią grupę kontrolną w celu lepszego uzasadnienia wyników (*Adv Clin Exp Med* 2011, 20, 1, 79–85).

Słowa kluczowe: fizjoterapia, zaburzenia czynności stawów skroniowo-żuchwowych, ocena fotograficzna.

Material and Methods

The study group comprised 15 people (12 women, 3 men) with confirmed temporomandibular joint dysfunctions. The average age in the study group was 23.9 years (SD = 2.6 years). Among the women the average age was 22.9 years (SD = 1.8 years), and among the men it was 27.7 years (SD = 2.1 years). A histogram of the age distribution in the study group is shown in Figure 1.

Participants were qualified to the study group on the basis of the occurrence of at least one of the following symptoms: cracking noises, pain in the vicinity of the temporomandibular joint or temporomandibular joint prolapse [9, 14, 18]. The frequency of occurrence of these symptoms is shown in Figure 2.

Each participant in the research was submitted to two physical therapy treatments: TENS (Transcutaneous Electrical Nerve Stimulation) and infra-

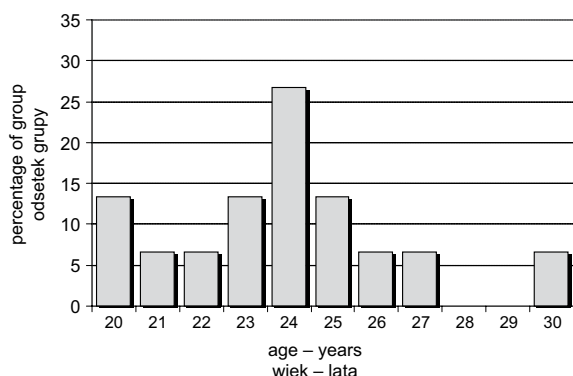


Fig. 1. Age distribution in the study group

Ryc. 1. Rozkład wieku grupy badanej

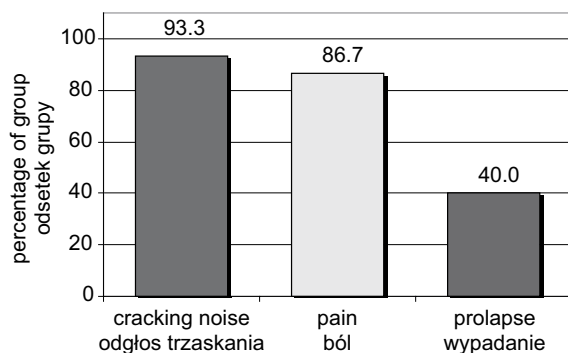


Fig. 2. Distribution of symptoms

Ryc. 2. Rozkład objawów



Fig. 3. Infrared lamp

Ryc. 3. Lampa na podczerwień

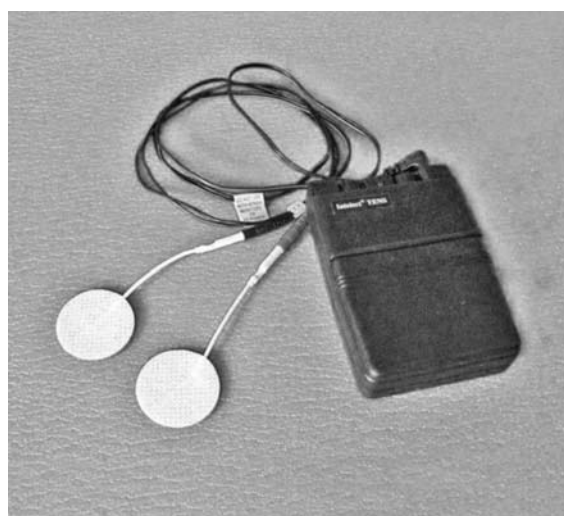


Fig. 4. Portable TENS apparatus

Ryc. 4. Przenośny aparat TENS



Fig. 5. Electrode arrangement

Ryc. 5. Rozmieszczenie elektrod



Fig. 6. Measurement of the jaw's ROM in the sagittal plane [8]

Ryc. 6. Pomiar zakresu ruchomości żuchwy (z.r.ż.) w płaszczyźnie strzałkowej [8]

red radiation, which were conducted in accordance with accepted methods [2, 5, 10, 15–17]. Both of these treatments were performed using readily available home-use apparatus (Fig. 3, 4). The treatment area was chosen on the basis of physical examinations and the patients' descriptions of the discomfort [6]. The scheme of electrode arrangement during the TENS treatment is shown in Figure 5 [5, 16]. Each TENS treatment lasted 20 minutes and the current intensity was adjusted to each patient's comfort level. Infrared radiation was performed from a distance of 20–30 cm; the duration of each treatment was 15 minutes.

Functional evaluation of the temporomandibular joint was performed by measuring the jaw's range of motion (ROM) in the sagittal plane and by using a photographic method of recording the jaw movement trajectory. Active and passive

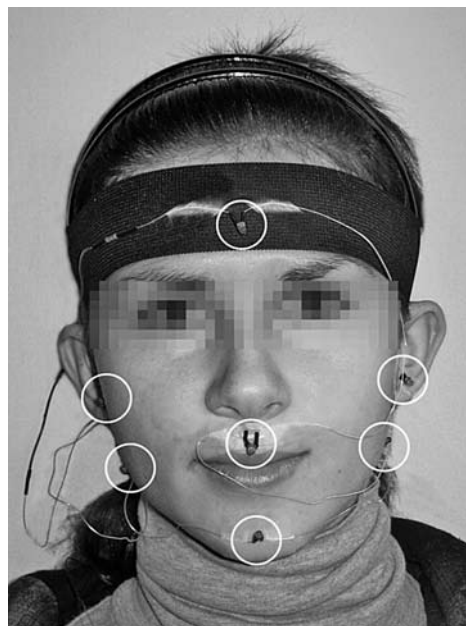


Fig. 7. Positions of LED markers on the angles of the jaw and *protuberantia mentalis*

Fig. 7. Pozycja wskaźników LED w kątach żuchwy i *protuberantia mentalis*

ROM were measured three times and then averaged; the average values were compared before and after therapy. The jaw's ROM was defined as the distance between the midline of the top and bottom incisors measured by slide calliper (Figure 6). Active movement was measured by having the patients open their mouths maximally while the researcher measured the distance between the edges of the incisors. Passive movement was measured in a similar way, but instead of using the jaw muscles to open their mouths, the patients put their thumbs on the edge of their upper teeth and second fingertips on the edge of their lower teeth to increase the mouth opening [6, 8, 14, 24].

A special system was used in the study to evaluate the jaw movement trajectory. The system consists of a series of connected miniature light-emitting diodes (LEDs), powered by external battery and located on moving (red diodes) and immobile (green diodes) parts of the patient's head at selected characteristic points (Figure 7). A digital camera was used to take photos with a long exposure time (2 seconds) during abduction and adduction of the jaw.

Results

Figures 9–12 show deviations from the normal movement trajectory while the mouth is opening and closing. Differences can be observed between the shapes of the movement trajectories while low-

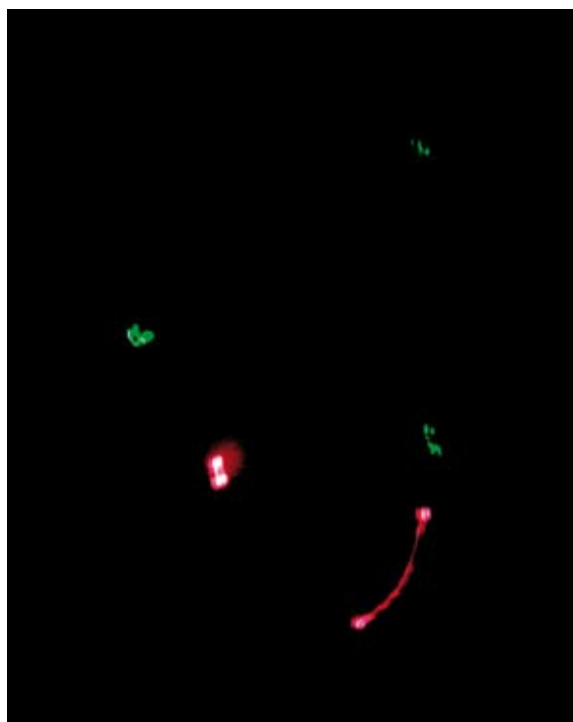


Fig. 8. Movement trajectory recorded during abduction of the jaw (sagittal plane)

Ryc. 8. Trajektoria ruchu zarejestrowana podczas odwodzenia żuchwy (płaszczyzna strzałkowa)

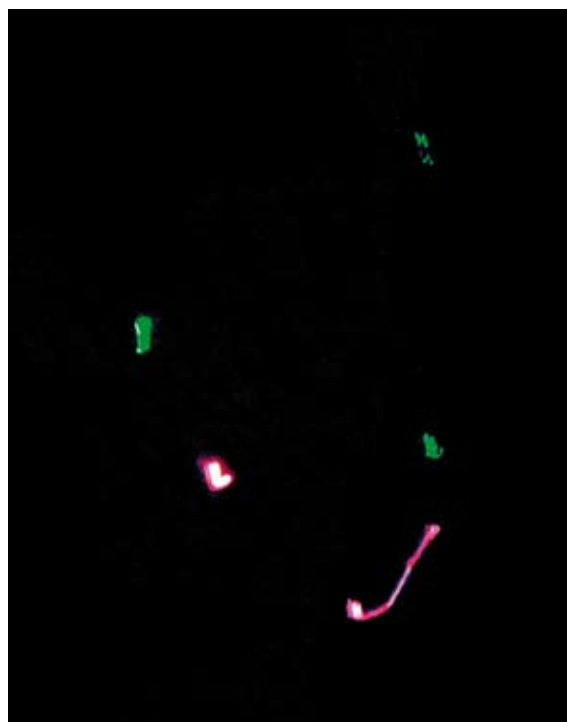


Fig. 9. Movement trajectory recorded during adduction of the jaw (sagittal plane)

Ryc. 9. Trajektoria ruchu zarejestrowana podczas przywodzenia żuchwy (płaszczyzna strzałkowa)

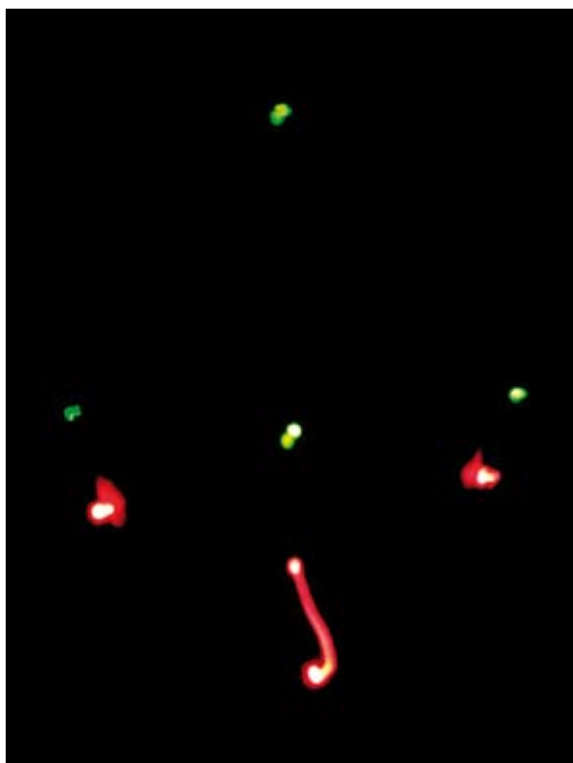


Fig. 10. Movement trajectory recorded during abduction of the jaw (frontal plane)

Ryc. 10. Trajektoria ruchu zarejestrowana podczas odwodzenia żuchwy (płaszczyzna czołowa)

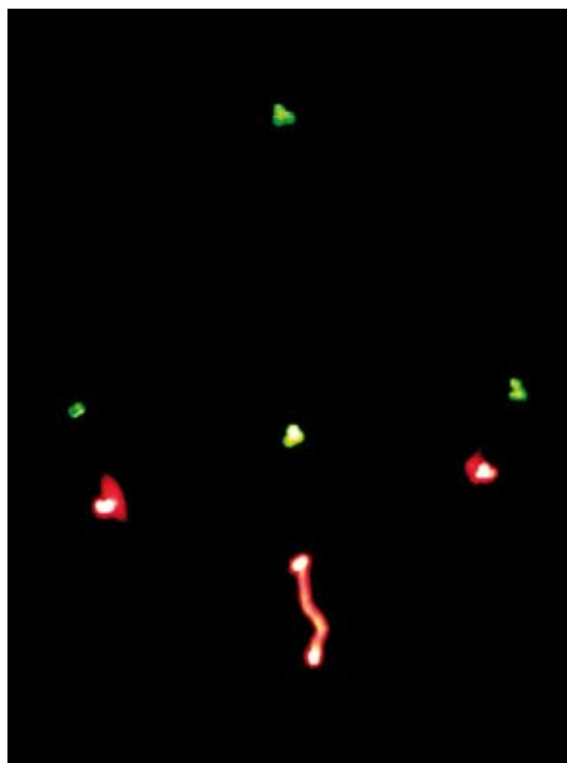


Fig. 11. Movement trajectory recorded during adduction of the jaw (frontal plane)

Ryc. 11. Trajektoria ruchu zarejestrowana podczas przywodzenia żuchwy (płaszczyzna czołowa)

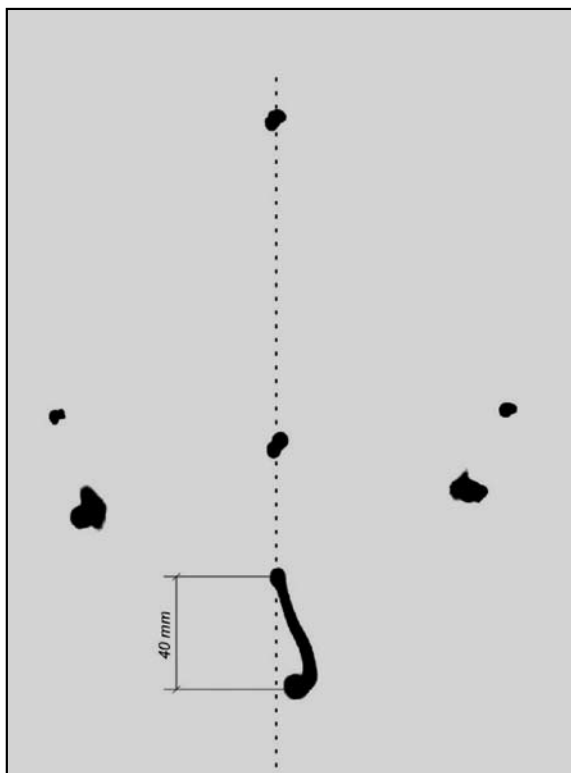


Fig. 12. Example analysis of one patient's movement trajectory during abduction of the jaw (frontal plane)

Ryc. 12. Analiza trajektorii ruchu żuchwy na przykładzie wybranego pacjenta podczas odwodzenia (płaszczyzna czołowa)

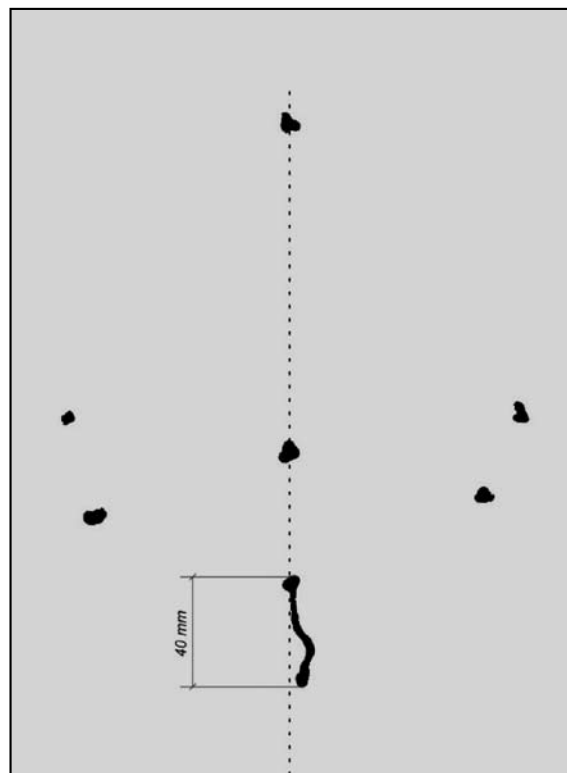


Fig. 13. Example analysis of one patient's movement trajectory during adduction of the jaw (frontal plane)

Ryc. 13. Analiza trajektorii ruchu żuchwy na przykładzie wybranego pacjenta podczas przywodzenia (płaszczyzna czołowa)

ering and raising the jaw. These differences may result from asymmetry in the temporomandibular joint structure and condyle-disc disorders [6].

Figures 12–13 present an example analysis of the recorded mandible movement trajectory in the sagittal plain. Differences can be observed between the normal trajectory (shown a dotted line) and the recorded trajectory. No improvement in the mandible movement trajectory was observed in any of the patients after the therapy.

In 60% of the patients, the jaw's active ROM increased after therapy. In these people the average value of the jaw's ROM in the sagittal plane was 43.1 mm (SD = 8.4 mm) before therapy, while after physiotherapy the ROM was as high as 46.0 mm (SD = 6.3 mm).

Discussion

In an era when lifestyles are undergoing constant acceleration and the technology of medical diagnostics is improving, people still forget how to take care of their own health. This problem concerns spine or hip ailments as well as dysfunctions of the masticatory organ. It is rare for a person to consult a doctor only because of pain in the jaw area that appears while biting nails or chewing

gum, or when the third molars are growing. Epidemiologic investigations indicate that dysfunctions of the temporomandibular joint affect about 80% of the human population, which makes them the third most frequent dental disorders after caries and parodontopathy [26]. Temporomandibular dysfunction affects more women than men [9], which was confirmed in the current study by a proportion of 4:1. Although degenerative changes in temporomandibular joints are connected with long-term use, disease more and more frequently affects young people who are exposed to stress-related risk factors. The period of university studies is a phase of life characterized by a particularly high susceptibility to stress. Because of this, university students are a high-risk group for diseases of the masticatory organ [20]. These facts were a crucial factor in deciding on the profile of the study group. People were qualified as participants in the research on the basis of common diagnostic criteria: the presence of acoustic symptoms, pain in the vicinity of temporomandibular joint or jaw prolapse [6, 9, 11, 13, 14, 18, 19].

Following the example of other clinicians [13, 14, 21], TENS was used in the current study (due to its remarkable analgesic effect) along with infrared radiation (which reduces muscle hypertonia).

Measuring changes in the jaw's ROM in the sagittal plane, it was noticed that ROM increased in 60% of the participants, reaching normal ROM levels [12, 14, 16, 23–25]. This confirms the results of other researchers [1, 3, 4, 7, 9].

The method used in the research was a simple, cheap and non-invasive form of evaluation of the masticatory organ's functional state: a photographic method of recording the jaw movement trajectory. A similar tool was used at the Szczecin Technical University [22]. Deviations from the normal jaw movement trajectory are evidence of temporomandibular joints dysfunction [8, 12, 25] and were observed in 100% of the patients in the study.

The authors concluded that physical therapy performed using readily available home-use apparatus can be an ideal supplement to stomatognathic treatment, and the outlined photographic method of recording the jaw movement trajectory can be a non-invasive, simple, cheap and fast diagnostic tool for practicing physiotherapists to use when dealing with temporomandibular joints dysfunctions.

Further research on this method is warranted to confirm these results, with a larger study group and an appropriate control group.

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