

UNIVERSITY OF MEDICINE AND PHARMACY

CRAIOVA

FACULTY OF DENTAL MEDICINE

*Clinical and pathological correlations on  
oro-maxillo-facial territory*

***-HABILITATION THESIS-***

Abstract

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2014

## ABSTRACT

This habilitation thesis entitled „Clinical and pathological correlations on oro-maxillo-facial territory" is structured in accordance with CNATDCU Romania recommendations and national laws, in three sections.

The first part describes the scientific work, including milestones of his career and the most important results of my editorial activity: publications, conferences and research projects acquired through national competition.

Professional activity:

Teaching:

1996-1998 *Junior Assistant Professor* at the Department of Dental Prosthetics, Faculty of Dentistry, University of Medicine and Pharmacy Craiova

1998-2006 *Assistant Professor* at the Department of Dental Prosthetics, Faculty of Dentistry, University of Medicine and Pharmacy Craiova

2006-2008 *Lecturer*, Department of Prosthetic Dentistry, Faculty of Dentistry, University of Medicine and Pharmacy Craiova

2008-present, *Associate Professor*, Department of Occlusology, Fixed Prosthetics, Dental Aesthetics - Faculty of Dentistry, University of Medicine and Pharmacy Craiova

Medical:

- ✓ 1996-1998 dentistry resident Emergency Hospital Craiova,
- ✓ 1998-2003 General Dentistry specialist Emergency Hospital Craiova,
- ✓ 2003 Senior dentistry doctor-Emergency Hospital Craiova,
- ✓ 2013 MD Dental Prosthetics.

Science:

*PhD in Medical Sciences* from supporting the thesis "*Odonto-periodontal changes in occlusal trauma*" under leadership Univ. dr. Constantin Andreescu, 2005, Faculty of Dentistry, University of Medicine and Pharmacy,, Carol Davila "Bucharest. During the doctorate project, activity focused on aspects of odonto-periodontal changes in occlusal trauma. Based on these researches, I have established benchmarks and correlations regarding the role of functional occlusion in specific homeostasis of dentomaxilar device together with the systematization of the factors which cause dysfunction occlusion.

After graduating my thesis, I continued my studies following four main research directions. Continuation, as a first research direction of occlusion-joint dysfunction, of which I associated the possibilities of prosthetic reconstruction and research on dental-somato-facial integration.

The partially intercalated edentation offers the practitioner the possibility of the functional rehabilitation of the dental arcades through conjunct gnato-prosthetic devices [1,2].

The functions of the dento-maxilar device, disturbed by the presence of edentation, require a treatment approach so that, without pre-planning or estimating, the result can lead most of the times to failure in terms of functionality. Clinical evaluation associated with pre- and proprosthetic treatment can also impose, in some situations the evaluation of the dental units involved in prosthetic rehabilitation. The association and implementation of the prosthetic construction in the occlusive-articular ensemble, as well as the counterbalancing of the mastication forces per dental unit and whole interarch system, linked to the distribution of the forces at the level of the pillar teeth and prosthetic construction, represent the goal of this theoretical study. The association of the occlusive parameters of natural teeth with the occlusive parameters that can be obtained with the conjunct gnato-prosthetic devices, for a variety of edentation types, represent a starting point in the evaluation of the prosthetic treatment [3,4]. The colligation of the data obtained through an occlusive examination with the protocol of evaluation on force distribution within the pale of occlusive mechanics, will enable the planning and realization of the prosthetic construction design.

Interleaved partial edentation represents at first sight a situation where prosthetic treatment poses no problems. Major subject in many situations is determined by the type of prosthesis used. Prognosis of mobile prosthetic restorations using special anchoring system is not superior to fixed prosthetic restorations, quite the contrary. In situations where is chosen

for the implementation of fixed prosthetic restorations with implant support, their survival is similar to the aggregation level of the tooth. In conclusion we can say that prosthetic treatment using dental units remaining, limit based on topographic distribution, remains a first choice.

Clinical and paraclinical evaluation without assessing the potential and limits can lead to a failure aesthetic extensive prosthetic rehabilitation. Recovery of each dental unit may be in some cases the verge between fixed and mobile prosthesis. Corroborating data on dental and periodontal treatments associated with partial local morphology partial edentulous patients themselves requires planning and prosthetic plan while adjusting the phase requirements and expectations and, often, the imperative demands of patients.

The reassessment of the "quality" of smile has continuously been a desideratum of the dentist, unfortunately being treated superficially very often. The execution of the prosthetic reconstruction without implementing it in the dental-facial harmony is a frequent mistake. The association of the data gathered by means of clinical investigation with the data representing references of global aesthetics contributes to the achievement and improvement of the dental-facial attraction[5,6,7]. It is known that dental-facial attraction is an integral part of the so called "physical attraction". The impact of the smile is visually absorbed and transposed into the determination of interpersonal relations.

The smile or the "moment of truth" of the communication relations associates various elements starting with dental morphology and its relation with the dental-facial assembly up to the assessment of lips expansion, associated to the psycho-emotional present state. The social integration by smile offers the free consented support of each person of association, assessment and reassessment of interpersonal relations and the dental medicine has the possibility to improve their perception and quality by taking part, willingly or not, to the success or failure regarding the cooperation and mainly the approaching without imposed or not imposed restrictions of the people.

The modifications resulted at the level of dento-parodontal units could result subsequent to the modification of the direction of forces operating on them; it is therefore proved that any change of their direction could determine the appearance of the occlusal trauma phenomenon characterized by specific clinical signs.

On the assumption that any occlusal force acting on a tooth, besides those distributed on the vertical axis, could determine modifications of the local biology, or it may influences

the local physiology through “waves” transmitted towards other dental units, with negative consequences on the dento-maxillary apparatus, subjective and objective clinical signs were revealed which may be classified as characteristic signs for the occlusal trauma phenomenon.

The occlusal trauma by means of triggers may lead to changes in pulp and dentinal tissues. A multitude of internal or external factors could act on the dental pulp, either indirectly through strong tissues surrounding the pulp, or directly in the case of pulp chamber opening. The pulp tissue succeeds sometimes to protect itself resulting in a remission of the phenomena finally restoring the normal state (*restitutio ad integrum*) or it undergoes a series of pathological transformations. The reaction of the dental pulp to the action of different rousing factors is generally similar to the reaction of other conjunctive tissues within the body but nevertheless some particularities arise due to the conditions under which the dental pulp is located.

The pathological modifications are determined by the intensity and duration of the action exercised by the irritable factors (occlusal trauma) and also by the reaction capacity of each separate body. As the modifications perceived at this level are many times similar with those revealed within the orodental pathology, the present study attempts to find another approach which could define the concept of occlusal trauma in terms of results achieved and to assess the impact on the pulp-dentine complex on the basis of records regarding the existence of the respective phenomenon attested through clinical and paraclinical examination. The histopathological study through correlation with the clinical manifestations provides significant data on the tolerance of dento-paradental units within the occlusal dysfunction. Also, subsequent to the analysis of the possible actions of aggression generated by the occlusal trauma correlations could be determined between the type of the histological lesion of the pulp-dentine complex and the etiopathogenic factors, as well as correlations depending on the damage degree through occlusal trauma of the dental parts involved.

The dental pulp is a common site of disease and this disease is typically associated with pain. In fact, the application of various stimuli to either exposed dentin or to pulp tissue generally produces the sensation of pain [8]. The nerve fiber density within the human dental pulp is quite impressive and multiple studies have characterized these structures. Teeth have unusual neural features such as dense polymodal nociceptive sensory innervation of coronal dentin, pulp, and vasculature; sparse autonomic innervation and sensory nerve involvement in dentinal fluid dynamics, pulpal blood flow regulation, protective reflexes, to preserve dental tissues, and dental wound healing [9]. In this study, we have done an immunohistochemical and

an electron microscopy examination of normal and inflamed human dental pulp specimens in order to evaluate the morphological aspects of the nerve structures from the dental pulp.

Numerous clinical studies on dental structure were focused on the study of surface characteristics of enamel or dentin etched with ortho-phosphoric acid, and so making important observations and results of this phenomenon [10,11,12,13,14,]. We have noticed a weaker focus of researchers on the influence of adhesive application techniques on adhesive bond strength. Many experimental investigations relied on guidelines supplied by producers of materials studied. Thus, we intend to focus on issues arising from modification of applying technique for adhesive materials, considering that they have a major impact on dental adhesive restorative clinic, but also in the quality of adhesion.

The condition of building strength during time depends on the quality of composite substrate adhesion achieved between enamel and dental composite. From image comparative analysis of clinical techniques achieved through adhesive brush application and rotational technique, we found that the latter is an enabling element in improving the final composite system (adhesion), and could be a key to clinical success along with existing techniques.

Another research direction was the orientation to pathology of oro-maxillo-facial territory, making correlations between clinical situations and fundamental pathological research.

Squamous carcinomas represent about 3% of human cancers and over 90% of malignant tumors with oral location, being diagnosed worldwide each year over 350,000 new cases [15-17]. In lesions appearance are incriminated various risk factors and chronic exposure to tobacco and alcohol are the most important [18,19]. Epidemiological data indicates a predominance of squamous oral carcinomas of the lip and lingual localization in men over 40 years [16,20].

Oral carcinogenesis is a multistage process, precancerous lesions, invasive and metastases being often present simultaneously [21,22]. Browsing of cell cycle and proliferation of malignant tumoral cells involves loss of control mechanisms that ensure normal tissular functioning.

Studies that have investigated the expression of some proteins involved in these biomolecular mechanisms demonstrates the permanent concern for the identification of biomarkers with oral squamous carcinomas predictive potential. P53 and p16 are cell cycle control proteins, which provide the "arrest" and apoptosis of cancer cells and stops their proliferation by maintaining in a hypophosphorilate status of retinoblastoma protein, while

Ki67 is present in the nucleus located in the division [23-25] Currently there is no consensus on the timing of occurrence and prognostic significance of aberrant expression of these proteins [26-29]. The purpose of this study was to analyze p53, p16, Ki67 immunoexpression in oral carcinomas and adjacent dysplastic epithelium, given their role in regulating cellular cycle and proliferation.

In the second step was taken in the study the EGFR and Her2/neu expression, the purpose being to identify their role in oral carcinogenesis, following, in the same time, the possible connections between them or between them and the analyzed clinic-morphological parameters and choosing those with statistical significance.

The four major research direction was structured to combine general pathology, namely diabetes, with dento-periodontal changes and pathological aspects, knowing that any changes in the body cause changes in the dentomaxilar device.

The pathogenesis of the periodontal disease is complex, because it derives from the initiation and maintenance of the chronic inflammatory process by the plenty microbial flora and its numerous bacterial products. The host response in front of this infection mediates a complex cascade of tissue destructions [30].

The supplementary factors that contribute to disease initiation and progression include some systemic diseases, especially diabetes mellitus that can exacerbate the host response in front of local microbial factors leading to an intense and uncommon periodontal destruction. As a fact, the aggressive periodontitis is recognized as the sixth complication of the diabetic disease by Löe H [31], who concluded that multiple epidemiologic studies demonstrated that both type 1 and 2 diabetes are predictors for periodontal disease in the presence of a poor systemic control.

Although it is difficult to conclude about the specific effects of the diabetes upon the periodontium, there have been described a variety of alteration: the presence of gingival inflammation, sessile or pediculated gingival polyps, gingival proliferations, periodontal abscesses, periodontitis and dental losses [32–34]. The histological study had as a purpose to make evidence of the histopathological changes occurring in the gingival epithelium, especially the gingival sulcus epithelium–sulcular epithelium and junctional epithelium. Another step was the study of gingival inflammatory infiltrate analysis in patients with chronic periodontitis and diabetes mellitus.

All my research results are presented in comparison to the latest data from the chosen topic area for research. Because the work has a highly interdisciplinary character, the most results were obtained in a large and complex team which included prominent names from our

university, and young PhD students and postdocs, along with colleagues from other research centers and specialties.

The second section describes future plans and strategies for further development of scientific and academic career. The main research directions described in this section match the objectives of proposed and integrated research into research directions and strategies of our University. Most of these research directions are consistent with the view to improve and extend the results already obtained, used as a benchmark for new research techniques integration, evaluation and prognostic associated and developed with other medical specialties. However, due to the concept of integrated academic and research career, a special attention will be focused in order to improve academic skills and management.

A future direction of research will be focused on the interaction between prosthetic reconstruction and occlusal reconfiguration associated with maxillofacial territory restoration through minimally invasive techniques of plastic surgery and repair.

Dental aesthetic is a stomatology specialty that records a growing success, as this specialty services become more accessible and, besides rehabilitation of aesthetics, it improves functions of the maxillary. We often find that improved physical appearance raises confidence and smile is part of the first things noticed in a person, so we are able to turn beautiful teeth into a successful business card. Another important element in beauty is the proportion and proportion concepts are based on elements found in nature. The term "aesthetics" means "natural beauty" and can be defined as the science of beauty that is applied in nature and in art.

Prosthetic rehabilitation and aesthetic implant seeks to achieve harmony between all details, simulating natural tooth structure to achieve the desired beauty. In other words the beauty in modern dentistry is no different than the general concept of art.

Experience has shown that many patients appreciate not only functional improvements due to prosthetic rehabilitation, but also improvements in their social and spiritual lives due to changes in physical appearance.

Any aesthetic restoration requires special imaginative and clinical skills and understanding of the comprehension of all the facial relationships that make treatment to be successful. While logic is important to develop a treatment plan and analyse all existing elements, imagination plays a special role for the whole therapy vision. The social plan must

also be taken into account when treatment, aesthetic oral being socially vital attribute in personal image, social interactions.

These considerations have led to the understanding of the importance and value of aesthetics in oral rehabilitation. For diagnosis and classification of patients in the treatment planning of maxillary fixed rehabilitation, it requires thorough analysis of the aesthetic, using the principles of total prosthetics. The following diagnostic elements are critical: 1 incisal edge position of anterior teeth, considered to be the starting point of all complex oral rehabilitation.

This is determined by aesthetics and phonetics:

- ✓ position of the cervical edge and aesthetic proportion of front teeth. Determine the length of the incisors on standard dental proportions.
- ✓ smile line - the upper lip position is one of the most important elements in the anterior aesthetics. Its analysis in static and dynamic positions will determine the required fixed prosthesis.
- ✓ The gingival exposure - directly proportional to the position of the gum and cervical maxillary incisors and smile line;
- ✓ upper lip support - depends on anterior maxillary teeth, alveolar bone loss, length of nose, nose tip angulation, chin angulation.

In clinical decision criteria such as abutments structurally compromised, periodontal or endodontic treatment favours the choosing of prosthetic restorations on implants. Starting from these considerations will include directions for research on anthropometry and facial aesthetics. Quantitative skeletal morphological variations are the result of genetic and environmental differences between population types and their evaluation metric is one of physical anthropology research objects.

From a stomatology point of view, anthropology should be seen as complementary examination that allows assessment of the relationship between the size of different parts of the head and face, to obtain data on the rate of growth of each individual through repeated measurements at regular intervals and assessing relationships between alveolar arches, base of jaws and facial appearance.

Specific anthropometric measurements can be made directly on the patient, or mannequins, skull, study models, photographs, x-rays and computer models, and based on their assessment can calculate anthropometric indices. They differ depending on the application: prosthetics, orthodontics and dental-facial orthopaedics, plastic and reconstructive surgery.

From a psychological point of view smile and laughter can be considered as being expressive behaviour. Besides talking and facial expression, physical appearance affects interpersonal communication. Oral region becomes a centre of attention when people talk, smile and show their emotions. As a result, the oral region plays an important role in facial attractiveness. A bright smile is associated with empathy, extraversion, intelligence and attractiveness.

Expressions and emotions play an important role in our daily life. Human social behaviour is strongly affected by perception, interpretation and response to these signals. Individuals of the same breed show and play similar expressions and emotions.

Automatic recognition of facial expression can be beneficial as they interact with people. In this way we create a model that uses as benchmarks balancing aesthetics hubs. We can speak of a computerized facial expression revaluation and duplication of a mathematical model to facilitate an assessment protocol of the clinical status of the patient and also to outline directions for rebalancing dental-facial somatosensory.

The main concept in PC algorithm consists of the following steps:

- 1 Initiate parameters to zero.
- 2 generate the model (point positions)
- 3 Finding the parameters that best align the points on the model
- 4 Project coordinated by inverting the model and their transformation anthropometric points.
- 5 Design of tangent plane by scaling
- 6 Updating the model parameters found by clinical examination anthropological values.

## 7 Creating of convergent facial balance.

Dental intervention level can cover various aspects starting from minimally invasive treatment, to orthodontic and prosthetic treatment.

The final effect depends on specialties that help integrate dental-facial somatosensory collaboration.

Main objectives of the research direction:

- ✓ creating a first stage of a database related to morphology, anthropology of different races.
- ✓ Development and validation of a clinical protocol for assessing dental-facial somatosensory
- ✓ development of a number that may overlap in real time and standard deviations over clinical data
- ✓ creation of a minimally invasive protocol facial rehabilitation
- ✓ creation of a rehabilitation protocol that complement rehabilitation facial prosthetics
- ✓ Prosthetics make-up

The project will become enlightening and implemented in practice only by working both medical and non-medical specialties involved.

Working with the pathology centres for the local oral-maxillary-facial pathology will be a research direction that will actually continue present studies.

It will outline the data about pulp changes, periodontal and dental hard structure associated with general diseases. As new research direction will be associated phenomenon of occlusal trauma, in its 2 stages (primary occlusal trauma, secondary occlusal trauma) that pathology.

Main Objectives of the research direction:

- ✓ health assessment of the patient with general pathology
- ✓ health assessment of dental-maxillary device

- ✓ determination by clinical examination of the occlusal disorders
- ✓ establishment and phasing phenomenon of occlusal trauma
- ✓ pathological collection of parts (unrecoverable periodontal dental units)
- ✓ evaluation results and establish a correspondence between causal factors.

Expansion of advanced study and research on the interrelationships between dental-maxillary device and general pathology will be another research direction. Evaluation of patients with coronary artery disease and creating a protocol implemented in dental office is a first step in oral rehabilitation.

Major medical emergencies may occur in dental office. Although they do not show a noticeable frequency there are no exceptions. Fast identification of these emergencies, conduct proper therapy, applying a well-established protocol with time until the arrival of a specialized crew of emergency medicine increases the chance of survival of the patient. If dental exam may reveal signs and symptoms that precede or highlight dental pathology, where there are few dental pathology may underlie the development of many pains and general body. Of these ischemic heart disease in onset and often tragic consequences is one of the major emergencies. There are more than a few situations where the dentist is confronted with various aspects of cardiovascular disease, the patient's life depending on the promptness and decision-making capacity. Pain in oro-maxillo-facial territory, one of the atypical features of acute myocardial infarction, may take many aspects that can influence decision time, but can be rewarding in the evolution case.

Scientific research and academic management were the two major directions that led to the development of my academic career at the University of Medicine and Pharmacy Craiova. Specifics dental helped develop my skills and also their extension to the communication, teamwork ability, leadership capacity and to summarize the results. The dedication of any professor of working with students and medical residents is mutually beneficial for both professional and personal development. The clinical hard work must be completed by medical research, many times requiring great efforts to maintain the thin balance between clinical work, medical research and publishing activity. Publications reflect the medical research and the number of clinical cases gathered over time, which should be openly shared and discussed during conferences and congresses. I have personally embraced the teaching career out of the desire to be in contact with students and medical residents in

order to share with them my knowledge and experience, while developing both personally and professionally together.

Inside this frame I intended to straight my career development towards the following guidelines:

- Balance and interplay with the criteria of scientific research and educational skills for continued development of new communication skills.
- Further accumulation of new skills with the possibility of development and reorganization of the existing.
- Improving the contact with different groups from other research centers and universities both national and international.
- Enlarging the multidisciplinary character of my research by introducing new approaches and new groups from different domains.
- Enhancing, improve and continue testing the knowledge and skills acquired.
- Developing new skill and improving the existent ones in the teaching activities according with the students requirements and abilities.
- My evolution in the academic hierarchy, closely related to both scientific results and science communication.

Teaching activity should be always based on the newest existing strategies and methods in order to be an attractive and easy to understand way for the students. For achieving this purpose I will put my efforts in developing the following directions:

- ✓ Continuously renewed the information and references for teaches subjects (Occlusology, Dental Prosthetics, Aesthetics dental facial somatosensory).
- ✓ Updating the existing logistic for the students
- ✓ Improving response time to new and diversifying stages of study by creating an integrated management
- ✓ Identifying analyzing and implementing the student's opinion in the educational process.
- ✓ Increasing collaboration with the other colleges o achieve an integrated learning and connected to the new requirements of the European Union
- ✓ Diversifying the educational techniques in order to improve students capability of analyses

- ✓ The integration and interpretation of the information in order to cause a reaction and generating a response
- ✓ Individualization of education processes according on age or other characteristics of students groups for an increased efficiency;
- ✓ Increasing the students accessibility towards the scientific language and scientific related activities powered by examples and in order to increase students integration in the scientific research activities
- ✓ Encourage and in scientific cooperation between students from dental schools in the country
- ✓ Student involvement in medical decision making and the formation of skills on the usual techniques of dentistry
- ✓ Making use of numerous new educational devices technological tools (video, computer, web sites etc.)
- ✓ Development of courses focused on the acquisition of knowledge through dialogue, through stimulating creativity and the conduct and constant repositioning to diagnose perfectible
- ✓ Acquiring knowledge by combining theory with specific dental techniques and repositioning as a medical option by continuous assessment
- ✓ Permanent updating of the educational edited materials according with the newest directions and researchers of the subject.

I am trying to channel the attention of the students to the following areas:

➤ Theoretical Knowledge

Apart from the courses, theoretical knowledge will be outlined during practical work and will refer to dental protethics and also fields that are related to that topic (anatomy, physiology, medical psihology, general pathology). Theoretical knowledge will be assessed and detailed as clearly as possible during every class of practical work, in connection to medical practice in the field.

➤ Clinical practice Knowledge:

- Practical knowledge in the examination of patients with dental pathology, which should include specific maneuvers such as:
  - examination and assessment of facial changes
  - examination of skin tumors
  - examination and evaluation of dental-periodontal pathology
  - examination and evaluation of dental units in terms of prosthetic
  - examination and evaluation of dental occlusion
  - evaluation esthetics areas
- Practical knowledge of specific paraclinical/laboratory investigations and their interpretation:
  - radiological examination
  - Ultrasonography of soft tissues
  - CT imaging of facial bone structures of the massif and dental units
  - CT imaging of soft tissue tumors
  - interpretation the laboratory investigations
- Proper strategies for accurate diagnosis:
  - Diagnosis of probability
  - Differential diagnosis
  - Positive diagnosis
  - Diagnosis of certainty
  - Structuring and classification of specific dental medicine diagnoses as well as other related pathologies.

For the implementation the above described approaches for education purpose I will:

- ✓ Defining a creative design of the lectures in order to improve the structure of the presentation of the theoretical elements

- ✓ Level the debate open to motivate and enable expression of views on the topics discussed
- ✓ Developing in collaboration with the colleges from others related subjects of integrated knowledge modules for specific topics
- ✓ Permanent updating of the curricula and teaching subjects available for the students according with the newest knowledge
- ✓ Developing a feedback from the students: exposure, understanding, practical application of knowledge
- ✓ Periodically question the students about their opinion related to the lecture management and implemented the results
- ✓ awareness to the individual needs of students regardless of the type of request: scientific or personal;
- ✓ permanent encouraging of the students to evaluate their own results according to their aims and to the college performances
- ✓ permanent guidance of the students according their future career options and developments
- ✓ assisting the students in developing their own personality according to the requirements of the medical domain: team work spirit, devotion to the patient care, leadership
- ✓ Health reassessment corroborating clinical data with software dedicated to the possibility of creating new diagnostic strategies using PC

The evaluation process of the performance of the students is a critical phase of the educational process. In order to assure a fair and correct evaluation of the students and I will:

- Improving constantly the existing set of evaluation criteria;
- Assessment is by a set timetable previously agreed with the students;
- Correct and fair students evaluation, evidence based, to reflect the real state of the theoretical and practical knowledge of each student;
- Encouraging the study and allowing connections untilizand achieve a perfect database
- Discussion- oriented examination inside the frame of the subject;

The target groups of dental prothetics and occlusology training process are:

- ✓ Students of the University of Medicine and Pharmacy Craiova.

- ✓ Exchange students in Romania
- ✓ Specialists
- ✓ PhD and post-doctoral

I will participate further as a guest lecturer at several post-graduate courses and training workshops for specialists in various fields, to inform them of the recent developments in dental prothetics, occlusology and dental esthetics.

As a researcher with postdoctoral experience I am actively involved in guiding the appropriate doctoral research topic for each PhD student, identifying funding sources for conducting research, supervising experiments, publication results through presentations at conferences and full text articles. Exposure data and their quantification in international databases and the creation of new research directions by empowering doctoral students in setting their own research directions

The third section presents bibliographic references.

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